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NWU Self-Directed Learning Series

Volume 8

Blended learning environments to foster Self-Directed Learning

Edited by

Christo van der Westhuizen, Mncedisi C. Maphalala & Roxanne Bailey

NWU Self-Directed Learning Series
Volume 8

Blended learning environments to foster Self-Directed Learning

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EDITORS
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Roxanne Bailey

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Peer review declaration

The publisher (AOSIS) endorses the South African 'National Scholarly Book Publishers Forum Best Practice for Peer Review of Scholarly Books'. The manuscript underwent an evaluation to compare the level of originality with other published works and was subjected to rigorous two-step peer review before publication, with the identities of the reviewers not revealed to the editor(s) or author(s). The reviewers were independent of the publisher, editor(s) and author(s). The publisher shared feedback on the similarity report and the reviewers' inputs with the manuscript's editor(s) or author(s) to improve the manuscript. Where the reviewers recommended revision and improvements, the editor(s) or author(s) responded adequately to such recommendations. The reviewers commented positively on the scholarly merits of the manuscript and recommended that the manuscript be published.

Research justification

This book is the eighth volume in the North-West University book series on self-directed learning. It follows on from its predecessors and elucidates another facet of active learner-centred teaching-learning that can be utilised to foster self-directed learning. The book highlights the focus on research conducted in blended learning environments specifically aimed at fostering self-directed learning skills and dispositions. Blended learning environments encompass a variety of applications in active teaching and learning. The authors associated with this book are researchers who have implemented one or more active teaching-learning strategies within a blended learning environment, albeit in online or blended learning environments. The authors also shed light on the implementation of blended learning environments supported by applicable technology applications within different contexts in education. In the 21st century, where self-directed learning has become imperative for tapping into the immense potential of the Fourth Industrial Revolution (4IR), it is vital to publish cutting-edge research that illustrates how blended learning environments can and should be implemented to foster self-directed learning. The use of blended learning environments has never been as important as it is in today's educational setting. With the realities of educational technology use and the need for blended learning in education, all scholars in the field of teaching and learning in all education and training sectors will benefit from the findings and practical examples provided in this book. The different teaching and learning contexts addressed in this book provide valuable insights for all scholars interested in implementing blended learning environments to foster self-directed learning. Various research methodologies are employed in this book, including critical literature studies, systematic literature reviews, design-based research, qualitative research conducted auto-ethnographically and through interviews and questionnaires, as well as mixed-method studies where data from quantitative instruments were combined with qualitative data.

The target audience is scholars in the field of self-directed learning, especially blended learning environments. Readers of the book will find that although the chapters are written by several authors, each providing their own voice on the topic, a coherent focus on blended learning environments – specifically the fostering of self-directed learning in these environments – is placed at the fore.

All authors who have contributed have agreed to have their work published in this book. After the ten chapters were submitted to the book's three editors, the editors conducted an initial internal review of the chapters and provided feedback to their co-authors. The editors believe that the contributions in the book will guide other academics to conduct similar research and, in doing so, enhance the scholarship of blended learning and foster self-directed learning (an imperative for 21st-century success within the 4IR).

This book adheres to the requirements set out by the South African National Department of Higher Education and Training (DHET); this book contains more than 50% original content that was not published prior to this work. No part of the work was plagiarised.

Christo van der Westhuizen, Research Unit Self-Directed Learning, Faculty of Education, North-West University, Potchefstroom, South Africa.

Mncedisi C. Maphalala, Research Unit Self-Directed Learning, Faculty of Education, North-West University, Mahikeng, South Africa.

Roxanne Bailey, Research Unit Self-Directed Learning, Faculty of Education, North-West University, Potchefstroom, South Africa.

Contents

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List of abbreviations

4IR	Fourth Industrial Revolution
AI	Artificial Intelligence
BL	Blended Learning
BLE	Blended Learning Environment
BLT&L	Blended Learning Teaching & Learning
CAD	Computer-aided Design
CAPS	*Curriculum and Assessment Policy Statement*
CAT	Computer Applications Technology
CoI	Community of Inquiry
CPTD	Continuing Professional Teacher Development
DBE	Department of Basic Education
DBR	Design-based Research
DHET	Department of Higher Education and Training
DoBE	Department of Basic Education
DoE	Department of Education
EDURAC	Education Restructuring Committee
EGD	Engineering Graphics and Design
ERT	Emergency Remote Teaching
ERT&L	Emergency Remote Teaching and Learning
F2F	face-to-face
FCA	Flipped Classroom Approach
FET	Further Education and Training
FFHS	Swiss Distance University of Applied Sciences
FP	Foundation Phase
HMSAM	Hedonic-motivation System Adoption Model
HOD	Head of Department
HOM	Habits of Mind
HSRC	Human Sciences Research Council
IC	Interpersonal Communication
ICALT	International Conference on Advanced Learning Technologies
ICT	Information and Communication Technology
ICVRV	International Conference on Virtual Reality and Visualization

IHL	Institutions of Higher Learning
IoT	Internet of Things
IP	Intermediate Phase
IPET	Initial Professional Education of Teachers
ISfTE	International Society for Teacher Education
JGHE	*Journal of Geography in Higher Education*
LM	Learning Motivation
LMS	Learning Management System
NWU	North-West University
ODL	Open Distance Learning
OER	Open Educational Resources
PAT	Practical Assessment Task
PBL	Project-based Learning
PCK	Pedagogical Content Knowledge
PEOU	Perceived Ease of Use
PI	Planning and Implementing
PPC	Person–Process–Context
PRO	Personal Responsibility Orientation
PU	Perceived Usefulness
SAERA	South African Education Research Association
SAIDE	South African Institute of Distance Education
SAP	System Analysis Program
SD	Standard Deviation
SDL	Self-directed Learning
SDLI	Self-directed Learning Instrument
SDLL	Self-directed Language Learning
SDLRS	Self-directed Learning Readiness Scale
SDLTS	SDL with Technology Scale
SM	Self-monitoring
SoTL	Scholarship of Teaching and Learning
SPSS	Statistical Package for Social Sciences
SRL	Self-regulated Learning
SRSSDL	Self-rating Scale of Self-directed Learning
SUS	System Usability Scale
TAM	Technology Acceptance Model
TDL	Teacher-directed Learning
TDT	Transactional Distance Theory
TLAs	Teaching-learning Activities

TPD	Teacher Professional Development
TRA	Theory of Reasoned Action
UKZN	University of KwaZulu-Natal
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISA	University of South Africa
VR	Virtual Reality
WHO	World Health Organization
ZPD	Zone of Proximal Development

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Notes on contributors

Roxanne Bailey
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: roxanneb@uj.ac.za
ORCID: https://orcid.org/0000-0001-5326-274X

Roxanne Bailey is a senior lecturer in the Computer Science Education subject group at the Faculty of Education, North-West University. She is also the leader of the sub-area 'Cooperative learning to enhance self-directed learning' within the Research Unit Self-Directed Learning. Her main research focus is on the promotion of self-directed learning through the implementation of cooperative learning. She has received several research grants and is currently involved in three research projects investigating technology-supported cooperative learning. She was also selected as one of three research fellows to complete a four-month fellowship under the guidance of the UNESCO Chair on Personalised and Adaptive Distance Education. She has published at national and international levels and also acts as a supervisor for postgraduate students.

Nicole Bergamin
Department of Computer Sciences,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland
Email: nicole.bergamin@ffhs.ch
ORCID: https://orcid.org/0000-0002-0638-6325

Nicole Bergamin is a research associate at the Institute for Research in Open-, Distance- and e-Learning and the UNESCO Chair on Personalised and Adaptive Distance Education as well as at the Department of Computer Science (specialisation in business information systems) at the Swiss Distance University of Applied Sciences (FFHS). She is also a lecturer in the field of finance and accounting, and she is working on instructional designs in this field. Her main research focus is on the development and improvement of instructional designs and technology-enhanced learning environments.

Per B. Bergamin
UNESCO Chair on Personalised and Adaptive Distance Education,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland;
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: per.bergamin@ffhs.ch
ORCID: https://orcid.org/0000-0002-2551-9058

Per B. Bergamin is a professor of Didactics in Distance Education and e-learning at the Swiss Distance University of Applied Sciences (FFHS).

Since 2006, he has been working as the Director of the Institute for Research in Open-, Distance- and e-learning, and since 2016 has been the United Nations Educational, Scientific and Cultural Organization (UNESCO) Chair on Personalised and Adaptive Distance Education. His research activities focus on self-regulated and technology-based, personalised and adaptive learning – the main aspects are instructional design, usability and application implementation. As a researcher, he cooperates with or leads different national and international projects and contributes to different Swiss advisory boards for e-learning development. As a teacher, he covers the topics of Educational Psychology and e-Didactics. Furthermore, he was the founder and president of the executive board of a company for e-business and learning applications, which he sold in 2016.

Betty Breed
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: betty.breed@nwu.ac.za
ORCID: https://orcid.org/0000-0002-1127-4985

Until her retirement in 2016, Betty Breed was an associate professor in the Computer Science Education subject group at the Faculty of Education, North-West University, South Africa. Her main research focus and project involvement was in the effective use of cooperative learning and metacognitive strategies in the teaching and learning of Information Technology and Computer Applications Technology, to both promote self-directed learning among students and scholars and empower teachers in these subjects. She has published at national and international levels, and has acted as a supervisor for postgraduate students.

Byron J. Bunt
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Vanderbijlpark, South Africa
Email: byron.bunt@nwu.ac.za
ORCID: https://orcid.org/0000-0002-2102-4381

Byron J. Bunt is a lecturer and subject leader in the History in Education subject group at the Faculty of Education, North-West University, South Africa. His main research focus is on game-based learning, gamification and cognitive education. He has received two teaching awards and is currently involved in two Scholarship of Teaching and Learning projects: one is focused on developing a historical card game in a history class, while the other uses an application called Habitica in the History class to establish self-directed learning. He has published at national and international levels and also acts as a supervisor for postgraduate students.

Joyce P. Dhlamini
Research Unit Education and Human Rights in Diversity,
Faculty of Education, North-West University,
Mahikeng, South Africa
Email: joyce.dhlamini@nwu.ac.za
ORCID: https://orcid.org/0000-0002-6903-7843

Joyce P. Dhlamini is a senior lecturer and researcher at North-West University. She joined UNISA as a tutor in 1997 and later as a full-time lecturer. She has coordinated various research projects, including SANLI and the Kha ri Gude Mass Literacy Campaign, as well as the evaluation of annual national assessment in the Eastern Cape and in KwaZulu-Natal. She is a member of the International Society for Teacher Education and SAERA and has presented research papers both locally and internationally. She served in the Faculty of Education Research Committee (as secretary), Faculty Higher Degrees Committee, and as coordinator for the master's and doctoral program and Faculty of Education Restructuring committee.

Divan Jagals
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: divan.jagals@nwu.ac.za
ORCID: https://orcid.org/0000-0001-5840-6298

Divan Jagals is a senior lecturer in the Curriculum Studies subject group at the Faculty of Education, North-West University, Potchefstroom Campus. He is also an editorial board member for several international journals. His main research focus is on facilitating metacognitive awareness to promote and understand self-directed learning. He has received several research grants and is involved in three international research projects. His most recent project involvements include the facilitation of metacognitive awareness through a personalised and adaptive online learning platform, as well as a project set towards developing a self-transcendent philosophy of self-directed learning. He was also selected as one of three research fellows to complete a four-month research fellowship under the guidance of the UNESCO Chair on Personalised and Adaptive Distance Education at the Swiss Distance University of Applied Sciences (FFHS). He has published both nationally and internationally and acts as a supervisor for postgraduate students.

Albert Kemp
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: albert.kemp@nwu.ac.za
ORCID: https://orcid.org/0000-0002-5335-262X

Albert Kemp is a lecturer in the Technology Education subject group at the Faculty of Education, North-West University. He teaches Engineering Graphics and Design, with a focus on 2D/3D CAD, 3D printing and 3D scanning. His main research focus is on Engineering Graphics and Design and self-directed learning. He also acts as a co-supervisor for postgraduate students.

Corné Kruger
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: corne.kruger@nwu.ac.za
ORCID: http://orcid.org/0000-0003-4042-4476

Corné Kruger is a senior lecturer in the Early Childhood Development and Education subject group at the Faculty of Education, North-West University. Her main research focus is metacognition, with a specific focus on the role of teacher metacognition in their self-directed professional development. She is currently involved in a research project with a focus on establishing critically reflective communities of practice across teaching and learning contexts to enhance teacher development. A recent project also follows a collaborative approach to integrating indigenous knowledges in the Grade R (reception year) curriculum. She has published at national and international levels and acts as a supervisor for postgraduate students.

Donnavan Kruger
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom Campus, South Africa
Email: donnavan.kruger@nwu.ac.za
ORCID: https://orcid.org/0000-0003-2013-261X

Donnavan Kruger is a lecturer in the Natural Science Education subject group at the Faculty of Education and a member of the Research Unit Self-Directed Learning. His research interests include Life Science Education, inquiry-based learning, contextualised education, adaptive learning, blended learning and self-directed learning. Donnavan was awarded a research fellowship under the guidance of the UNESCO Chair on Personalised and Adaptive Distance Education to investigate how inquiry-based learning can be implemented in an adaptive online platform. He has published at national and international levels and acts as a supervisor for postgraduate students.

Celizma Lotz
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: celizma@gmail.com
ORCID: https://orcid.org/0000-0001-8182-1203

Celizma Lotz recently completed her MEd degree within the Research Unit Self-Directed Learning in the Faculty of Education of North-West University. In this study, she researched the implementation of a flipped-classroom approach for the sake of metacognitive gains to prepare mathematics student-teachers for the 21st century. She has had experience teaching mathematics at the school level. Her research focus is on self-directed learning and metacognition in the field of mathematics.

Matome M. Mabiletja
School of Language Education,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: matome.mabiletja@nwu.ac.za
ORCID: https://orcid.org/0000-0002-0714-6673

Matome M. Mabiletja is a lecturer in the African Languages for Education subject group at the Faculty of Education, North-West University. She teaches Sesotho sa Leboa (Sepedi) home and additional languages. Her main research focus is on African languages linguistics, sociolinguistics, self-directed language learning and multiliteracies and multimodalities. She also acts as a co-supervisor for postgraduate students.

Sfiso C. Mahlaba
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Mahikeng, South Africa
Email: 32535856@nwu.ac.za
ORCID: https://orcid.org/0000-0001-6153-3917

Sfiso C. Mahlaba is a lecturer of Mathematics Education in the Faculty of Education, North-West University. He is a deputy subject group leader for mathematics education at the Mafikeng campus. Mahlaba has received SDL funding in 2019 and 2021 and is involved in two research projects: one is on cooperative learning to enhance SDL, and the other is on solving multiple solution tasks as an SDL activity to improve pre-service teachers' competency in problem-solving and teaching mathematics. The second project is part of the projects under the scholarship of teaching and learning (SoTL) at NWU. His main focus is on mathematical problem-solving and enhancing pre-service teachers' content knowledge of mathematics and their strategies for problem-solving. In his problem-solving focus, he looks to incorporate elements of SDL as the main driver for success in problem-solving. He has published in national and international journals and is currently a co-supervisor for one PhD student.

Mncedisi C. Maphalala
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Mahikeng, South Africa
Email: mncedisim1@dut.ac.za
ORCID: https://orcid.org/0000-0002-1078-1985

Mncedisi C. Maphalala is a research professor in the Faculty of Education at North-West University and a former professor and dean in the Faculty of Education at the University of Zululand. He has worked for the KwaZulu-Natal Department of Education (as a teacher, HOD and deputy principal), the University of the Witwatersrand, and the University of South Africa. Between May and August 2015, he was a visiting scholar at the University of North Dakota. Prof. Maphalala has edited two books, co-authored one book and published a number of book chapters and research articles in peer-reviewed journals. He also acts as a supervisor for postgraduate students. He has conducted a number of large-scale commissioned research projects by external organisations such as South African Institute of Distance Education, Human Sciences Research Council, National Research Foundation and Council on Higher Education. He currently serves on the Umalusi Research Forum, a sub-committee of Umalusi Council, on a four-year term. His research interests are teacher education, curriculum studies, self-directed learning, blended learning and assessment in education.

Victoria Mirata
UNESCO Chair on Personalised and Adaptive Distance Education,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland
Email: victoria.mirata@ffhs.ch
ORCID: https://orcid.org/0000-0003-4147-2090

Victoria Mirata is a researcher in the field of Personalised and Adaptive Distance Education at the Institute for Research in Open-, Distance- and e-Learning and the UNESCO Chair on Personalised and Adaptive Distance Education (UNESCO PADE) at the Swiss Distance University of Applied Sciences (FFHS). Her main research focus is on e-learning innovations, technology-enhanced learning, development and implementation of personalised and adaptive learning in online environments (massive open online courses [MOOCs]). The methodology draws on qualitative and mixed-methods approaches. She has published at national and international levels and teaches qualitative research methods at bachelor's and master's levels.

Emmanuel Ngwenya
School of Language Education,
Faculty of Education, North-West University,
Vanderbijlpark, South Africa
Email: emmanuel.ngwenya@nwu.ac.za
ORCID: https://orcid.org/0000-0002-0774-7612

Emmanuel Ngwenya is a lecturer in the School of Languages in Education, African Languages subject group at the Faculty of Education, North-West University. He teaches isiZulu home language, isiZulu additional language and isiZulu conversational language. His main research focus is socio-linguistic and self-directed learning.

Jako Olivier
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Mahikeng, South Africa
Email: jako.olivier@nwu.ac.za
ORCID: https://orcid.org/0000-0002-5860-6027

Jako Olivier is the holder of the UNESCO Chair on Multimodal Learning and Open Educational Resources and is a professor of Multimodal Learning in the Faculty of Education, North-West University. His research within the Research Unit Self-Directed Learning focuses on self-directed multimodal learning, open educational resources, multiliteracies, blended and e-learning in language classrooms, as well as multilingualism in education. He currently holds a Y rating from the National Research Foundation (NRF), and was awarded the Education Association of South Africa's Emerging Researcher Medal in 2018. In addition to recently editing books on self-directed learning in terms of multimodal learning and open education, he has published numerous articles and book chapters at national and international levels, and he also acts as a supervisor for postgraduate students.

Christo van der Westhuizen
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: christovdw@uj.ac.za
ORCID: https://orcid.org/0000-0002-4762-8538

Christo van der Westhuizen is currently a professor of Geography and Environmental Education in the School of Natural Sciences and Technology for Education at the Faculty of Education Sciences, North-West University, Potchefstroom Campus. He is the sub-area leader for blended learning in the Research Unit Self-Directed Learning. He has been working in the field of Teacher Education for the past 22 years, and his research focus is on the effective integration of ICTs (including geospatial technologies) in blended learning environments to foster self-directed learning. He is an Editorial Board member of the *Journal of Geography in Higher Education*.

Nicolaas van Deventer
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Vanderbijlpark, South Africa
Email: 24378682@nwu.ac.za
ORCID: https://orcid.org/0000-0003-4900-7994

Nicolaas van Deventer is a junior lecturer in the History for Education subject group at the Faculty of Education, North-West University. His main research focus is on historical thinking and self-directed learning in History education.

He is currently busy with his master's in Education in Curriculum Studies, as well as a school community engagement research project that focuses on self-directed learning.

Egon Werlen
UNESCO Chair on Personalised and Adaptive Distance Education,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland;
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa
Email: egon.werlen@ffhs.ch
ORCID: https://orcid.org/0000-0001-5550-7552

Egon Werlen is head of a research field at the Institute for Research in Open-, Distance- and e-Learning and the UNESCO Chair on Personalised and Adaptive Distance Education of the Swiss Distance University of Applied Sciences (FFHS). His main research focus is on emotions in reading and learning, adaptive learning and self-directed learning. He is currently involved in a research project in which emotions in student texts are automatically estimated in order to support students in their learning. He has published at national and international levels and acts as a supervisor for undergraduate students.

Foreword

Michael K. Ponton
Department of Higher Education and Learning Technologies,
Texas A&M University-Commerce,
Commerce, TX, United States of America

Self-directed learning (SDL) is a manifestation of a person's personal agency to learn by intentionally identifying a learning need, creating a learning activity to satisfy this need, regulating actions to participate in the learning activity, evaluating the outcomes and reflecting upon the activity and its consequences to shape future learning. Individual control to further personal interests and accomplish self-selected goals is how the use of SDL as a mechanism for human development enables each individual to create a unique narrative both personally and professionally. Quite simply, SDL is how people create individuality.

In order to engage in SDL, a person must invoke many cognitive, affective and conative strategies that support motivation, self-efficacy, resourcefulness, initiative and persistence in light of considered situational and contextual factors, both real and imagined. In order to promote learner self-directedness (i.e. the ability and propensity to engage in SDL), requisite mental strategies must be honed and metacognitively implemented, all of which can be learned or strengthened. Societies have created systems of formal education as preparation for a graduate's productive, satisfying life afterwards. In a world where change is a predictable constant, there is no more important preparation than the ability to engage in competent SDL to satisfy self-selected and often-novel pursuits.

The focus of this book is to offer the reader myriad instructional strategies that can be used in a blended learning environment – a learning environment that utilises both online and face-to-face (F2F) experiences – with the express intent of strengthening students' learner self-directedness. These strategies build upon extant theories of learning and teaching that include inquiry-based learning, flipped classroom approaches, cooperative learning, pair problem-solving, transactional distance theory, and student reflection. Theoretical frameworks are presented that discuss salient cognitive and metacognitive strategies as they relate to SDL, while findings from associated studies provide support for instructional design recommendations to strengthen learner self-directedness.

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Over the past decade, North-West University's Research Unit for Self-Directed Learning has been working diligently, thoughtfully and cooperatively to engage in research that produces data-driven educational strategies that facilitate self-directed, lifelong learning. This research unit is the driver behind a series of books related to SDL, and its affiliated scholars represent the dominant portion of authors for this latest volume, similar to previous ones. Although this unit is a rather recent addition to the SDL landscape, the SDL-related research of many of its scholars greatly precedes the unit's inception.

By reading this book, I am quite confident that any educator interested in developing students into self-directed learners via blended learning will learn invaluable theories and methods that support this outcome. Developing competent self-directed learners is the most important function of education. Thus, this volume (as well as previous ones) should be carefully examined by faculty, scholars, administrators, policy-makers and government officials interested in maximising the productive impact of education on society.

I commend and thank these authors for sharing their work, thoughts and recommendations to the international community, thereby leading us all along novel pathways that facilitate SDL.

Preface

Christo van der Westhuizen
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Mncedisi Maphalala
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Mahikeng, South Africa

Roxanne Bailey
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Within the context of the Fourth Industrial Revolution and the increasing need for the development of 21st-century skills, the notion of 'self-directed learning' (SDL) has become increasingly important, especially when integrated into blended learning environments. Self-directed learning has been conceptualised differently by several authors over the last few decades. The main accepted and quoted definition of SDL can be traced to that of Knowles (1975). Apart from defining SDL differently, several models for SDL have been constructed. Just so, blended learning has been viewed from different perspectives and models, the Community of Inquiry (CoI) framework being the most widely accepted to guide the quality of designed online learning environments.

This book is Volume 8 in the NWU Self-Directed Learning Series, initiated by the NWU's Research Unit Self-Directed Learning. This series addresses different aspects of research being conducted within the wider field of SDL and, specifically, within the mentioned research unit. In addition, this specific publication relates to research done in the sub-area of blended learning environments to foster SDL.

This book comprises 10 chapters. In Chapter 1, Van der Westhuizen and Bailey make a case for aligning the two prominent models in blended learning and SDL (the PPC model of Hiemstra and Brocket and the CoI framework of Garrison) to stimulate and guide SDL development within a blended learning environment. This chapter also sets the theoretical stage for chapters to follow by illustrating the myriad ways in which both blended learning and SDL can be defined. One aspect that is especially highlighted in the models presented in Chapter 1 is the importance of setting the correct and conducive environment to support SDL development and the cognisance of the individual (person) interacting with this environment.

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Chapter 2, written by Kruger et al., conceptualises the tenets of using inquiry-based learning as a teaching-learning strategy within blended learning environments to promote SDL. Although not directly, this chapter also specifically focuses on the affective domain that connects to the 'person' aspect of the PPC model of Hiemstra and Brockett.

Continuing the focus on teaching-learning strategies, in Chapter 3, Bailey and Breed report on the use of the flipped classroom approach (as a blended learning strategy) combined with cooperative learning to increase students' SDL. By including a focus on metacognitive self-questioning (implemented in the F2F cooperative learning sessions), they found that students' perceived SDL had increased.

Blended learning environments can also be defined differently, and in Chapter 4, Kemp and Van der Westhuizen make use of computer-aided design and learning management systems to foster students' SDL development within an Engineering Graphics and Design module at a university in South Africa. They report on how utilising computer-aided design and learning management systems correctly gave students the opportunity to take the initiative and responsibility for learning, illustrating an increase in self-direction through the use of a blended learning environment.

In Chapter 5, although it may seem that we are moving to a post-COVID era, Maphalala and Mahlaba specifically focus their research on the use of blended learning environments to foster SDL, especially as necessitated during the COVID-19 pandemic. Their findings on blended learning echo those of previous scholars, where it was found that the F2F component of their blended learning environment alleviates student challenges and sets the stage for greater SDL development. Important to note, however, is that it still uses a blend of F2F and online learning that collectively contributes to the students' SDL skills development.

In Chapter 6, connecting to the work of Bailey and Breed in Chapter 3, Lotz, Kruger and Olivier also investigate the use of the flipped classroom approach (as a blended learning strategy) to foster SDL. Through their investigation, they formulate set guidelines that include the acknowledgement of the changed roles of students and lecturers in a flipped classroom approach, efficient integration of technology in a blended setting, the need for more and clearer feedback, and scaffolding of SDL.

Most scholars in this book define blended learning as the blend between F2F learning and online learning; however, it is accepted that blended learning can also include a blend of aspects either in just a F2F setting or in an online teaching-learning setting. In her chapter (ch. 7) on academic flexibility when implementing information communication technology in using blended learning, Dhlamini focuses on the conducive use of information and communication technology when using blended learning. She continues to report on how flexible (or not) staff members at a particular institution of higher learning were when confronted with the required use of information and communication technology within blended learning. The flexibility of staff speaks to their self-direction and highlights an important aspect for future research.

In Chapter 8, Olivier, Mabiletja and Ngwenya bring imperative research to the fore by focusing on self-directed language learning in blended learning environments, but specifically highlighting Sesotho sa Leboa and isiZulu student-teachers' perspectives. By drawing on the strengths of blended learning environments, they make a case for implementation thereof in the context of African language learning. Through the use of blended learning environments, the participants in their study are of the opinion that self-directed language learning is indeed present.

Another unique aspect of this book is its application of blended learning environments in contexts beyond the borders of South Africa. In Chapter 9, Werlen, Mirata, Jagals and Bergamin highlight the importance of appropriate tasks in the online part of the blended learning environment. Drawing on the strengths of immediate, automated feedback that can be provided while students are interacting with the online part and developing a self-control task, students' SDL skills are adequately addressed.

In conclusion, Chapter 10 by Bunt and Van Deventer brings another dimension of blended learning to the table. They investigate the use of a combination of blended learning and gamification to develop BEd students' SDL abilities. They specifically include the use of the Habitica game to ensure student engagement in the blended learning environment. In order to determine whether students' perceived SDL skills had improved, they distributed both pre- and post-tests. Analyses of the quantitative results indicate that the combination of blended learning and gamification did indeed support SDL development.

Chapter 1

A 21st-century vision for self-directed learning in blended learning environments

Christo van der Westhuizen
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Roxanne Bailey
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Abstract

The person–process–context (PPC) model by Brockett and Hiemstra is a reconfiguration and updated version of the person–responsibility–orientation (PRO) model for self-directed learning (SDL). The PPC model highlights the importance of the person or learner, the teaching-learning transaction or process, and the social context. All three elements of the model must be treated with equal importance. In the PPC model, the optimal situation for SDL to be most effective is when the person, process and context are balanced.

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In other words, the learner is highly self-directed, the teaching–learning process is set up in a way that encourages students to take control of their own learning, and the socio-political context and the learning environment support the climate for SDL. In their research informing the PPC model, Hiemstra and Brockett highlighted the importance of the social aspects of SDL. Furthermore, it is clear that the PPC model has not yet received the necessary attention when being implemented in a blended or online learning environment. This conceptual chapter sets out to propose a guideline for the implementation of the PPC model in a blended learning environment, as we will focus on how the CoI framework of Garrison aligns with the PPC model of Hiemstra and Brockett – to elucidate a 21st-century vision for SDL in blended learning environments. The PPC model will require the same balance in blended learning environments, which calls for a higher cognitive presence to foster SDL, which means a balanced social and teaching presence. We argue that the alignment of the two models holds the key to stimulating and guiding SDL development within a blended learning environment.

■ Introduction

Self-directed learning is imperative for success in the 21st century. In 1975, Knowles defined SDL as:

> [*A*] process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

Merriam, Caffarella and Baumgartner (2007) listed three integral aims of SDL: fostering self-determination in students regarding their studies, promoting transformational learning and increasing emancipatory learning and social action. In the current era we are living in, being a self-directed learner has never been more important. Times have changed in so many ways: the COVID-19 pandemic has occurred, and students (fortunately) no longer have the luxury of always having access to direct instruction, also well known as a 'sage on the stage' idea. Thus, it has become imperative for students (in all learning sectors) to be equipped with the necessary skills to cope with the rapid changes occurring around them and to know how to use these varieties of skills and technologies optimally. Apart from the constant, rapid changes in information, the use of and variety of technology has also increased.

When discussing blended learning environments to foster SDL, it is important to contextualise it within the Fourth Industrial Revolution (4IR) and 21st-century skills. The 4IR is the fourth main industrial era since the First Industrial Revolution. The 4IR fuses technologies, implying a fusion between physical, digital and biological spheres. These 4IR environments include trends such as the Internet of Things (IoT), robotics, virtual reality and artificial intelligence (AI). The 4IR is changing the way we exist and is inherently changing the way we learn. The 4IR will not only impact our way of learning but also our identity, including our feelings towards privacy, ownership, consumerism, time management, skills development and, importantly, our relationships with others.

This impact on relationships necessitates focusing on putting people first and investigating how we can empower them. Butler (2018:n.p.) explained in the *South African Journal of Sciences*: 'Over the next three years, half a million more jobs will be created'. Employment for workers with scarce skills and who can manage and work alongside new technologies will become more competitive. AI will, at the same time, also replace more jobs than it will create. This will have significant implications for education. To succeed:

- Students must have numeracy and literacy skills and understand how the ever-changing new world operates.
- Students studying applied sciences must have an understanding of the political and social nature of the world.
- Students who study humanities must have at least a basic understanding of AI.
- All people must possess problem-solving skills, be adaptable, and can communicate in both the written and spoken words.
- All people will need to be able to make sound moral decisions that will not be duplicatable by a successful AI system.

Furthermore, information of a technical nature is more than doubling every two years. This implies that half of what students learn in a four-year degree will be dated by the time they graduate. Our educational landscape has not kept up with the changes and demands to equip our students with the necessary skills to utilise the opportunities that the 4IR offers. What is needed, amongst other aspects, is soft skills (e.g. people skills, social skills, communication skills, character or personality traits, attitudes, career attributes, social intelligence and emotional intelligence quotients). These soft skills increase productivity and collaboration and contribute to conducive work environments that improve the success of an organisation in a competitive world.

Ultimately, the education system should invest in teaching and learning strategies that foster more SDL skills for students to survive the 21st century with its unique demands. Therefore, it is imperative to accept learning as 'lifelong' and 'lifewide'; cultivate self-directed, autonomous students; foster learning that engages the mind, the body and the spirit; and, most importantly, develop critical thinkers and reflective practitioners with an array of soft skills.

With this in mind, Akgunduz and Akinoglu (2016) mentioned that technology has become such an important part of our lives, especially in education, that teaching-learning approaches will have to be adapted.

They also stated that face-to-face (F2F) learning will decrease; thus blended learning as a learning model or environment has been gaining more and more interest. In 2016, Akgunduz and Akinoglu could hardly foresee the forced decrease in F2F learning that COVID-19 would bring about.

In the recent case of the pandemic of COVID-19, which interfered with the way of life of many, the education system was also affected. Some of the steps taken by the South African government to counter the spread of COVID-19 were to prohibit public meetings at the height of the pandemic, introduce social distancing, and temporarily close schools. This required a move to ‘emergency’ online learning and put forward what it means to be a teacher and a learner in a pandemic setting (Mhlanga & Moloi 2020). The transition from the traditional teaching approach to an acceptance of ‘emergency’ online learning was inevitable when it became mandatory during the pandemic to implement a more proactive way of engaging in the education curriculum (Mhlanga & Moloi 2020). Previously recognised for focusing on F2F delivery, HEIs are now adopting new Internet-based technology.

The COVID-19 pandemic, the daily advancements in technology and the growing momentum of the 4IR have exposed the dire need for new teaching and learning methodologies. Jamiu and Yakubu (2020) highlighted that the paradigm shift from teacher-centred (where the teacher is the sole controller of teaching and learning activities) to student-centred (where students are actively involved) had gained worldwide advocacy for its practice at all levels of education.

With these challenges brought about by COVID-19 and the need to be even more self-directed, especially with education globally moving towards emergency online learning, the necessity to better investigate and understand the implementation of blended learning to foster SDL skills has become more prevalent.

To address the need to investigate and understand the implementation of blended learning to foster SDL, an investigation into SDL models and how these models relate to a blended learning environment is required. Although we will highlight various models of SDL and blended learning, we pay specific attention to the PPC model of Brockett and Hiemstra (1999) and the Community of Inquiry framework (CoI) of Garrison, Anderson and Archer (2000).

This conceptual chapter proposes guidelines for implementing of the PPC model in a blended learning environment, especially the online design of courses and activities, as we will focus on how the CoI framework of Garrison aligns with the PPC model of Brockett and Hiemstra. We end the chapter with a conclusion on how the PPC model can be used when facilitating SDL skills development through a blended learning environment.

Conceptual and theoretical framework

This research is informed by the social constructivist theory. Social constructivism asserts that learning occurs through both social interaction and individual meaning-making (Bozkurt 2017). When referring to Knowles' pioneering definition of SDL, it is thus also clear that social constructivism could have played a role in his mind when he stated, 'with or without the help of others'. Apart from social constructivism being relevant in SDL, it also holds value in blended learning, as several scholars have proved that blended learning environments gain success when incorporating social learning, for example, Van der Westhuizen (2015). To elucidate why this theory forms the basis of the conceptual and theoretical framework, we will discuss each concept (SDL and blended learning) of the chapter separately and indicate how it relates to the social constructivist theory.

Self-directed learning

Background to self-directed learning models

Self-directed learning (although being related to self-regulation, self-sufficiency and self-control; Ayyildiz & Tarhan 2015) has its roots in adult education with authors such as Houle, Tough and (probably the most cited) Malcolm Knowles (Sawatsky et al. 2017). Brockett and Hiemstra (1991) noted that few topics in adult education have gained as much attention as SDL. As mentioned, the most widely cited definition of SDL is that of Malcolm Knowles. He defined SDL as (Knowles 1975):

> [*A*] process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

Ayyildiz and Tarhan (2015:670) highlighted that a self-directed learner possesses the following skills:

- A desire for lifelong learning.
- A sense of responsibility towards their own learning.
- A metacognitive ability to learning how to learn.
- Basic literacy and numeracy skills.
- Higher-order thinking, such as critical thinking, problem-solving and metacognition.
- Interpersonal skills, such as social skills.

They (Ayyildiz & Tarhan 2015:670) further used their observations from literature reviews to create a measuring scale of SDL skills that included the following key factors:

- Attitude towards learning.
- Learning responsibility.

- Motivation and self-confidence.
- Ability to plan to learn and acquire knowledge.
- Ability to use learning opportunities.

Baumgartner (2003) mentioned that SDL has three definitions: SDL as a 'goal', SDL as a 'process' and SDL as a 'personal attribute'. They continued to categorise SDL models into three categories: sequential (which places students' SDL into steps), interwoven (which emphasises examining characteristics of a learner and its connection to the learning context/ teaching-learning environment) and instructional (which provides set of instructions to teachers to develop SDL in their teaching-learning environment) (Baumgartner 2003:26).

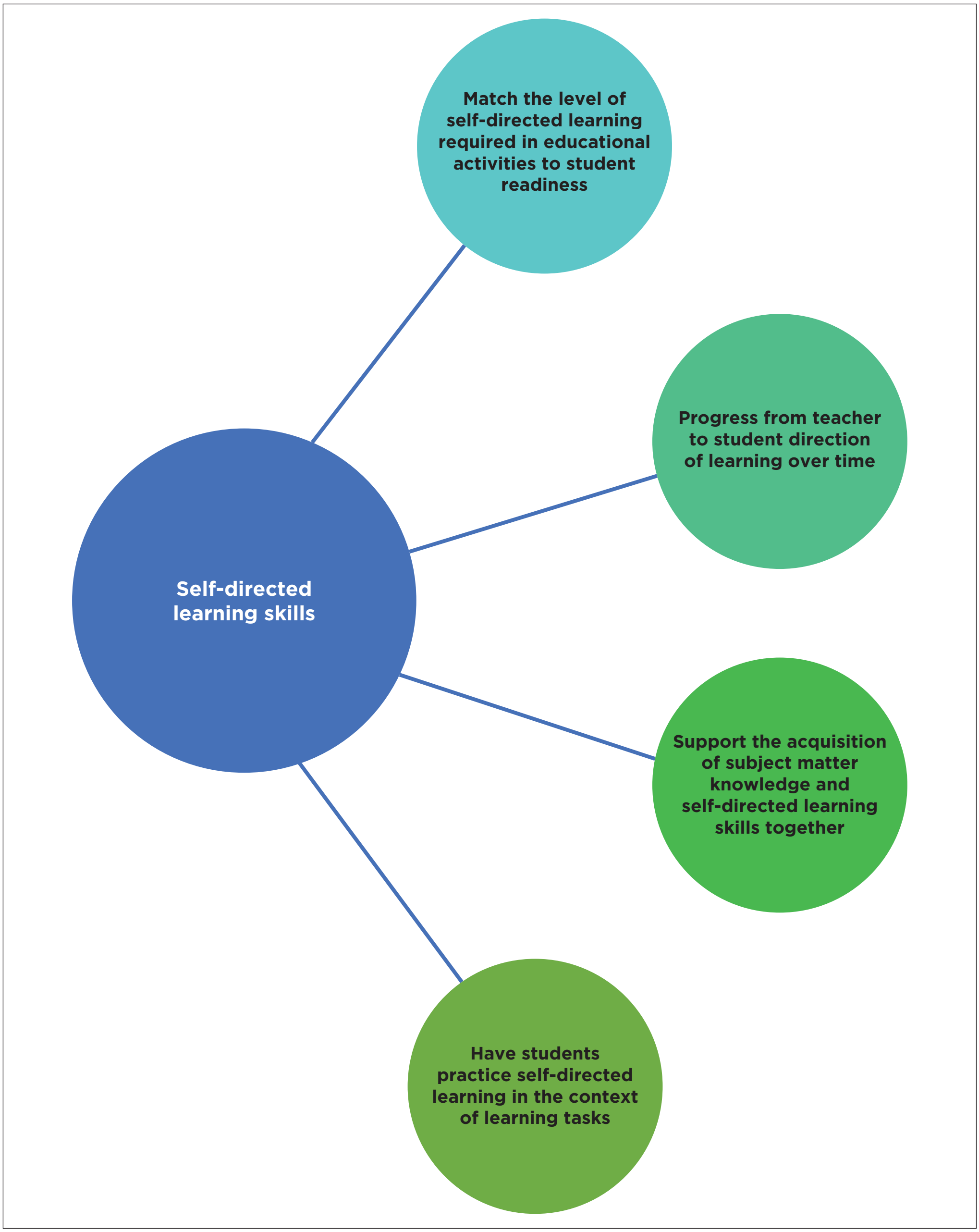
Sawatsky et al. (2017) noted that several theories of SDL were followed after the initial introduction of SDL in literature. They noted that all these theories, in some ways, are informed by Knowles' definition. According to Sawatsky et al. (2017), these theories all encompass three key elements: process, personal attributes, and context. Even when referring to factors mentioned by Ayyildiz and Tarhan (2015), it is clear that the process, personal attributes and context play the most vital part in SDL development. Francom (2010) also noted that although there are several factors that influence SDL development, the teaching-learning environment (as in the context of this chapter in a blended learning environment) can be manipulated to foster SDL. Subsequently, three models (Francom 2010; Grow 1991; Wichadee 2011) of SDL development will be mentioned (in no particular order), followed by an in-depth discussion on the PPC model (as one of the most popular models and arguably the most relevant model for SDL development).

Francom (2010:33) developed a model of SDL development where they specifically made conclusions about the 'principles for fostering students' self-directed learning skills'. These principles were concluded from a comprehensive review of empirical research and theoretical literature reviews on the body of scholarship on SDL. The four prescriptive principles, as described by Francom (2010), are illustrated in Figure 1.1.

The four principles are given as follows (Francom 2010:33–36):

- Match the level of SDL required in educational activities to student readiness.
- Progress from teacher to student direction of learning over time.
- Support the acquisition of subject matter knowledge and SDL skills together.
- Have students practise SDL in the context of learning tasks.

In Francom's model, it is clear that the learner/student stands at the centre of the teaching-learning environment; however, the instructor/teacher still prescribes and manipulates the teaching-learning environment to



Source: Francom (2010:34).

FIGURE 1.1: General principles for fostering self-directed learning skills in formal education.

successfully guide the student from being less self-directed to more self-directed. The onus lies with the teacher to match the self-directed activities with the student's self-directed readiness. Although only discussed later in this chapter, it is already clear that the flexibility of blended learning environments provides a greater possibility for this ‘match’ of activity and readiness. Francom (2010) also highlighted the importance of centring learning tasks in order to have learning transfer from one context to another context. This model describes four prescriptive principles of SDL skills development; however, it can be noted that, as mentioned by Sawatsky et al. (2017), it encompasses three key elements: process, personal attributes and context. This notion again links up with Hiemstra and Brockett’s PPC model, which will be discussed at the end of this section.

Another model worth noting is that of Wichadee (2011). By using a literature review, designing a draft of the model, implementing and evaluating it (by experts) and implementing it in their classroom, Wichadee (2011) developed an SDL instructional model with specific application in a reading ability course. The SDL instructional model thus included three stages:

- Preparation stage.
- Learning stage.
- Evaluation stage.

During the preparation stage, the teacher identifies students’ needs (and background) in terms of reading skills to use the data as a guideline for teaching them (Wichadee 2011).

In the learning stage, students engage in a seven-step process: choosing learning content that they are interested in, stating the learning goals, developing a learning contract, developing a plan to reach their set goal, engaging in the set learning activities, combining the knowledge they have acquired and evaluating whether their learning goals have been met (Wichadee 2011).

Finally, Wichadee (2011) concluded their SDL instructional model with the evaluation stage. This stage focused on three types of assessment activities: the teacher examining the students’ reading ability, the teacher examining the students’ self-directed learning ability (SDLI) and the teacher studying the students’ view of SDL.

Unfortunately, one cannot deny that Wichadee’s model relies quite heavily on the teacher and has the teacher directing the greater part of the learning experience. It is clear, once again, that the three stages suggested by Wichadee (2011) can be aligned with the notion of Sawatsky et al. (2017) in that the preparation stage coincides with the ‘personal attributes’, the learning stage coincides with the ‘process’ and all three stages link with the notion of ‘context’.

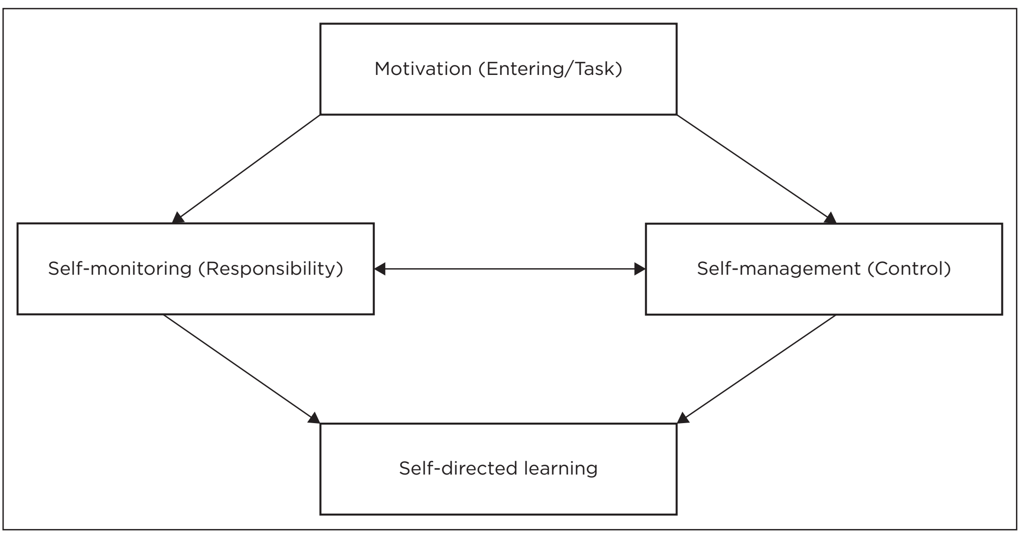
Another popular model for SDL is that of Grow (1991). He noted that SDL consists of four stages:

- **Stage one:** Students are other-directed and are dependent on the teacher to present content to them.

- **Stage two:** The teacher's role moves from a lecturer to a motivator. The teacher, however, still directs the learning process, and learning is thus quite teacher-directed.
- **Stage three:** The learner moves from being teacher-directed/other-directed to being facilitated – a move to a more learner-centred learning process. This can also occur when the learner engages in peer activities that they themselves direct.
- **Stage four:** The learner takes full responsibility for their own learning, and the learning process is thus fully learner-directed and self-directed (Grow 1991).

Professor Randy Garrison (father of the CoI framework) already developed a pivotal SDL model in 1997. Figure 1.2 illustrates Garrison's 1997 comprehensive model of SDL.

Referring to the model of Garrison (Garrison 1997:22), it is clear that SDL includes three overlapping dimensions/elements: 'self-management (task control), self-monitoring (cognitive responsibility) and motivation (entering and task)'. In the self-management dimension, the focus is placed on the social and behavioural aspects of learning (i.e. external influences on the learning process). The self-monitoring dimension focuses on the cognitive and metacognitive aspects of learning (i.e. learning strategies). In the motivation dimension (which seems to be the most difficult to unpack), the focus is placed on aspects such as entering motivation (deciding to participate) and task motivation (persisting in participation). Although we only briefly mention the three elements/dimensions of Garrison's model,



Source: Garrison (1997:22).
FIGURE 1.2: Dimensions of self-directed learning.

Garrison (1997) emphasised that it should be clear that these elements are 'intimately connected' and should not be seen in silos. These aspects relate well with the PPC model of Hiemstra and Brockett (2012) in the sense that they are 'intimately connected' and also fit into the three elements suggested by Hiemstra and Brockett (person, process and context).

Song and Hill (2007) summarised the major models of SDL by placing them in three categories, as noted by Sawatsky et al. (2017). In Table 1.1 (as taken from Song & Hill 2007:28), it is clear that three perspectives of SDL occur (as mentioned by Sawatsky et al. 2017); furthermore, three main models are illustrated: Candy's (1991) model, Brockett and Hiemstra's (1991) model and Garrison's (1997) model. Although Song and Hill do not include the models mentioned, yet, the models that they mention are noteworthy and popular amongst scholars in SDL research. It also includes Brockett and Hiemstra's (1991) personal responsibility orientation model (person–responsibility–orientation [PRO] model) that preceded the PPC model.

TABLE 1.1: Perspectives on self-directed learning.

Perspectives	Description	Models		
		Candy (1991)	**Brockett and Hiemstra (1991)**	**Garrison (1997)**
Personal attributes	Moral, emotional and intellectual management	• Personal autonomy • Self-management	• Goal orientation (personal attribute)	• Self-management (use of resources) • Motivation
Process	Learner autonomy over instruction	• Learner control • Autodidaxy	• Process orientation (learner control)	• Self-monitoring
Context	Environment where learning takes place	• Self-direction is context bound	• Social context: role of institutions and policies	• N/A

Source: Song and Hill (2007:28).

When referring to the models discussed in this section, and the body of scholarship on SDL theory, it is clear that a large cohort agrees that SDL, in whichever form, should include a focus on personal attributes, process and context. It is in line with this argument and the fact that social constructivism (as our conceptual framework) is supported that we accept the PRO model of Brockett and Hiemstra (1991), which was later adapted to the PPC model of Hiemstra and Brockett (2012), as the most acceptable and relevant model of SDL development. The following section will thus describe these two models in detail.

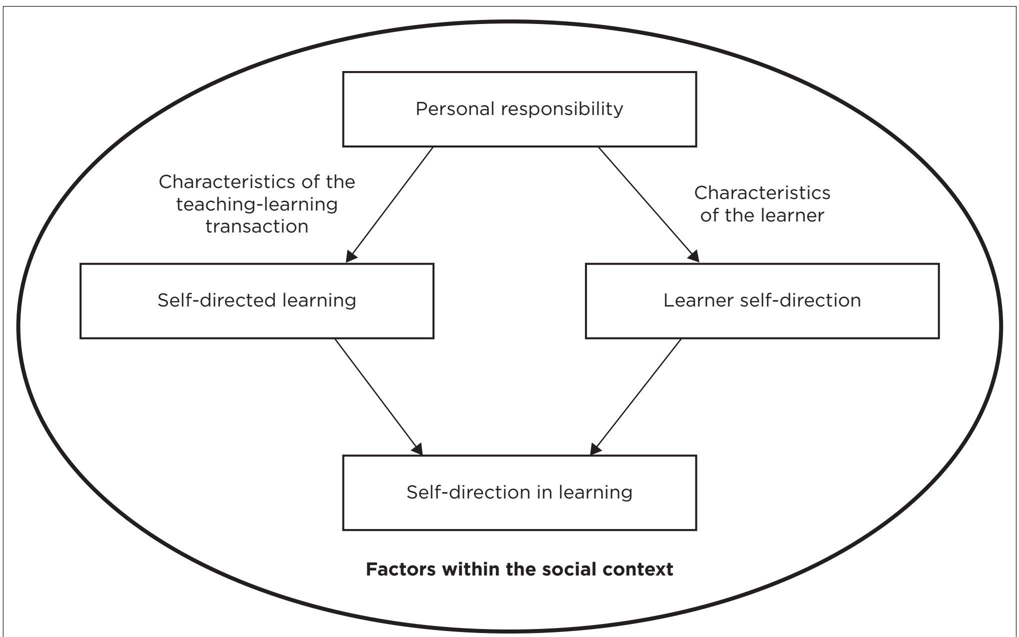
The person–process–context model of self-directed learning development

As the old saying goes, one cannot know where you are going if you do not know where you have been. Thus, to understand and fully grasp the PPC model (Hiemstra & Brockett 2012), one needs to first understand the PRO model (Brockett & Hiemstra 1991), which acted as the model that preceded the PPC model.

Brockett and Hiemstra (1991) noted that in their view, self-direction in learning could be divided into two categories or dimensions: (1) the process of the learner assuming the responsibility for the learning process and (2) the desire of the learner to assume responsibility of the learning process. Self-directed learning is thus seen as an 'instructional method' (i.e. the process of the learner assuming responsibility) and a 'personality characteristic' (the desire of the learner to assume responsibility).

In Figure 1.3, the PRO model diagram is illustrated. In this diagram (as developed by Brockett and Hiemstra 1991), four main components can be seen: (1) personal responsibility, (2) learner self-direction, (3) SDL and (4) self-direction in learning. It is also clear that factors within the social context play an important role. It is in line with this argument that we also accept the social constructivist theory as an appropriate theory for our conceptual framework.

Hiemstra and Brockett (2012) noted that the PRO model helped define SDL and explain the concept of self-direction in learning. Although they set out to 'update' their PRO model, they claim that the notions of the PRO model still hold the essence of their view and thinking regarding SDL. The main aim of



Source: Brockett and Hiemstra (1991:n.p.).
FIGURE 1.3: The personal responsibility orientation model.

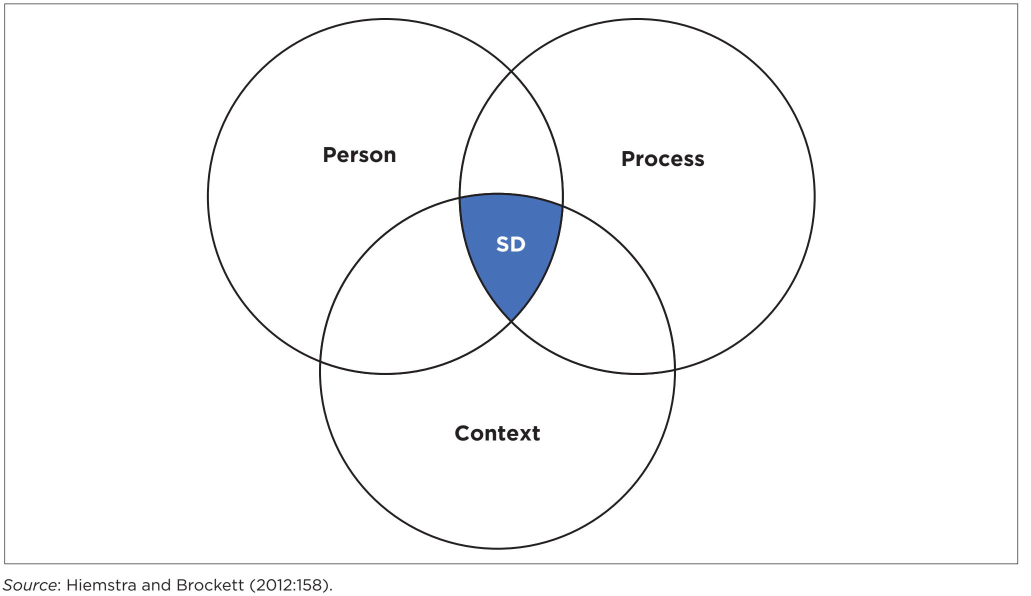
the PPC model thus was to reintroduce their thoughts about SDL in an understandable language (Hiemstra & Brockett 2012).

We have already discussed that the PPC model evolved from the PRO model above; however, we also should point out that the two authors had gained a cumulative experience of approximately 20 years between the PRO model and the PPC model (Hiemstra & Brockett 2021). Figure 1.4 illustrates the PPC model.

Figure 1.4 points out that all three elements in the PPC model share equal importance when referring to SDL development. Hiemstra and Brockett (2012:158) described the three elements as follows:

- *Person* includes personal attributes and or characteristics of the learner, such as 'creativity, critical reflection, enthusiasm, life experience, life satisfaction, motivation, previous education, resilience and self-concept'.
- *Process* involves the teaching-learning transaction (also known as the teaching-learning environment), including 'facilitation, learning skills, learning styles, planning, organising, evaluating abilities, teaching styles and technological skills'.
- *Context* 'encompasses the environmental and socio-political climate, such as culture, power, learning environment, finances, gender, learning climate, organisational policies, political milieu, race and sexual orientation'.

Hiemstra and Brockett (2012) further emphasised that SDL development is best achieved when all three elements are in balance. In their seminal work on



Source: Hiemstra and Brockett (2012:158).
SD, self-directed.

FIGURE 1.4: The person–process–context model.

the PPC model, Hiemstra and Brockett (2012) actually called for further future research to identify and investigate the intersections between the three elements. It is exactly to this call that we as authors heed – later in this chapter, it will become clear how we see the intersections of the PPC model when applying it to blended learning environments and what we believe should be placed in these intersections to fit technology integration in SDL; however, before that discussion, we first discuss the PPC model in more detail and as viewed by other authors.

Du Toit-Brits (2019) mentioned that in the PPC model, the teacher plays a key role in creating a conducive environment for students' SDL development. This notion (of Du Toit-Brits) plays to the 'context' and 'process' elements in the PPC model; however, it excludes the reality of the 'person'. Piotrowski (2020) noted that Hiemstra and Brockett stated that too little research was done on the 'person-context' interrelationship, thereby creating a gap for research on how the person/learner interacts with the context.

In their study on establishing new insights into SDL development, Nasri (2019) found that teachers should develop a promotive collaborative relationship with their students, recognise resources and restrictions and how these may hinder or promote SDL development in their classes and have support from their institutions about their teaching–learning strategies (which will support their students' continuous lifelong learning), as well as having support from their institutions in fostering collaboration between teachers. In short, Nasri (2019) may have mentioned that the institution should support the teacher to successfully support and engage with the 'person', 'process' and 'context' during SDL development. The aforementioned is also true when implementing blended learning in classrooms.

Apart from the apparent gap in SDL literature, especially concerning the PPC interrelationship, a gap exists between the development of SDL, specifically in blended learning environments and even more so post-COVID-19. We will subsequently discuss blended learning and how blended learning environments can promote SDL development.

Blended learning

Blended learning is a combination of F2F and computer-mediated instructions, referring to the integration of specific and complementary F2F and online approaches to teaching and learning (Garrison & Vaughan 2013; Graham 2006; Hung & Choub 2014). A blended learning environment can therefore be described as a teaching and learning environment that uses blended learning methods of instruction, which require interaction between students and educators, and innovative digital instructional resources (computer-mediated instructions) that do not specifically require student–educator interaction

(Graham 2006; Prohorets & Plekhanova 2015). A blended learning environment can be characterised by student self-directedness, in which students are aware of their own learning responsibilities and actively participate in learning processes such as acquiring information, planning and evaluating activities (Freeman et al. 2014; Geng, Law & Niu 2019). Therefore, students' ability to direct themselves in a blended learning environment can affect the learning effectiveness of students in a particular blended learning environment (Geng et al. 2019). Furthermore, a blended learning environment aims to improve students' learning effectiveness by creating meaningful student experiences and using time and physical materials effectively and purposefully (Singer & Stoicescu 2010). To effectively create a blended learning environment, educators and students will be required to employ blended learning models such as, but not limited to, station or lab rotations, a flipped-classroom or an individual-rotation model, which aim to combine the strengths of both F2F and computer-mediated instructions (Bosch 2017; Horn & Staker 2014).

Blended learning at the course and activity levels reflects the most common idea of blended learning and views blended learning as some combination of F2F and technology-supported instruction. The two most commonly used definitions of blended learning are those of Graham (2006:5) and Garrison and Kanuka (2004:96). Graham (2006:5) defined blended learning as 'the combination of F2F instruction with computer-mediated instruction', whilst Garrison and Kanuka (2004:96) defined it as 'the thoughtful integration of classroom F2F learning experiences with online learning experiences'. Both these definitions reflect the idea that blended learning is 'the combination of two different models of teaching and learning, namely traditional, F2F learning and online learning, each with its own historical background, learning strategies, strengths and weaknesses' (Hrastinski 2019:565).

Although there are still many discourses on finding a more reliable definition for blended learning that incorporates factors such as context, pedagogical approaches and learning theory (Cronje 2020:115; Hrastinski 2019:565; Smith & Hill 2019:838), the foundational idea is that F2F learning and e-learning should be integrated optimally in order to utilise the strength of each of the learning modes and in blending these into a unique learning experience conducive to the set outcomes of the learning purpose of the blended learning environment (Garrison & Vaughan 2013:25). However, when implementing blended learning, one cannot merely integrate technology in the classroom or determine whether there is a right blend of technologies that will be conducive to students' learning; blended learning requires the facilitator to create a 'transformative environment' where critical thinking and complex learning skills are developed (Halverson & Graham 2019:147). Thus, in a blended learning environment, the use of technology moves from being a 'teaching tool to the actual learning space where collaboration and sharing occur' (Delialioğlu 2012:313). Central to blended learning is thus also the collaboration component and, most vitally, the change from teacher-centred teaching to student-centred facilitation (Wallder & Brown 2019:661). From these discussions, it is clear why blended learning would often become the chosen approach to teaching and learning. Blended learning increases student access and flexibility, increases the level of active learning, and teachers and facilitators reach more positive student experiences and outcomes when implementing blended learning (Hrastinski 2019:564). In the following sections, the blended learning continuum and some models for blended learning will be discussed.

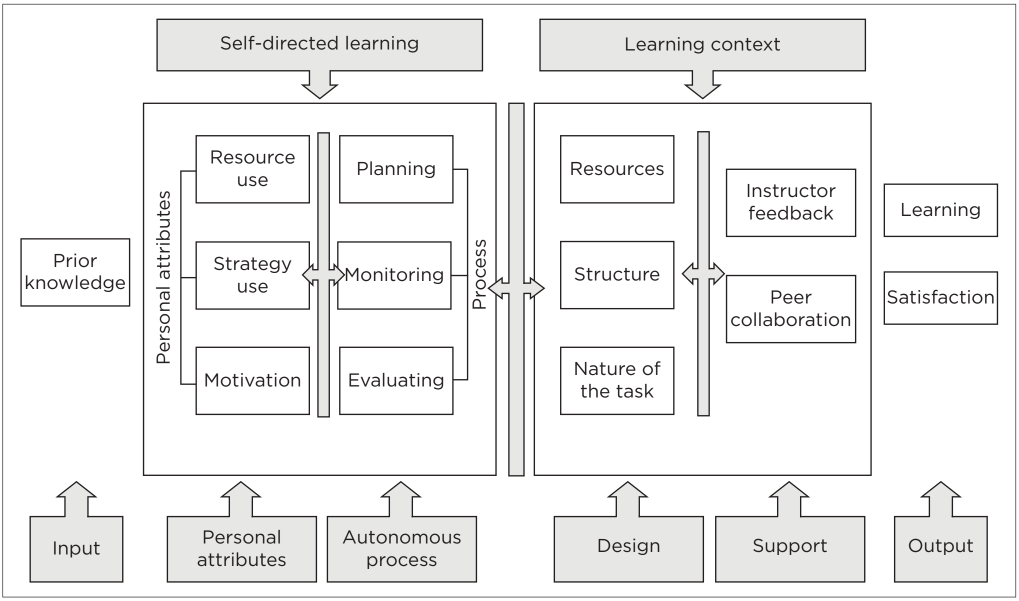
It is mostly the online part of blended learning where the most application difficulties occur as to what technologies should be blended with which teaching and learning strategies to optimise SDL and requires the most redesign. Laine, Myllymaki and Hakala (2021) emphasised the fact that online learning holds several possibilities for SDL development. This notion has been supported by several researchers across the body of scholarship on SDL. In the following sections, we thus discuss some models that pertain to blended learning (including online learning that holds relevance in blended learning environments) – we conclude the section with an argument that the CoI framework (Garrison et al. 2000) provides key concepts and elements when implementing blended learning environments to foster SDL.

☐ Song and Hill's conceptual model for understanding self-directed learning development in online environments

Without realising it, Song and Hill (2007) already paved the way for 2021, where SDL development would wholly depend on online learning environments. They based their notion of their model specifically on the fact that previous models of SDL development were mostly focused and based on F2F teaching-learning environments. Figure 1.5 illustrates Song and Hill's conceptual model for understanding SDL development.

Song and Hill (2007) also based the model on the three elements that are described by Sawatsky et al. (2017): personal attributes, processes and context. In Song and Hill's (2007) model, the personal attributes and processes form part of 'self-directed learning', whereas the learning context is removed from SDL and placed on its own.

Although the model does indicate an interaction between SDL and learning context, it does create a sense of disconnect between the two elements. The elements of Song and Hill (2007) also align with Hiemstra and Brockett's (2012) PPC model in terms of the three basic elements (person, process and context); however, Hiemstra and Brockett (2012) made a strong argument for placing all three elements in connection with each other in order to develop SDL successfully. They (and other authors) indicated that one element should not be prioritised above another



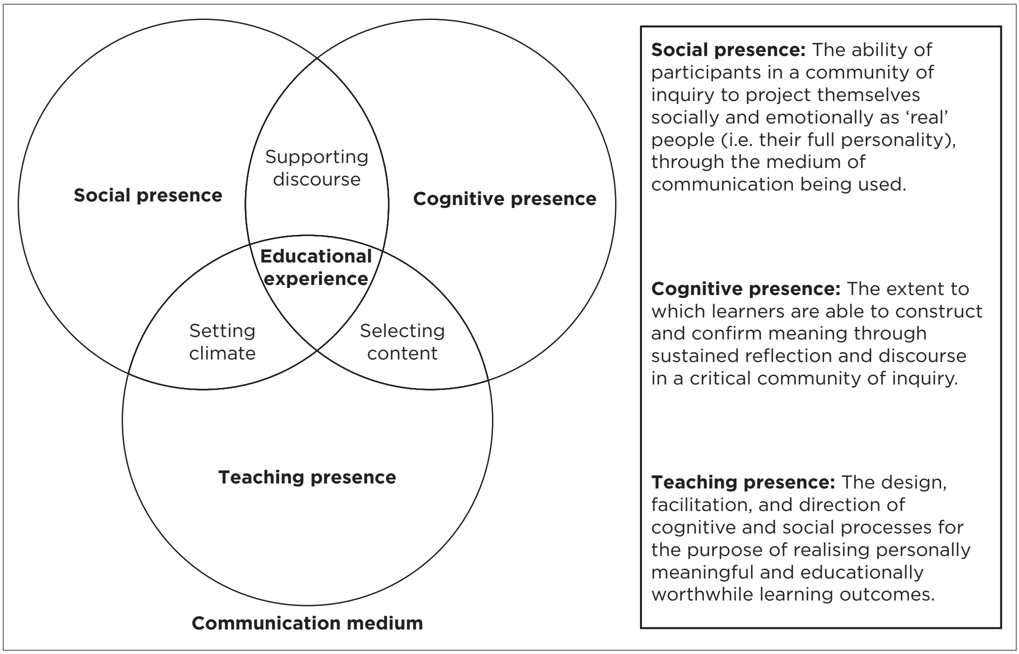
Source: Song and Hill (2007:31).

FIGURE 1.5: A conceptual model for understanding self-directed learning.

(although one sometimes cannot stop the balance between the elements). Another critique of Song and Hill's model is that it could possibly hold true for online learning; however, it lacks support in terms of blended learning (where F2F teaching-learning environments and online teaching-learning environments are combined to gain the greatest advantage from both). It is in line with these critiques that we will subsequently discuss the CoI framework as developed by Garrison et al. (2000) as a successful model when engaging with online and blended learning environments (as proven by several authors in recent studies, for example, Van der Westhuizen 2015). This will be followed by a discussion on the usefulness of the CoI framework for SDL development.

Community of Inquiry model by Garrison, Anderson and Archer

In 2000, Garrison et al. (2000) developed a framework for describing the critical elements when engaging in higher education online learning and blended learning (Garrison & Vaughan 2008). This model has been well studied in the literature (according to Google Scholar, this model was cited just below 3 000 times) and proved to be a meaningful framework for the development of online courses, especially in higher education, as it is seen



Source: Garrison et al. (2000:2).
FIGURE 1.6: Community of Inquiry (CoI) framework.

as a dependable and valid measuring instrument to analyse the quality and efficiency of designed online learning environments (Rapchack 2017). Figure 1.6 illustrates the CoI framework[1] as designed by Garrison et al. (2000:3) and focuses on three important presences, that is, the teaching, social and cognitive presences (Shea, Pickett & Pelz 2003; Shea et al. 2005).

For the purposes of this chapter, the following needs to be highlighted again to allow for a sufficient comparison and overlap of the CoI framework of Garrison et al. (2000) and the PPC model of Hiemstra and Brockett (2012).

A fair amount of the research demonstrates the CoI framework's validity in analysing and evaluating the processes and designs associated with the creation of higher-order learning activities to ensure that students become engaged in a learning process of critical inquiry (Morueta et al. 2016; Rapchak 2017; Swan, Garrison & Richardson 2009; Szeto 2015).

1. The CoI framework is also extensively covered in the AOSIS's NWU Self-Directed Learning Series volume 1 (ch. 9) and volume 5 (ch. 2, 6 and 9), which are freely downloadable at https//doi.org/10.4102/aosis.2019.BK134 for Volume 1 and https//doi.org/10.4102/aosis.2020.BK210 for Volume 5.

Firstly, the CoI framework is theoretically grounded (Cho, Kim & Choi 2017) (Garrison et al. 2000):

> [/]n social constructivism that views collaboration among the participants as [*essential*] for meaningful knowledge [*construction*] (Garrison, Cleveland-Innes & Fung 2010). Students' mindful engagement in interactions with the instructor [*or tutors*] and with other students can help them to develop relevant knowledge [*and skills*]. (p. 11)

As indicated above, the CoI framework entails three interactive, all overlapping, presences, namely teaching presence, social presence and cognitive presence and can (according to Cho et al. 2017; Morueta et al. 2016) be defined or described as follows:

1. *Teaching presence* entails 'the design, facilitation, and direction of cognitive and social processes for the purpose of realising personally meaningful and educationally worthwhile learning outcomes' (Anderson et al. 2001:5). Teaching presence is fundamentally the starting point and essence – the glue – of an online learning environment and plays a key role in nourishing, supporting and maintaining the social and cognitive presences of online learning environments (Akyol & Garrison 2011; Garrison, Anderson & Archer 2010). Teaching presence entails two overall functions: '(1) the design of the educational experience and (2) facilitation among the instructor and the students. It is the responsibility of the instructor to design and integrate both cognitive and social presence for educational purposes through scaffolding, modelling or coaching' (Morueta et al. 2016:124).
2. *Social presence* entails 'the ability of participants to identify with the community (e.g. course of study), communicate purposefully in a trusting environment, and develop interpersonal relationships by way of projecting their individual personalities' (Garrison 2009:352). It is also important to note that 'social presence emphasises participants' communication skills in relation to other members and contributes to the creation of a collaborative learning climate' (Akyol & Garrison 2011:184). Social presence is, therefore, divided into three sub-categories, namely: 'Affective, interactive, and cohesive and reflects a supportive context for emotional expression, open communication, and group cohesion for the resolution of the respective task. Social presence, an important factor critical to F2F teaching, is a challenge for instructors to facilitate in online learning environments' (Morueta et al. 2016:123).
3. Finally, *cognitive presence* entails 'the extent to which students are able to construct and confirm meaning through sustained reflection and discourse in a critical Community of Inquiry' (Garrison et al. 2001:11). 'Through cognitive presence, students develop meaningful knowledge' (Cho et al. 2017). The cognitive presence can be further categorised into four phases, with each phase defined by specific descriptors: (1) *triggering events* – identifying an inquiry topic; (2) *exploration* – discussing and reflecting on

the issue; (3) *integration* – building meaning from ideas developed through exploration; and (4) resolution – applying newly acquired knowledge to a real-world context (Morueta et al. 2016:122).

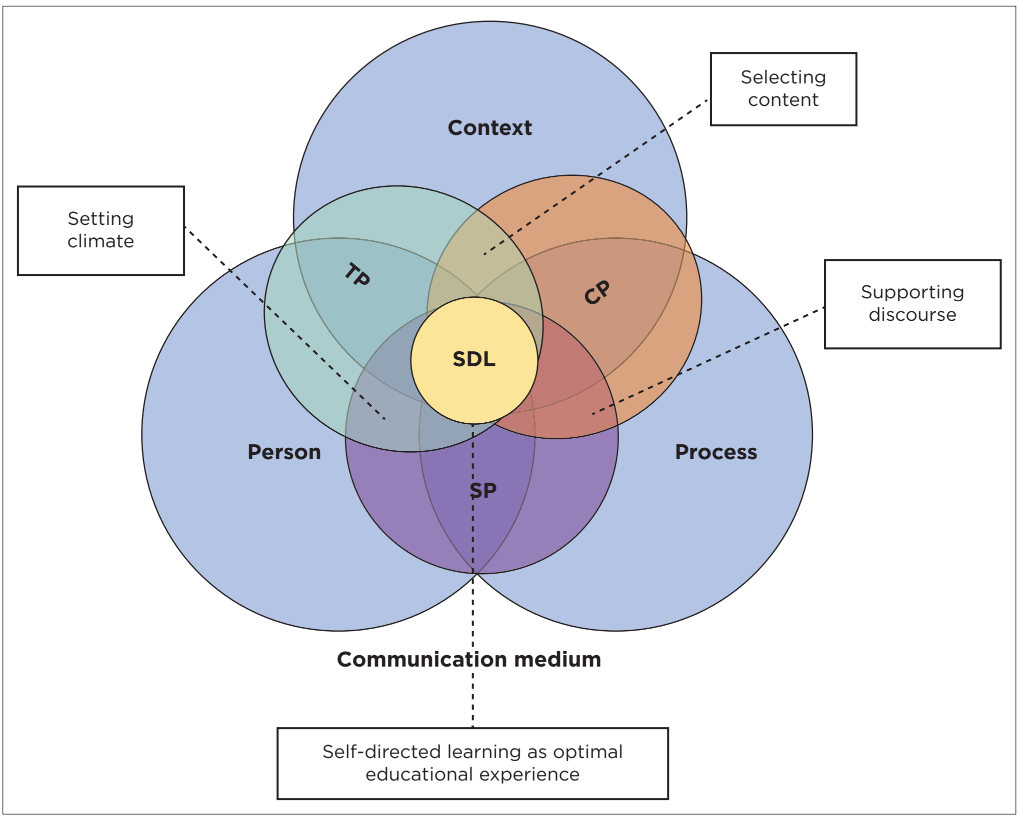
Teaching presence is, therefore, the integrating and overarching authority that facilitates online collaboration and interaction to structure, organise, manage, administrate and lead the online teaching and learning environment and processes through deliberate, collaborative, and continuous processes. *Social presence* refers to the ability of the virtual environment to connect users safely and smoothly, allowing members of the online community and the lecturer to collaborate at a more personal level. The idea of *cognitive presence* refers to the cognitive and metacognitive construction of meaning, acquiring higher-order skills, and understanding deeper concepts through collaborative inquiry (Garrison 2006). 'It is the balanced overlapping of these three elements that generate the core of a CoI where collaborative constructivist teaching and learning experiences can be accomplished' (Garrison 2006:30). Online learning experiences and interaction between these presences should continuously advance to maximise the 'learning experience' of students or learners as it affords intellectual, social and cognitive interaction amongst online collaborators and study materials, ultimately achieving the set learning outcomes of course work (Annand 2011).

Finally, for complex, higher-order learning activities, it is important to ensure an optimal social presence to assure the achievement of awareness and a high cognitive presence. Thus, the complexity and nature of the activity or task appears to affect the cognitive abilities and activity of the group (Morueta et al. 2016).

■ Alignment of the person–process–context model and Community of Inquiry framework

As mentioned earlier in the chapter, Hiemstra and Brockett (2012) called for investigations into the intersections that encompass the three elements of their PPC model. Furthermore, a need to investigate a model for SDL that proves relevant and possible in blended learning environments and online learning environments (as noted by Laine et al. 2021) is more imperative now than ever. In an attempt to adhere to this call, as well as to allow for technology integration within blended learning environments, we subsequently indicate why we argue that a combination of the PPC model and the CoI framework holds the key to successful SDL development in blended learning environments and therefore apply the PPC module guidelines when designing online courses or activities. Figure 1.7 illustrates our proposed suggestion of combining the CoI framework with the PPC model for optimal SDL development for designing online or blended learning environments. The figure is followed by a discussion of how we see each element and how each element interacts with the other within the context of designing blended learning environments to foster SDL. There is also an observation that the CoI framework lacks proper guidelines to take SDL into consideration when designing online courses or activities, and there also might be uncertainty on how to apply the PPC model in online or blended learning environments.

As illustrated in Figure 1.7, we suggest that blended environments that aim to foster SDL should follow the PPC model, taking into account the person (referring to the characteristics of the learner), the process (referring to the teaching-learning process) and the context (referring to the sociocultural context of the learner and the teacher). We further propose to introduce the three core presences of the CoI framework into the blended learning environment. As indicated earlier in the chapter, these presences are the cognitive presence (illustrated with 'CP' in the figure), the social presence (illustrated with 'SP' in the figure) and the teaching presence (illustrated with



Source: Hiemstra and Brockett (2012:158) and Garrison et al. (2000:3).
Key: TP, teaching presence; CP, cognitive presence; SP, social presence; SDL, self-directed learning.

FIGURE 1.7: Proposed framework aligning the person–process–context model with the Community of Inquiry framework.

'TP' in the figure). We argue that balancing the three elements of the PPC model and the three presences of the CoI framework is the key to successful SDL development when designing and managing blended and online learning environments.

In order to elucidate the claims made in the aforementioned paragraph, we will discuss each intersection separately.

Person-context intersection: Teaching presence

To illustrate the connection between the person and context and how the teaching presence overlaps with the characteristics of the person and context elements and serves as an intersection between these two, we have placed the three individual elements in a table. Box 1.1 indicates the components of the 'person' element that relate to the components of the 'teaching presence' in the middle column. We also added the components of the 'context' element that relate to the 'teaching presence' component in

BOX 1.1: Teaching presence as intersection between person and context.

Person **(Hiemstra & Brockett 2012:158)** **'This includes characteristics of the individual, such as creativity, critical reflection, enthusiasm, life experience, life satisfaction, motivation, previous education, resilience, and self-concept.'**	**Teaching presence** **(Pool 2014:185)** **'Contributes to effectiveness of online learning through guided communication towards higher levels of learning through reflective participation.' Anderson et al. (2001:3)**	**Context** **(Hiemstra & Brockett 2012:158)** **'This encompasses the environmental and socio-political climate, such as culture, power, learning environment, finances, gender, learning climate, organisational policies, political milieu, race, and sexual orientation.'**
Motivation and life satisfaction	Ensure student satisfaction throughout	Culture, gender, finances, race and sexual orientation
Critical reflection	Perceived learning by realising personally meaningful and educationally worthwhile learning	Culture, gender, finances, race and sexual orientation
Characteristics of the learner and life experience	Create a sense of community by establishing a prominent social presence	Culture and socio-political climate
Motivation and previous education	Design of cognitive and social processes to engage in meaningful learning	Environmental and socio-political climate, learning environment and learning climate
Motivation, previous education and self-concept	Facilitation discourse of cognitive and social processes to engage in meaningful learning	Learning environment and learning climate
Motivation, life experience, previous education and self-concept	Direction of cognitive and social processes to engage in meaningful learning	Organisational policies, learning environment and learning climate

Source: Hiemstra and Brockett (2012:158) and Garrison et al. (2010:7).

a column. In this way, we indicate how and which components of each element taken from the PPC relate to the teaching presence of the CoI. It must be noted that, although the teaching presence fits well within the overlap section between person and context, there are also prominent characteristic similarities and overlaps between creating a teaching presence in online learning and aspects to take into consideration in the person sector only of the PPC model. In the same account, there is also a robust characteristic overlap between the teaching presence and the context aspect of the PPC model.

Context-process intersection: Cognitive presence

To illustrate the connection between the context and process and how the cognitive presence overlaps with the characteristics of the context and process elements and also serves as an intersection between these two, we have placed the three individual elements in a table. Box 1.2 indicates the components of the 'context' element that relate to the components of the 'cognitive presence' in the middle column. We also added the components of the 'process' element that relate to those components of the 'cognitive presence' in a column. In this way, we indicate how and which components of each element taken from the PPC relate to the cognitive presence of the CoI. It must be noted that, although the cognitive presence fits well within the overlap section between process and context, there are also prominent characteristic similarities and overlap between creating a cognitive presence in online learning and aspects to take into consideration in the process sector only of the PPC model. In the same account, there is also a strong characteristic overlap between the teaching presence and the context aspect only of the PPC model.

Person-process intersection: Social presence

To illustrate the connection between the person and process and how the social presence overlaps with the characteristics of the person and process elements and also serves as an intersection between these two, we have placed the three individual elements in a table. Box 1.3 indicates the components of the 'person' element that relate to the components of the 'social presence' in the middle column. We also added the components of the 'process' element that relate to those components of the 'social presence' in a column. In this way, we indicate how and which components of each element taken from the PPC relate to the teaching presence of the CoI. It must be noted that, although the social presence fits well within the overlap section between person and process, there are also prominent characteristic similarities and overlap

BOX 1.2: Cognitive presence as intersection between context and process.

Context **(Hiemstra & Brockett 2012:158)** **'This includes characteristics of the individual, such as creativity, critical reflection, enthusiasm, life experience, life satisfaction, motivation, previous education, resilience, and self-concept.'**	**Cognitive presence** **(Pool 2014:197)** **'Refers to higher-order levels of learning and, therefore, requires purposeful discourse in order to collaboratively construct, critically reflect and confirm understanding.' (Garrison & Vaughan 2008:19)**	**Process** **(Hiemstra & Brockett 2012:158)** **'This encompasses the environmental and socio-political climate, such as culture, power, learning environment, finances, gender, learning climate, organisational policies, political milieu, race, and sexual orientation.'**
Culture, gender, finances, race and sexual orientation	Reflective inquiry and confirm meaning and understanding through sustained reflection and discourse in a critical CoI	Learning skills, learning styles, planning, organising and evaluating abilities
Culture, gender, finances, race and sexual orientation	Critical thinking by reflecting critically with discourse to construct and confirm meaning	Learning skills, learning styles, planning, organising and evaluating abilities
Environmental and socio-political climate, learning environment and learning climate	Triggering event as well as exploration, integration and resolution in the process of constructing and confirm meaning through sustained reflection and discourse in a critical CoI	Teaching-learning transaction, teaching styles and facilitation
Environmental and socio-political climate, learning environment and learning climate	Exploration and critical reflection of meaning with purposeful discourse in order to collaboratively construct	Learning skills, learning styles, planning, organising, evaluating abilities and technological skills
Learning environment and learning climate	Integration of critical discourse and reflection in a CoI	Learning skills, learning styles, planning, organising, evaluating abilities and teaching-learning transactions
Culture, gender, finances, race, sexual orientation, organisational policies, learning environment and learning climate	Resolution of critical discourse and reflection in a CoI	Learning skills, learning styles, planning, organising, evaluating abilities and teaching-learning transactions
Learning environment and learning climate	Development could be dependent on success in teaching presence	Teaching-learning transactions, teaching styles and technological skills

Source: Hiemstra and Brockett (2012:158) and Garrison et al. (2010:6).

between creating a social presence in online learning and aspects to take into consideration the person sector only of the PPC model. In the same account, there is also a strong characteristic overlap between the social presence and the person aspect only of the PPC model.

As indicated in the discussion above, the CoI framework can be seen as the missing link that serves as the interrelationship and intersection between the three main elements of the PPC model. We thus argue that it is in the combination of the PPC and CoI that SDL development in blended learning environments will best reach success in the 21st century.

BOX 1.3: Social presence as an intersection between person and process.

Person **(Hiemstra & Brockett 2012:158)** **This includes characteristics of the individual, such as creativity, critical reflection, enthusiasm, life experience, life satisfaction, motivation, previous education, resilience and self-concept.**	**Social presence** **(Pool 2014:50)** **'Contributes to the effectiveness of online learning, contact or distance learning through collaboration and discourse because it facilitates the achievement of cognitive objectives by initiating, sustaining and supporting critical thinking in a community of students.' (Garrison & Anderson 2003)**	**Process** **(Hiemstra & Brockett 2012:158)** **This encompasses the environmental and socio-political climate, such as culture, power, learning environment, finances, gender, learning climate, organisational policies, political milieu, race and sexual orientation.**
Characteristics of the learner and life experience	Open communication as a medium and having learners who portray themselves as authentic people utilising their full personality	Learning skills, learning styles, planning, organising and evaluating abilities
Characteristics of the learner and life experience	Group cohesion through open communication as socially and real emotional people	Learning skills, learning styles, planning, organising and evaluating abilities
Characteristics of the learner, self-concept and life experience	Social identity and ability to socially express themselves through open communication socially and emotionally as 'real' people.	Learning skills, learning styles, planning, organising and evaluating abilities
Motivation, critical reflection and previous education	Mediating element between teaching presence and cognitive presence	Teaching-learning transaction, teaching styles and facilitation
Characteristics of the learner and self-concept	Identifying with the community	Learning skills, learning styles, planning, organising, evaluating abilities and teaching-learning transactions
Critical reflection and self-concept	Communicating purposefully	Learning skills, learning styles, planning, organising, evaluating abilities and technological skills
Characteristics of the learner and self-concept	Developing interpersonal skills	Learning skills, learning styles, planning, organising, evaluating abilities, technological skills and teaching-learning transactions

Source: Hiemstra and Brockett (2012:158) and Garrison et al. (2010:7).

□ Convenient intersections overlap between the Community of Inquiry framework and the person–process–context model to optimise self-directed learning in blended learning environments

Finally, we should take cognisance of the fact that the overlapping sections of the CoI framework intersect each time with all three elements of the PPC model. Thus, the overlap between the teaching and social presence is wherein you set the climate for the learning environment and, therefore, should consider all three elements, as well as the overlapping characteristics, of the PPC model. Also, the overlap between the teaching presence and cognitive presence is where careful selection of learning content happens, and the three

PPC model elements should also infuse the decision-making process. But most importantly, for the promotion of SDL, the overlap between the social presence and cognitive presence is wherein the encouragement supporting discourse should be established, and the applicable characteristics of the three elements of the PPC model should be central in this part of the online design.

Essential balance amongst the elements of the person–process–context model and the elements of the Community of Inquiry framework to foster self-directed learning

Of scientific interest is that both models require each of the three elements (i.e. context, person and process for the PPC model and teaching, social and cognitive presence in the CoI framework) equal attention to create an even balance between these elements for the optimisation of learning experience and the optimal fostering of SDL. As indicated, Hiemstra and Brockett (2012) made a strong argument for placing all three elements in connection with each other in order to develop SDL successfully. They (and other authors) indicated that one element should not be prioritised above another (although one sometimes cannot stop the balance between the elements).

Van der Westhuizen and Golightly (2019) made a very strong argument in their chapter 'Developing self-directed learning skills of geography student-teachers through online problem-based learning designs' in the SDL research book (SDL for the 21st century) that if blended learning environments adhere to the development and fostering of 21st-century skills within the call for the 4IR teaching and learning skills, it should be designed or redesigned with teaching and learning strategies that fit active, learner-centred, social constructivist teaching and learning that will foster and establish SDL skills in and for learners and students. For this reason, online problem-based collaborative learning environments were designed for modules in geography student-teacher training wherein a strong teaching presence was established with a university learning management system (LMS). Problem-based learning is one of the prime teaching and learning strategies within SDL. A strong social presence was created by integrating the collaborative capabilities of Google Docs within the university's LMS. By elevating the social presence above the expected norm (explained below) for online learning environments, the cognitive presence can subsequently be elevated to the expected norm so that higher-order learning, according to Bloom's taxonomy, takes place. This attention to detail and optimisation of each presence (element) established the correct and acquired balance between the three elements so that besides the optimal reaching of learning goals online, the perceptions of the student's readiness in SDL also increased when using the Self-Rating

Scale of Self-Directed Learning (SRSSDL) instrument developed by Williamson (2007). Furthermore, the findings also indicate that the perceptions of student-teachers on their readiness for SDL before and after the implementation of the online project-based learning (PBL) activities correlate well with other studies in different disciplines using the same Self-Directed Learning Readiness Scale (SDLRS) questionnaire of Williamson. With reference to the subsections of SDL, 'awareness, interpersonal skills and learning strategies' received the highest means before and after the online PBL intervention, meaning that SDL skills were developed.

Moreover, by using cooperative learning (as proven teaching and learning strategy for the promotion of SDL) in the collaboration space in online learning environments, it is likely that the very important social presence can be additionally enhanced to assist and manage the group members and their social interaction in an attempt to also increase the cognitive presence. Subsequently, the research findings of Van der Westhuizen and Mentz (2020) in their chapter 'Implementing cooperative learning elements in Google Docs to optimise the online social presence in a self-directed environment' in the SDL research book, *Multimodal learning to foster SDL*, also proved beneficial for SDL promotion in online learning environments.

Using cooperative learning to support online problem-based learning increased the social and teaching presences to be more than the recommended mean for the CoI framework for online learning environments. It proves that the implementation of cooperative learning within the online Google Docs environment has increased not only the social presence but also the self-directedness of students. To improve the cognitive presence (as perceived by students) in online learning environments, it becomes necessary to place even greater emphasis on the positive role of interdependence, F2F promotive interaction and group processing that is also being suggested by the PPC model. As no clear guidelines to include the five elements of cooperative learning in an online SDL environment exist, this intersection of the CoI framework and the PPC model provides valuable guidelines and stimulates future research for, amongst others, refining the structuring of the five elements of cooperative learning for added enhancement of the teaching, social and cognitive presences, optimising the CoI and SDL.

Measurableness of the person–process–context model and the Community of Inquiry framework for optimisation of self-directed learning and blended learning environments

Among the most widely used instruments in educational research for measuring SDL readiness and determining how effective teaching and learning environments were designed to foster the development of SDL in students/learners, the following are some:

- Guglielmino's (1977) SDLRS
- SDLRS developed by Fisher et al. (2001)
- SRSSDL developed by Williamson (2007)
- Cheng et al.'s (2010) self-rating instrument to measure SDLI.

The levels of acceptance of the presence of the CoI can be measured with the CoI questionnaire based on teaching presence, social presence and cognitive presence (Arbaugh et al. 2008):

> The five-point Likert scale of the CoI questionnaire, which contains 34 items, is used to examine the participants' responses to the three elements: teaching presence (items 1–13), social presence (items 14–22) and cognitive presence (items 23–34). (p. 134)

If the mean suggested scores of Arbaugh et al. (2008) are used as a guideline for the assessment of the three interdependent presences, the acceptable scores for an effective and acceptable online collaborative teaching and learning environment should be 4.18 (teaching presence), 3.98 (social presence) and 4.14 (cognitive presence) out of 5 on a Likert scale.

The research of, for example, Van der Westhuizen and Golightly (2019) and Van der Westhuizen and Mentz (2020) proves that if active, learner-centred, social constructivist blended teaching and learning environments be designed, it will increase the social presence that will automatically increase the cognitive presence that in the end will foster SDL skills for learners and students. Thus, if online learning environments are designed so that it reaches the required measurement for each of the three presences, adhering to the guidelines provided by the PPC model, optimal teaching and learning environments will be designed to foster SDL.

Conclusion

We have to take cognisance of the fact that the PPC model highlights the importance of the person or learner, the teaching-learning transaction or process and the social context and that all three elements of the model must be treated with equal importance. To optimise SDL in any learning environment, the three elements of person, process and context should be in balance. An essential contribution of the PPC model is that the learner ends up being highly self-directed, and the teaching-learning process is properly set up to encourage students to take control of their own learning. Also, the socio-political milieu and the learning setting support the environment for SDL.

In their research informing the PPC model, Hiemstra and Brockett highlighted the importance of the social aspects of SDL. This is parallel to the notion of the CoI framework, where research clearly shows that, in order to increase and maintain a sound social presence throughout, it is highly possible to create a high cognitive presence and an SDL experience. It should be noted that within the context of 21st-century learning skills that need to be developed to serve the core purpose of the 4IR, it is essential to design teaching and learning environments with active, learner-centred, social constructivist teaching and learning strategies that will foster and develop SDL skills for learners and students. If blended learning and online learning environments are designed, it should be done within the CoI framework with the guidelines of the PPC model at the centre, and then changes are great that optimal SDL environments will foster the necessary SDL skills.

It can, therefore, safely be argued that the overlap sections of the three elements of the PPC model, namely person, context and process, fit well with the design principles of the three presences, namely teaching, social and cognitive presences, of the CoI framework and mostly overlap regarding guidance in self-directed blended learning environments.

Four measuring instruments exist for the measurement of the level of self-directedness being achieved in teaching and learning environments designed to foster SDL. If properly designed, practically significant differences will be measurable for the perceptions of readiness in SDL for learners and students. Equally so, if blended or online environments are designed to achieve the desired level of perceptions from learners and students regarding the three presences in the CoI, it will hold positive outcomes for the affordances of SDL skills for learners and students. Thus, if these instruments are used within the application of the PPC model and the CoI framework when designing blended learning environments, successful SDL skills will be fostered.

We argue that the alignment of the two models mostly overlaps and holds the key to stimulating and guiding SDL within blended learning environments. Without proper consultation of these two models and application of guiding principles, proper self-directed blended learning environments can be created.

Benefits for both

When using the PPC model or the CoI framework in conjunction with the other, it should hold benefits for both, allowing for more precise SDL environment designs contributing more effectively towards the establishment, development and stimulation of 21st-century skills:

- For the *PPC model*, the CoI framework provides easily applicable scientific guidelines to design online or blended self-directed environments that fit well with the balanced characteristics of the elements, namely person, process and context. It can be suggested that the CoI framework provides a solution for the description of the overlapping sections of the circles (domains) of the PPC model.

- For the *CoI framework*, the PPC model provides more detailed guidelines for consideration when designing online or blended learning environments to foster SDL. It is within the margins of this PPC background that the design of online or blended learning environments should take place, especially the overlap characteristics of the three PPC elements.

Considering that in 1997 Garrison had already compiled a model focused on SDL that resonated with the later PPC model of Hiemstra and Brockett (in 2012), it is not surprising that his (and his colleagues') CoI model of 2000 would prove to be viable and relevant to SDL development. Furthermore, we conclude that our proposed framework (illustrated in Figure 1.7) provides a possible solution for SDL development with the PPC model addressing the F2F context of the blended learning environment and the CoI framework addressing the online learning context of the blended learning environment. It is in the successes of the two models that we envision success for SDL development in blended learning environments.

Chapter 2

Curiosity killed the cat, but satisfaction brought it back: Inquiry-based learning in blended environments to promote self-directed learning

Donnavan Kruger
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Egon Werlen[a,b]
[a]UNESCO Chair on Personalised and Adaptive Distance Education,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland
[b]Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Per B. Bergamin[a,b]
[a]UNESCO Chair on Personalised and Adaptive Distance Education,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland
[b]Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

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Abstract

To capitalise on the omnipresence and educational capabilities of technology in the 21st-century classroom, the careful selection and utilisation of appropriate instructional strategies are essential in the pursuit to present learning environments that can accommodate and differentiate support for individual students' learning needs. Inquiry-based learning has proven to be a successful instructional strategy that enhances the effectiveness of learning across disciplines, especially in science curricula, and has gained popularity in education and global research. One of the reasons for its success in digital learning settings can be ascribed to how easily electronic learning environments support this strategy's integration. As an active learning strategy, placing the student at the centre of learning, inquiry-based learning enhances critical thinking, creative problem-solving and communication skills that pivot around an investigation of a question, problem or case and culminates into a conclusion or project. The tenets that arise from inductive reasoning when following the cyclical process of inquiry-based learning can be interconnected to the skills of the self-directed learner when supported by a blended approach. Because inquiry and learning through inquiry are deeply motivated by the individual, emotions like curiosity and interest play an integral part in this process. The role of emotions is further extended into blended learning and SDL. Literature showed a positive relationship between motivations to metacognitive and cognitive strategies in the blended context, and self-motivation elements like self-efficacy, outcome expectations, task interest or value and goal orientation can increase self-direction. The purpose of this study was to conceptualise the connection between inquiry-based learning, blended learning and SDL and to focus on how the interrelationship of each concept and approach can create opportunities to enhance learning via their interconnected tenets and the role of learning-related emotions in each. A literature review was conducted to determine the extent to which literature reveals trends or patterns, and to examine previous research on the use of inquiry-based learning in blended learning environments, how the process of inquiry is used to promote SDL, and how these two concepts are fused together. Furthermore, literature on the role that emotions play in learning was also reviewed to examine its connections within inquiry-based learning, blended learning and SDL. This chapter conceptualises the tenets of using inquiry-based learning as a teaching-learning strategy within blended learning environments to promote SDL. The authors also elucidate how epistemic emotions and their relation to the affective domain in learning may play a significant role in the interface between the teaching and learning triad of inquiry-based learning, blended learning and SDL. We also argue that other constructivist pedagogies that involve active, student-centred learning are subsets within the inquiry-based learning family. Inculcating an attitude of self-directed inquiry has never been more apt than in the era where information is at our fingertips, and the need

for adapting to a changing world has become a necessity rather than a luxury. An increased focus on the affective domain in learning with inquiry-based self-directed approaches may act as a catalyst for the effectiveness of learning.

Introduction

'*Change is the only constant.*' – *Heraclitus* (cf. Botha 2015:4)

Self-directed learning as a 21st-century skill

The development of SDL skills is crucial for successfully navigating a rapidly changing social and economic era, where the ever-increasing infusion of digitalisation within society is the order of the day (Boyatzis 2002; Guglielmino, Guglielmino & Long 1987; Male 2018). Educating a society to become lifelong and self-directed learners in the 21st-century has, therefore, been at the frontiers of research on human learning. Technology and learning have evolved alongside each other, with technology-enhanced instruction giving rise to an array of teaching-learning strategies, methods and designs. The past few decades have been distinguished by leaps in the innovation of smart devices, wearable technology, communication and sensor technologies, AI and e-learning platforms (Sezer, Dogdu & Ozbayoglu 2018). The speed at which these innovations have developed, together with the other new technologies of the Fourth Industrial Revolution, has created a lagged response regarding the widespread adoption in the education sector and is set to disrupt the way we engage in teaching and learning in the future (Mishra & Vladova 2021; Oke & Fernandes 2020). Mishra and Vladova (2021:151) also asserted that it has become vital to remodel education across disciplines and age groups, as well as the mode of delivery as a whole.

Countless individuals all around the globe engage in self-directed, online, informal learning, either individually or collectively (Bonk & Lee 2017:36; Kim et al. 2015). Because of the mushrooming and the ease of access to online information, students are increasingly more in charge of their own learning activities, giving SDL a high priority (Brookfield 2013; Sze-Yeng & Hussian 2010). Online and distance education was typically mainly reserved for adult learning to substitute or supplement post-secondary education options to those unable to otherwise commit to place-based education, but the advent of the COVID-19 pandemic has ubiquitously flicked the proverbial switch to 'emergency remote teaching' across the educational landscape (Bamoallem & Altarteer 2021; Lockee 2021:5). However, mixed modes of delivery date as far back as the 1950s when B.F. Skinner introduced individualised learning programmes (Skinner 1958), followed by the work of F. Keller in the 1960s through to the 1980s to advance further the personalised system of instruction (Eyre 2007; Keller 1968). Originally, the term 'blended learning' plainly referred to the integration of e-learning activities with traditional contact classes (Singh 2021:16). However, with the passing of the last two decades, the understanding of blended learning has been broadened to additionally include combinations of several media and 'designed to complement each other and promote learning and application-learned behaviour' (Singh 2021:16). The change in digital learning was prompted by advancements in learning psychology, information and communication technology (ICT), technological accessibility, reducing technology costs and generational development, which made blended learning worldwide relevant and its widespread adoption attainable (Bandyopadhyay et al. 2021). The experimentation with different pedagogical approaches, strategies and instruments within blended learning environments has expanded because of this.

The affective domain of self-directed, inquiry-based learning in online environments

Inquiry-based learning is one of the most distinctive teaching methodologies in the blended learning domain and has received attention in multiple disciplines (Fegely, Hagan & Warriner 2020; Yang, Zhang & Bridges 2012; Zain 2018). Inquiry-based learning is a student-centred, active learning strategy and philosophical approach to learning, where learning is driven by student engagement in an inquiry process (Spronken-Smith et al. 2007:74). The effectiveness of the inquiry approach in learning as a teaching-learning method was proven over decades across many specialist domains (Avsec & Kocijancic 2014; Cetin 2021; Laksana 2017; Major & Palmer 2001). These demonstrated successes of inquiry-based learning in learner performance and engagement; its intrinsic nature to follow the scientific method, together with the ease of access to and superfluity of information online, has indubitably made inquiry-based learning one of the most popular methodologies in blended learning (Al Mamun, Lawrie & Wright 2020; Cherner & Fegely 2017). One of the reasons for the accomplishments in digital learning settings can be ascribed to how easily e-learning environments support this teaching strategy's integration. The success praises go one important step further, and students enjoy the process. Not only do students experience the inquiry process as having more autonomy, competence and relatedness (Zhoa et al. 2021) but also their attitude towards the specific discipline in which the inquiry activity is conducted improves (Sandika & Fitrihidajati 2018).

Epistemic emotions are a subset of human emotions that have evolved to aid in the acquisition of information about the world and one's own self (Muis et al. 2015a). The objects of epistemic emotions are knowledge and the generation of knowledge; they are related to the scientific qualities of cognitive tasks and activities. Typical epistemic emotions are surprise, curiosity and enjoyment but also boredom, frustration, confusion or even fear. They arise, for example, in the case of discrepant information and cognitive incongruence (Pekrun et al. 2016). When one thinks about epistemic emotions that may drive inquiry in humans, from newborns to adults, curiosity may be one of the first that comes to mind. It is no wonder that the Mars rover set to explore the Gale Crater is aptly named after this construct.

The important role of emotions and feelings also named affects, during learning was recognised already in the 1960s by Krathwohl, Bloom and Masia (1964). In their taxonomy of educational objectives, they defined three domains. The best known is the cognitive domain, which involves knowledge and the development of intellectual skills such as recall and recognition of facts, procedures and concepts. The affective domain involves feelings, emotions and attitudes and is about the way people deal emotionally with internal and external matters such as values and motivation. However, literature shows that this approach was taken up more broadly sometime later, as the frequency of publications containing the words 'affect' and 'learning' in the title of research articles has increased only in the last two decades. The recent rise in the importance of affect in the learning sciences has been accompanied by a similar upsurge in the cognitive sciences, where affect and cognition are now widely believed to be interrelated (Clore & Huntsinger 2007; D'Mello & Graesser 2015; Mandler 1999; Schwarz 2012). In this context, amongst others, engagement is another construct relevant to learning which is often also considered (Pekrun & Linnenbrink-Garcia 2012). For example, it affects academic performance or learning satisfaction (Halverson & Graham 2019; Sahni 2019).

The affordances of self-directed, inquiry-based learning in blended learning environments

When looking for methods to teach 21st-century skills to educate society for the unknown future, many authors have turned inquiry-based learning into a means for the development of such skills. In their book, Chu et al. (2017) provided cutting-edge instructional strategies to encourage inquiry-based learning as a method of developing 21st-century capabilities in pupils. Instructional methods incorporate 'collaborative team-based teaching, social constructivist game design and gameplay and productive uses of social media such as Wikis' (Chu et al. 2017:3). Widely cited 21st-century skills include the '7Cs' (critical thinking and problem-solving; creativity and innovation; collaboration, teamwork and leadership; cross-cultural understanding; communications, information and media literacy; computing and ICT literacy and career and learning self-reliance) and the '3Rs' (Reading, 'Riting and 'Rithmetic) (Trilling & Fadel 2009:175), all of which can be honed by using the affordances provided by self-directed, inquiry-based learning in blended learning environments. Such a statement is rather problematic, and it hardly says anything about practical implementation. In fact, it is even more important to consider the danger that promoting SDL skills through inquiry-based learning in a blended learning environment can be unfavourable for learning without appropriate didactic support (Mayer 2005). In this respect, the integration of pedagogically sound teaching-learning strategies that promote self-direction in a blended learning environment is a primary issue for implementation in concrete learning designs and can have many advantages (Bosch, Mentz & Reitsma 2019; Chaeruman, Wibawa & Syahrial 2020; Ley, Kump & Gerdenitsch 2010). If one goes through the research literature on the topic, it becomes clear that there are many possibilities and practices that can be realised with positive learning effects. There is a growing body of literature in recent years in areas such as SDL, inquiry learning, blended learning and affect and learning. Each topic in itself has shown a considerable upward trend (Figure 2.1). However, it should be noted that the relationships and boundaries between the three components of SDL, blended learning and inquiry learning are not yet clear.

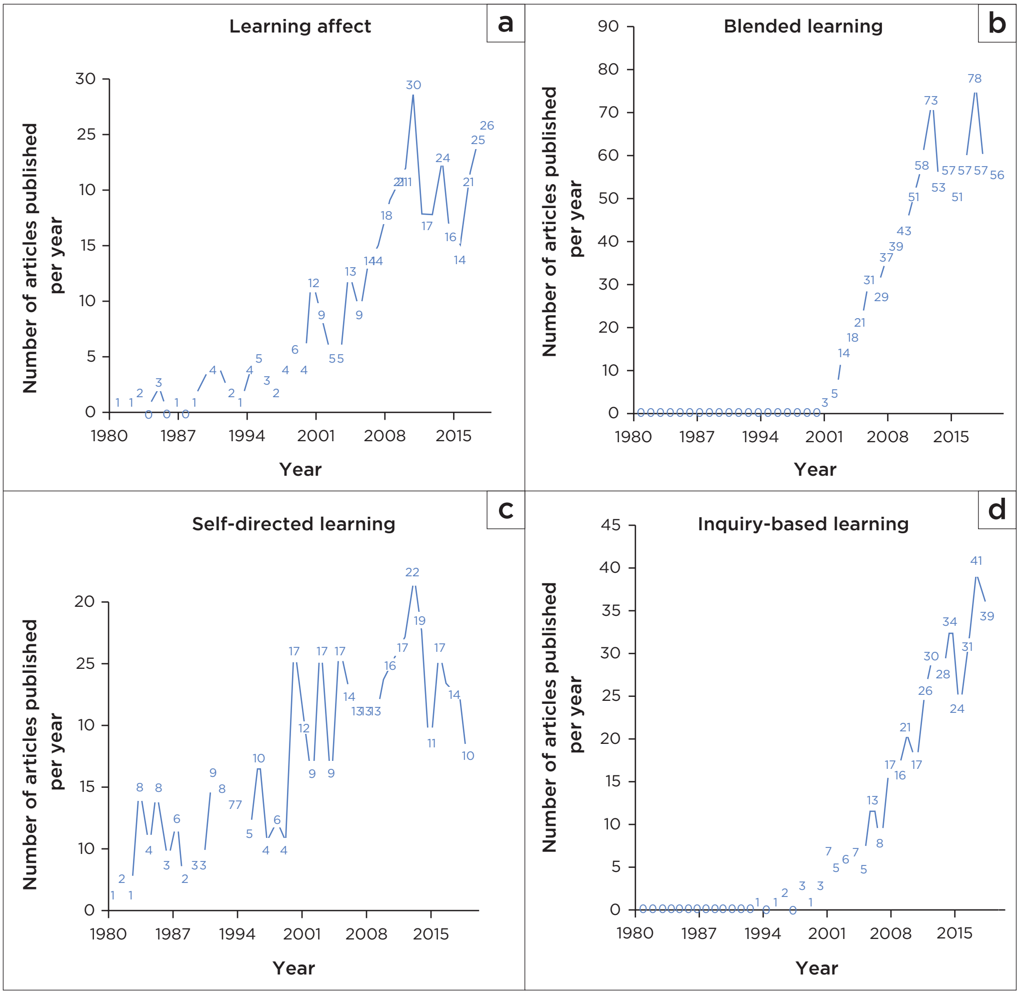
Therefore, the purpose of this study is to conceptualise the connection between inquiry-based learning, blended learning and SDL and to focus on how the interrelationship of each concept and approach creates opportunities to enhance learning via their interconnected tenets and the role of the affective domain in each. The two-pronged emphasis of this conceptual and exploratory study stemmed from two descriptive and exploratory research questions:

1. How can inquiry-based learning in blended learning environments promote SDL?
2. What role does the affective domain in learning play in inquiry-based SDL using a blended approach to learning?

The first question examines the benefits and characteristics of inquiry-based learning, blended learning and SDL using current research. The second question focuses on how the contribution of the affective domain to the affordances and features of the fused tenets of inquiry-based learning, blended learning and SDL.

Emerging from this, five descriptive secondary research questions were identified:

1. How can the affordances of blended learning support inquiry-based learning? (See the depiction of the overlapping area between inquiry-based learning and blended learning [A] in Figure 2.2.)
2. How can the affordances of inquiry-based learning enhance SDL? (See the depiction of the overlapping area between inquiry-based learning and SDL [B] in Figure 2.2.)
3. How can the affordances of blended learning support the process of SDL? (See the depiction of the overlapping area between blended learning and SDL [C] in Figure 2.2.)



Source: Harzing (2021).

FIGURE 2.1: Line charts showing the total number of annual publications in the Google Scholar database containing the following keywords in publication titles: 'learning affect' (a), 'blended learning' (b), 'self-directed learning' (c) and 'inquiry-based learning' (d) from 1980–2020.

4. How can the affordances of an inquiry-based learning approach within blended learning environments promote SDL? (See the depiction of the central overlapping area between inquiry-based learning, blended learning and SDL (D) in Figure 2.2.)
5. What role does the affective domain play in an inquiry-based, blended and SDL environment?

Consequent sections in this chapter will provide the theoretical and conceptual framework that will support the research questions. This will be followed by discussions on how the affective domain in learning can be used to interconnect

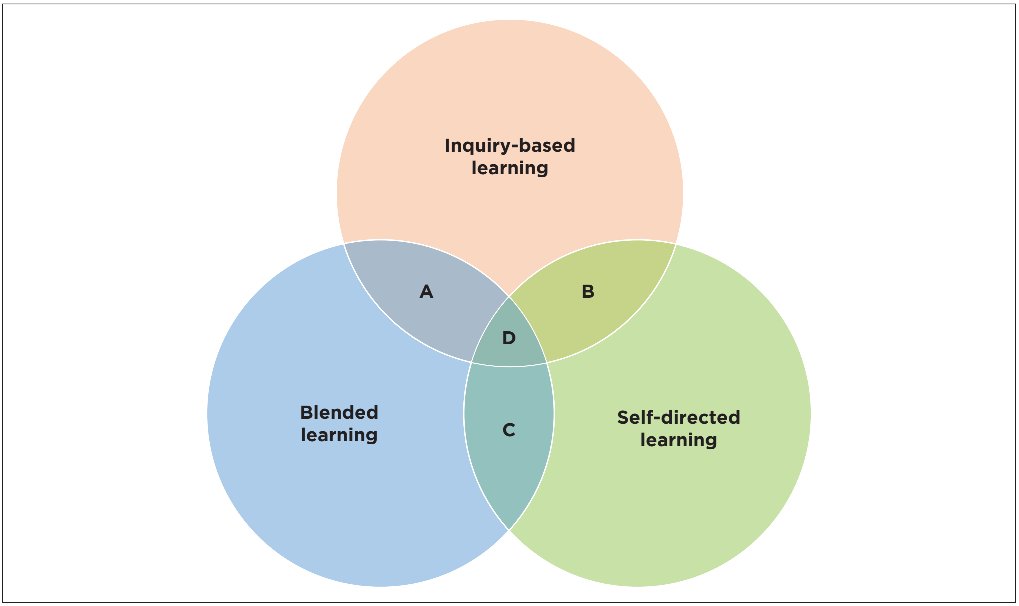


FIGURE 2.2: A diagrammatic presentation of the theoretical framework triad that provides the foundation for this chapter, namely inquiry-based learning, blended learning and SDL. Overlapping areas (A, B, C and D) represent the merging of the affordances of different combinations as a conceptual framework to direct the exploratory research questions.

these three concepts, after which a case is made for self-directed inquiry-based learning in blended learning environments.

Towards self-directed inquiry-based learning in blended learning environments

Three main concepts underpin this conceptual and exploratory study, namely SDL, inquiry-based learning and blended learning and instruction (Figure 2.2). These concepts are unpacked, and their relatedness is explained in a merging triad of conceptual and theoretical frameworks (Figure 2.2). The diagrammatic design of frameworks in an overlapping circular manner is also illustrated by Trafford and Leshem (2002:38) as we use it here for SDL, blended learning and inquiry-based learning (Figure 2.2). As blended learning and SDL also form central discussions in other chapters (e.g. see ch. 1) in this publication, we will focus on inquiry-based learning and the affective domain across these concepts.

Inquiry-based learning

Inquiry-based learning is deliberated to be the epitome of science education promoted to students at all levels because of its instructional method of constructing or discovering (new) knowledge via relevant activities and personal investigations (Johnson & Cuevas 2016). Inquiry-based learning is not only reserved for more experienced and higher achieving students. For example, Akaygun and Adadan (2021) examined the influence of inquiry-based learning on senior elementary school students' impressions of the science learning environment and their comprehension of climate change. In a longitudinal quantitative study conducted by Kuhn and Pease (2008), it was demonstrated that children from Grades four to six benefited from scaffolding strategies for inquiry because, on an inquiry assignment, they outscored the Grade 7 control group.

Inquiry-based learning can range from a structured and guided activity, mostly for inexperienced students or for revision of specific content, where the teacher may provide the questions and facilitate how to solve a particular problem through to more autonomous research where the students generate their own questions and determine how to research them. Furthermore, inquiry-based learning can be scaled according to the qualification needs within the curriculum and can vary from a discrete activity through to the design principle for the entire degree (Figure 2.3).

An essential initial planning stage in creating a guided inquiry learning environment is to formulate 'essential questions' (Jacobs 1989; McTighe &

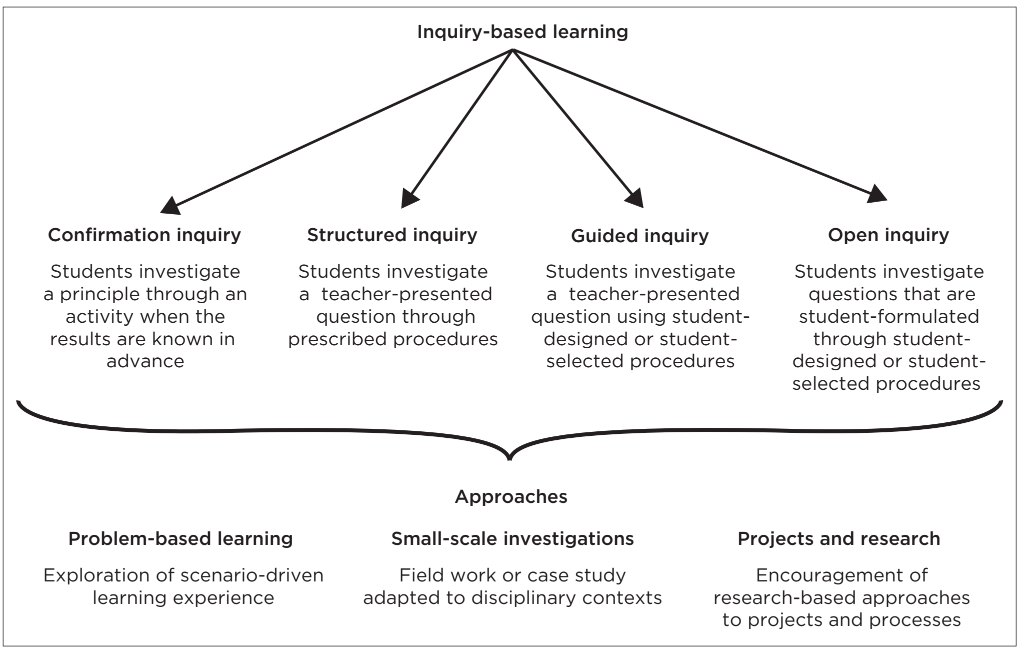
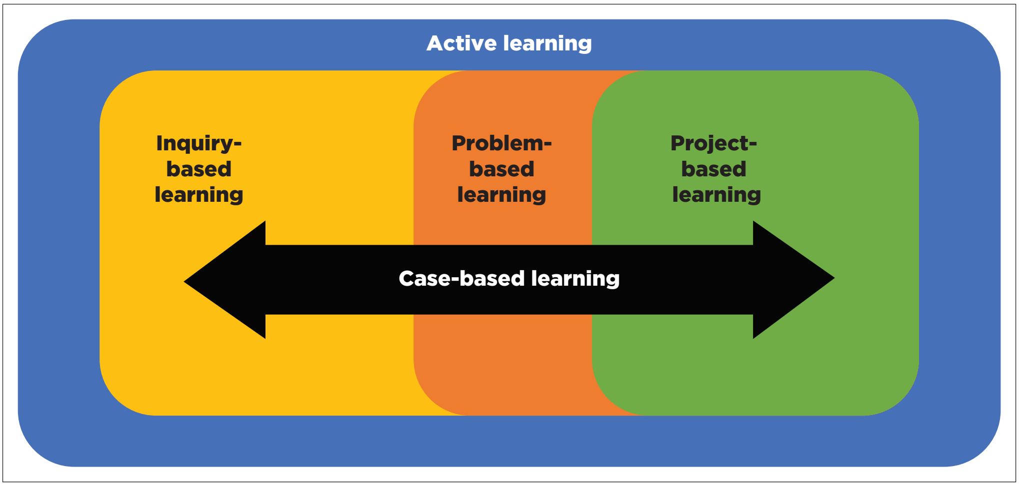


FIGURE 2.3: The four levels of inquiry are based on the level of the instructor's support provided to the student with the continuum from most support (confirmation inquiry) to least support (open inquiry).



Source: Spronken-Smith et al. (2007).
FIGURE 2.4: A diagrammatic representation of how active teaching-learning approaches are grouped according to inclusion or exclusion of learning outcomes.

Wiggins 2013; Wilhelm 2007). Although the practice of questioning in inquiry-based learning activities is important, alone, it will not account for inquiry. These will act as driving or central questions that will promote further investigation. These are the type of questions or problems that were initially asked or stated that led to the relevant knowledge and highlighted the purpose of learning.

Blended learning and instruction

> [*B*]lended learning is realised in teaching and learning environments where there is an effective integration of different modes of delivery, models of teaching and styles of learning as a result of adopting a strategic and systematic approach to the use of technology combined with the best features of face-to-face interaction. (Krause 2008:1)

This definition elaborates on the more simplistic definition by Graham, stating that blended learning is to 'combine face-to-face instruction with computer-mediated instruction' (Graham 2006:41). Other variations of these definitions and the theoretical underpinning of blended learning have been studied well (Cronje 2020:116), but for the purposes of this work, Krause's definition is sufficient.

The COVID-19 pandemic was the main driver to accelerating the move from 'emergency remote teaching' (Lockee 2021:5) to a blended approach and has, therefore, also caused a surge in the number of studies about blended learning, with 56 papers published in 2020 and 77 papers in 2021 to date (16 September) containing the keywords 'blended', 'learning' and 'COVID' in their titles (Harzing 2021; also compare Figure 2.1b). The question is, of course, how many of these courses that moved online or to a blended learning approach were successful? And which qualities were critical for the successful cohort?

Self-directed learning

One of the blended learning modes, as described by Bath and Bourke (2010:2), involves the use of technology to support SDL. Self-directed learning is an adult education concept (although extensively applied today across all ages), which was developed by the American adult educator Malcolm S. Knowles. In his seminal work on SDL, Knowles (1975) defined SDL as:

> [*A*] process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

Saks and Leijen (2013:192) described a self-directed learner, in an e-learning context, as 'able, ready and willing to prepare, execute, and complete learning independently'. It has consequently become required as a result of this learning tendency to employ digital instructional strategies to enhance students' self-direction.

Effectiveness of learning increases when the students' learning is adapted to their own learning needs (Felder & Brent 2005; Hart, Drummond & McIntyre 2013:601). Kruger (2020:112) conceptualised a model integrating SDL skills into adaptive learning systems, using goals (defined by students), preferences (aids in student motivation) and knowledge (students do not need to learn what they already know) of each student, using this model throughout the interaction in an online environment with the system to adapt to each student's cognitive needs on a continuous basis. Using blended learning environments to plan for the development of SDL skills specifically will have the potential to develop not only current learning and its effectiveness but also future learning and success (Kan'an & Osman 2015).

The affective domain in teaching inquiry-based learning

'Motivation is the portal to engagement.' (Barkley 2010:15)

Following the end of the nineties, since the publication of Damasio's 'Descarte's Error' (Damasio 1997), the importance of emotions and affective content has greatly increased in most domains. Correspondingly, since 1960, the publications mentioning the term 'affective domain' have multiplied many times. Yet, the relationship between publications found on Google Scholar containing the two terms, 'affective domain' and 'cognitive domain' increased in favour of the cognitive domain: eight (8) papers on the cognitive domain were published in 1960, and 3 922 papers were published in 2020, while 21 papers on the cognitive domain appeared in 1960 and 11 408 papers in 2020. Accordingly, cognitive aspects still remain important and have not changed over time, as Given (2007) wrote:

> [*T*]he role of affect – or emotional states of being – remains an area of information behaviour research that is under-studied but holds great promise for understanding individuals' holistic and contextual grounded information experiences. (p. 161)

Affective aspects, that is, inner experiences such as moods, feelings and emotions, are very important for learning (e.g. Boekaerts 2007; Pekrun 2014; Picard et al. 2004) and for living in general. Affective aspects represent one domain of several that influence learning. Other aspects are cognitive aspects, motivational aspects, physiological aspects and behavioural aspects (e.g. Dettmer 2005; Hoque 2016). Emotions, as part of the affective domain, are important for learning. It has been shown (Hascher 2010; Pekrun 2014) that both positive and negative emotions have a facilitating but also a hindering influence on learning performance, depending on the situation. The importance of affective factors on learning and memory is also shown in the further development of well-known theories of the cognitive load theory (Sweller, Ayres & Kalyuga 2011) and the cognitive theory of multimedia learning (Mayer & Mayer 2005) by Huk and Ludwigs (2009) and Moreno (2006).

The affective domain is defined in Krathwohl, Bloom and Masia (1964) as:

> [*L*]earning objectives that emphasise a feeling tone, an emotion, or a degree of acceptance or rejection. Affective objectives vary from simple attention to selected phenomena to complex but internally consistent qualities of character and conscience. We found a large number of such objectives in the literature expressed as interests, attitudes, appreciations, values, and emotional sets or biases. (p. 7)

Savickiené (2010) brought together the components of the affective domain from different authors. She came up with 13 components, the last eight of the following list were only found in one paper each. The components are *attitudes*, *values*, motivation, *beliefs*, *emotions*, *acceptance* or *rejection*, perceptions, preferences, interests, academic self-esteem, anxiety, locus of control and behaviour. The italicised components were mentioned in the original paper of Krathwohl et al. (1964). From a psychological view, some of these terms are not genuinely of an affective nature (e.g. perceptions and behaviour). Martin and Reigeluth (1999:485, 492) described the unclear meanings of affect and affective domain in the field of teaching and pointed out the different terms and their definitions, interconnections and their different applications. This makes it difficult to use the concept of the affective domain in an instructional design or research project.

According to Scherer (2005), emotions as a central component of the affective domain consist of five components, namely, feelings, cognitions, motivations, behaviours and expressions and thus contain the umbrella terms for most of the elements that are assigned to the concept of the affective domain. Scherer's (2005) definition of emotions is that:

> [*E*]motion is defined as an episode of interrelated, synchronized changes in the states of all or most of the five organismic subsystems in response to the evaluation of an external or internal stimulus event as relevant to major concerns of the organism. (p. 697)

In this sense, the affective domain in learning can be broadened somewhat and, in our view, contains the following elements: (1) emotions, including feelings and moods as a core component, (2) concepts with strong affective components such as self-efficacy and (3) concepts consisting of cognitive, emotional and other components such as engagement and attention.

Affective domain in inquiry-based learning, self-directed learning and blended learning

Inquiry-based learning requires students to work through a large part of the learning material themselves. Other than in traditional teaching, where instructions generally are given without activation of context or inquiry, in inquiry-based learning, the instructional design aims to arouse curiosity as a fundamental part of learning (Hmelo-Silver, Duncan & Chinn 2007:100; Pedaste et al. 2015:54).

Litmanen et al. (2012) found more negative emotions in inquiry-based learning, but the students reported in interviews that they enjoyed this form of learning more. They conclude that negative affect may help to take responsibility for the learning process. This will also foster SDL. In Kim and Seo (2011:abstract), the 'problem finding ability of the science inquiry skill' is correlated with the affective domain. Others found that inquiry-based learning increased positive or decreased negative emotions (e.g. Karimian, Hesami & Mohammadi 2009). Curiosity is particularly relevant for inquiry-based learning. In a study, Van Schijndel, Randel and Raijmakers (2018:1009) found that curiosity is positively associated with knowledge acquisition regardless of intelligence. Laine et al. (2017) found a decrease in interest over the years of study in an inquiry-based learning environment. However, qualitative interviews showed that students found the new environment interesting. The authors recommend letting students have a say in the implementation of the instructional design in order to promote their autonomy in terms of SDL and their engagement.

Muis et al. (2015b) described the relationship between epistemic beliefs, epistemic emotions, learning strategies and achievement. Concerning SDL, they found as part of their model that metacognitive self-regulation (here seen as part of SDL) is directly influenced by curiosity, enjoyment and confusion. In another study, Muis et al. (2018) proposed five antecedents of epistemic emotions that can be activated in all phases of self-regulated learning and five consequences of epistemic emotions that can facilitate or constrain self-regulated learning. Le et al. (2021) used emotional instructional design elements in a multimedia lesson. They found that positive emotional elements reduce ego depletion, that is, the temporary loss of self-control and the associated inhibition of learning. The authors explain the results by the fact that participants in the non-depletion condition have better self-regulation. This shows the influence of emotive elements on self-regulated and SDL.

Rastegarpour (2010:62) wrote a section in a conference paper on the role of students' effect in blended learning. At least some students struggle with the fact that they have to interact with a computer and resist the impersonal approach of communicating with a computer rather than with people. For these disadvantages of online learning to be overcome and for affective learning behaviour to develop, students must be provided with an appropriate learning experience. This requires that the affective domain be built into the instructional design so that students achieve a higher level of self-understanding and more SDL. The effects of a blended learning approach were studied in an evaluation of the introduction of a flipped classroom at a Swiss university (Castelli & Werlen 2017). It was found that, measured retrospectively, the social learning distance was greater in online learning at home than in the classroom and that fewer positive and negative emotions were reported in online learning at home. When recording subjective emotions during lessons, some negative emotions (e.g. anger and boredom) were rated higher in online lessons at home than in class. More generally, Kwon, Moon and Park (2015) reported in the abstract of their meta-analysis on the effects of blended learning in Korea that it has a positive effect on learning in both cognitive and affective domains.

Halverson and Graham (2019) developed a framework to measure engagement in blended learning environments. Engagement, as part of the affective domain, is related to learning performance and satisfaction. Therefore, it is important to design learning environments that enable engagement. They divide engagement into cognitive engagement and emotional engagement. Cognitive engagement includes the factors of attention, effort and persistence, time on task, cognitive and metacognitive strategy use, absorption and curiosity. Emotional engagement is divided into a positive part (interest, happiness and confidence) and a negative part (boredom, frustration and anxiety). Confusion does not belong to either part, as it influences engagement and learning depending on the context.

In short, there are influences and connections between the affective domain, blended learning, inquiry-based learning and SDL. It can be cautiously concluded that inquiry-based learning and blended learning trigger, or are related to, negative and positive emotions and other affective states and that affective states, including emotions, promote or are related to SDL (Bastos et al. 2013; Sabourin et al. 2012; Taub & Azevedo 2018; Wang 2014).

As for the cognitive domain, different levels were defined for the affective domain. The levels of the affective domain are, in essence, about how well learners are able to integrate content, ideas, etc., into their previous learning experiences and internalise them according to their existing or newly developed values. The five values – as explained on the website of Teach the Earth (2020) – are 'receiving' (being aware and tolerating ideas, material, and phenomena), 'responding' (a minimum of commitment by actively responding to ideas, material and phenomena), 'valuing' (be willing that others perceive the own valuing of ideas, material and phenomena), 'organisation' (integrating new values) and 'characterisation' (acting consistently to internalised values). From this description of the affective domain levels, it is plausible that the more advanced a student is on these levels, the more they should be able to be a self-directed learner.

The nexus of inquiry-based and self-directed learning in a blended learning environment

Inquiry-based learning within blended learning environments can develop many of the skills of student self-directedness (Al Mamun et al. 2020; Kuhn 2016; Pedaste et al. 2015; Wilhelm & Beishuizen 2003). Inquiry-based learning infused into a blended learning setting may mutually support and enhance benefits offered by blended learning, inquiry-based learning and SDL using the affective domain in learning. Inquiry-based learning can additionally provide the following affordances:

- Activates epistemic emotions, such as curiosity, interest and boredom, that are shown to be positively correlated with learning and self-regulation (Acosta-Gonzaga & Ramirez-Arellano 2021).
- Meets the learning needs of all students (Wilhelm & Wilhelm 2010:39).
- Engages students in the learning process, especially those reluctant to participate (Wilhelm & Wilhelm 2010:39).
- Provides opportunities to make the purpose of learning explicit and put what is learnt to use (Wilhelm & Wilhelm 2010:39).
- Helps students take ownership of their roles in learning (Wilhelm & Wilhelm 2010:39).
- Allows students to achieve observable competence, profound understanding and authentic achievement (Smith & Wilhelm 2006).
- Students have a higher engagement and achievement on tasks that are challenging (Newmann 1996; Newmann & Wehlage 1995; Wilhelm & Wilhelm 2010).

Learning in the blended setting provides for the following affordances relating to SDL and inquiry-based learning:

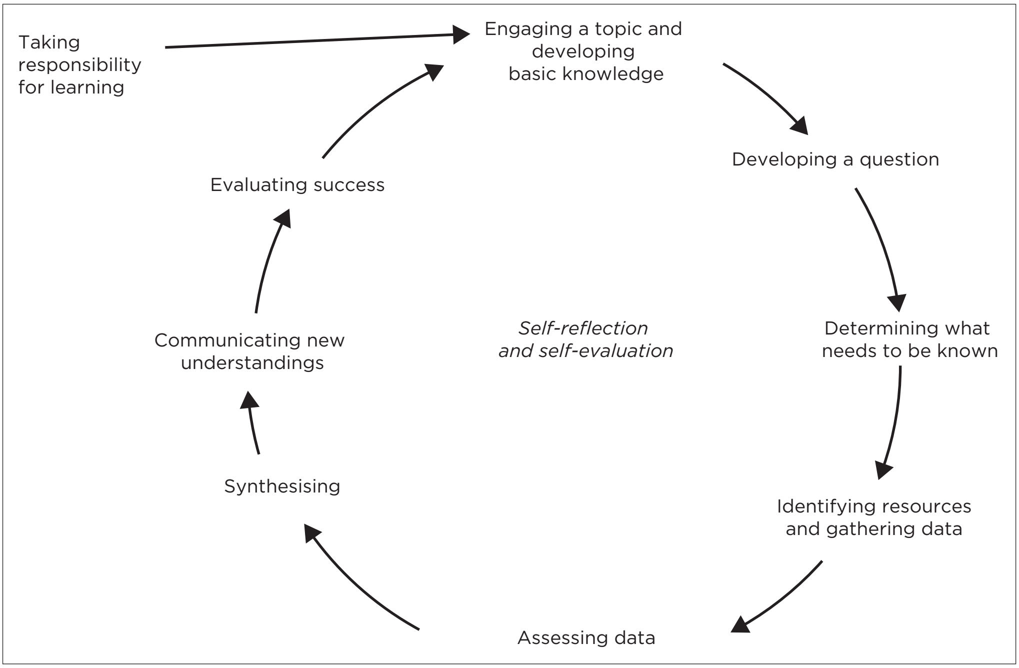
- Positive emotions play an important role in blended learning (Acosta-Gonzaga & Ramirez-Arellano 2021).
- Autonomy is supported by online access to information.
- Self-assessment and monitoring of learning can be supported via scaffolding and other feedback (AI solutions or using data analytics; Lämsä et al. 2021).

Inquiry-based learning has proven to be a successful constructivist instructional strategy that enhances learning across disciplines, but especially in science curricula, and has gained popularity in education and global research (see Pedaste et al. 2015). The overarching relationship between inquiry-based learning and the rest of the family of active learning pedagogies makes it one of the most flexible approaches (Spronken-Smith et al. 2007; Figure 2.4). Although it is often not mentioned as one of the reasons for the success of inquiry-based learning, the ease of integration of electronic learning environments is another quill in the adoption quiver (Pedaste et al. 2015:47). Furthermore, inquiry approaches to learning also develop SDL skills (Kuhn 2016; Pedaste et al. 2015; Wilhelm & Beishuizen 2003). Inculcating the pedagogy of inquiry-based instruction in student-teachers' curricula will create not only more self-directed future teachers but also the students they teach (Fecho 2000). However, it is important to keep in mind that the continuation of predominantly teacher-centred teaching practices in the implementation of the curriculum (De Beer & Ramnarain 2012) often inhibits inquiry-based learning. However, embedding the research process in a blended learning environment, facilitating ever-growing access to content and leading to increased student motivation and interest in a topic are supportive options (Heafner 2004; Shih et al. 2011; Wang & Reeves 2007).

Although the knowledge might not always be new to science, it is to the student. This approach is student-centred, leans towards SDL and is an active learning strategy (Spronken-Smith 2012; Figure 2.5). In their 2006 paper, Schraw et al. listed three likely reasons for enhanced learning effectiveness from inquiry-based teaching. Firstly, inquiry regularly allows you to communicate with an expert who can offer tactics and problem-solving techniques. Then, as the learner takes more ownership and shares control, an inquiry method may enhance motivation. Lastly, inquiry encourages self-reflection, which is an important component of metacognition and a critical competence for SDL (Schraw et al. 2006; Toh & Kirschner 2020:2).

Conclusion

Education often overlooks the emotive dimension, commonly referred to as the affective domain (De Beer 2016:34; Jackson, De Beer & White 2018:218).



Source: Justice et al. (2002:19).
FIGURE 2.5: Model of the inquiry process.

Over the last century, the subject of learning science has progressed, and we have refined our knowledge of how learning occurs and what the process requires. This covers the interaction of multiple brain areas (neurophysiology) and the involvement of emotion and interest in learning (affect). If we begin to comprehend the ramifications of these findings, we may develop curricula with aims and models that are markedly different from the traditional one-size-fits-all approach (Kruger 2020).

In this study, we associated the tenets of inquiry-based learning with those of blended learning and SDL and explored the role the affective domain in learning plays in inquiry-based SDL using a blended approach to learning. We argued that the commonality of the affective domain amongst inquiry-based learning, blended learning, and SDL could be used as a catalyst to enhance the effectiveness of learning and promote the self-directedness of students by tapping into epistemic emotions that may act as an impetus for lifelong SDL. Inculcating an attitude of self-directed inquiry has never been more apt than in an era where information is at our fingertips, and the need to adapt to a changing world has become a necessity rather than a luxury. An increased focus on the affective domain in learning with inquiry-based self-directed approaches may act as a catalyst for the effectiveness of learning.

An enriched instructional design paradigm to support students' independent study in blended environments has been furnished within the contexts of inquiry-based learning, blended learning and SDL. To support this, a conceptual study with practice-based data would be the next step to support the various concepts, and it has the potential to usher in the creation of interfaces that allow students to access resources and become independent learners (Al Mamun et al. 2020). For example, Garrison, Cleveland-Innes and Vaughan (2021) made significant contributions to the field of CoI framework and how much learning analytics can support collaborative learning by automatically monitoring dialogue and measuring learners' progress. These interfaces can then be used to create assessment tools that will engage the student in the learning process, in essence, providing learning opportunities *through* inquiry-based assessment within blended learning environments to support and enhance SDL.

Introducing their paper on understanding student differences, Felder and Brent (2005:57) stated that '[s]tudents have different levels of motivation, different attitudes about teaching and learning, and different responses to specific classroom environments and instructional practices'. Human diversity and uniqueness in their dispositions to life and learning are not new, but the education sector is rapidly transforming to tap into this uniqueness and diversity (Mossbridge 2016; Nolan & Levesque 2005; Williamson 2016). The framework presented in this study taps into the uniqueness of the thought processes of students and shows how learning can be mutually supported by making use of the shared affordances of SDL, blended learning and inquiry-based learning. Because teaching and learning are emotional exercises, it is imperative to engage with the emotional arena in education in ways that are critical and not sentimental or hedonistic (Hargreaves 2000). Chan and Luo (2021) made a case for a 'holistic competency', which is an umbrella term for a diverse set of generic skills (e.g. communication, teamwork and creativity), positive values and attitudes (e.g. consideration and respect) (Chan & Luo 2021). These competencies can possibly be applied to diverse settings and target audiences. Graduates are confronted with a less sure future, with increased political tensions, frequent updates of technology, rapidly changing demands of work and evolving responsibilities (Oliver 2015).

Ultimately, curiosity is a yearning to know or learn more (Kidd & Hayden 2015). Curiosity (like interest and fun) is an affective state and has a correlation with intrinsic and extrinsic motivation and learning (Di Domenico & Ryan 2017). The original version of the proverbial 'curiosity killed the cat' discourages unnecessary investigation or experimentation because of dangers that may be associated with it. However, the lesser-used rejoinder 'but satisfaction brought it back' suggests that the risk would make resurrection possible because of the satisfaction felt after reaching a conclusion, making affective states both the initial driver of inquiry and the impetus to repeat the process.

Chapter 3

Joining forces: Pair problem-solving, flipped classroom and metacognitive self-questioning to enhance self-directed learning

Roxanne Bailey
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Betty Breed
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Abstract

Developing 21st-century skills and SDL has become a priority, especially in subject fields where rapid changes, such as new technologies and curriculum updates, are visible. In this chapter, we report on research conducted with Computer Applications Technology (CAT) pre-service student-teachers.

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Employing a QUAN-qual design, we set out to determine the effect of pair problem-solving within a blended learning environment (supported by metacognitive self-questioning) on second-year CAT students' SDL abilities. Using cooperative learning and the flipped classroom approach (as a blended learning strategy) possibly gave students the opportunity to be more motivated to attend the class. From the results, we found that the metacognition questions (which were infused into the cooperative learning) gave students the opportunity to learn to formulate their own learning goals and, in doing so, increase aspects of their self-direction. What we found was that the metacognitive questions and the cooperative learning (in the form of pair problem-solving) used in conjunction with the flipped classroom method had played a positive role in the development of these students' SDL. In an era where students need to keep up with the ever-changing world and need to possess 21st-century skills, our research indicates that metacognitive questions infused into cooperative learning and the flipped-classroom approach (as a complete pedagogical 'package') hold possible great advantages for CAT students in a Microsoft (MS) Excel module.

Introduction

The subject of Computer Applications Technology is offered at the school level in South Africa from Grades 10–12. Pre-service teachers (BEd students) have the opportunity to elect CAT as a major subject in their course. In the CAT modules, pre-service teachers are exposed to the subject matter (software and systems), such as to Microsoft Office suite programs, MS Word, MS Excel, MS Access, and so forth, and pedagogical content knowledge (PCK) to equip them for becoming successful CAT teachers. It is against the backdrop of the MS Excel module that this investigation is placed.

The 'MS Excel module, like other CAT modules, is predominantly focused on practical skills. Participants in the module are required to illustrate proficiency in spreadsheet management and implementation. As with any computer-related subject, 21st-century skills are pivotal (Webb et al. 2017). Three strategies that have proven successful in supporting the development of 21st-century skills are (1) cooperative learning (to develop collaboration), (2) metacognitive self-questioning (to develop metacognition during problem-solving) (Lai & Viering 2012) and (3) blended learning (i.e. flipped-classroom method). Pair problem-solving, where students work alongside each other in pairs (as in pair programming – having a driver and navigator) to solve problems, was selected as a cooperative learning strategy for this research. Apart from these three strategies holding the possibility to develop 21st-century skills, fostering SDL can also enhance the development of 21st-century skills (Choy, Tan & Ang 2015; Lai 2011). However, many students do not possess such 21st-century skills (Jones 2010), nor are they self-directed in their learning (Hung 2009).

Self-direction in learning may positively influence students' development of 21st-century skills (P21 2018). Furthermore, 21st-century skills are emphasised in all educational areas, especially in computer and technology-related areas, as computational thinking is seen as one of the 21st-century skills (Mohaghegh & McCauley 2016). In the light of these statements, we set out to determine the effect of metacognitive questioning infused into cooperative learning (used alongside the flipped classroom method) on second-year CAT students' SDL development. The research question that guided this investigation was: What is the effect of pair problem-solving (supported by metacognitive questioning and the flipped classroom method) on second-year CAT students' perceived SDL ability?

To answer this research question, we positioned our research within the flow theory (Csikszentmihalyi 1990) as the conceptual and theoretical framework. The rest of this chapter sets out to report firstly on our conceptual and theoretical framework, followed by a discussion on our empirical investigation. In doing so, we aim to answer the research question. We end the chapter with some concluding remarks on lessons learnt.

Conceptual and theoretical framework

Several researchers have found that by intentionally focusing on metacognition development, success in cooperative learning is increased (Breed, Mentz & Van der Westhuizen 2015). Furthermore, it was established that cooperative learning holds advantages for SDL development (Bailey 2016; Mentz & Van Zyl 2016). Bringing these two worlds together (metacognition and cooperative learning to develop SDL) holds a more comprehensive answer. A further step in developing SDL amongst pre-service teachers is to utilise cooperative learning within a blended learning environment. Bailey and Lubbe (2020) found that using blended learning (through means of the flipped classroom) in conjunction with cooperative learning held great possibilities for pre-service teachers' SDL development. To elucidate these four concepts (metacognition, cooperative learning, blended learning and SDL), we will position them in the flow theory. Subsequently, a brief definition of the flow theory will firstly be given, followed by a discussion of each of the four concepts (including how they relate to the flow theory).

Flow theory

The flow theory is based on the notion that one can go into a state of consciousness where the outside world becomes irrelevant (Csikszentmihalyi 1990). Moore (2013) emphasised that flow exists when a balance is found between an individual's skills and the challenge of the activity. Working together with others gives students the opportunity to go into a flow as they are challenged not only by the content but also by all the other facets that come with working with others (interpersonal skills, social skills, etc.). Having the opportunity also to gather resources and work through the content set for a specific contact session (as was the case in this research context), students may also encounter episodes of flow as their skills are challenged (using technology and searching skills to find resources) and the activity of producing sufficient information before attending the contact session where cooperative learning (paired problem-solving) is implemented. We surmise that a student who is found to be highly self-directed and motivated to reach the learning goal, actively finding resources and constantly evaluating their progress, may be said to be in 'flow'.

Metacognition

To put it simply, metacognition is defined as 'thinking about one's own thoughts'. Flavell (1979), one of the early scholars in metacognition, defined it as the ability to reflect on one's own thinking and learning. Schraw and Dennison (1994) summarised scholarship on metacognition by dividing it into two aspects: knowledge of cognition and regulation of cognition. This subdivision is widely accepted by scholars working in the field of metacognition; however, it is also termed by some as metacognitive knowledge and metacognitive control (Lai 2011).

Metacognitive knowledge: Metacognitive knowledge, as described by Lai (2011), consists of knowledge about oneself and the strategies used to achieve a learning outcome. These strategies are influenced by oneself (in terms of learning preferences), the learning tasks at hand and the teaching strategies used (Breed et al. 2015). In a comprehensive literature review, Lai (2011) noted that metacognitive knowledge is divided into three aspects: (1) knowledge about oneself and the factors that influence your learning (declarative knowledge), (2) consciousness about possible strategies for cognition (procedural knowledge) and (3) knowledge about why and when to use these strategies (conditional knowledge). Although these three aspects seem to be individualised, one cannot omit the fact that they are influenced by factors beyond the learner. To give the learner an optimal chance to develop successful metacognitive knowledge, the educator needs to set the stage by implementing deliberate teaching-learning strategies that support metacognition development (Shannon 2008).

Metacognitive control: Breed et al. (2015) noted that metacognitive control includes three elements: planning, monitoring and evaluation. She continues to say that educators are responsible for focusing their learners and students on the relationship between these elements in an attempt to increase their metacognitive control. Lai (2011) divided metacognitive control into three aspects: (1) selection of strategies and allocation of resources (planning), (2) awareness of task performance (monitoring), and (3) assessing one's learning against the backdrop of the learning goal (evaluating). By continuously being in control of the learning process, learners can guide their learning and in effect, be more self-directed in their learning. Although learners should have the opportunity to be self-directed, it still remains the responsibility of the educator to set the stage for this self-direction to occur.

As with any teaching-learning strategy (in this case, cooperative learning), it will not be successful if the learner is not at the centre of it all. It is with this argument that we posit that metacognition should be placed within the flow theory. Flow in metacognition is the balance between the metacognitive awareness of the learner and the metacognitive control implemented. By focusing on the learners' metacognition, their state of consciousness is heightened, and the possibility of an optimal learning experience is raised. One strategy that has proved a success in metacognition development is cooperative learning – this will subsequently be discussed.

Cooperative learning

Cooperative learning is a teaching-learning strategy that has its roots in the social interdependence theory (Johnson & Johnson 2013). Although sometimes used interchangeably with collaborative learning (unstructured use of group work), cooperative learning is described as a much more structured and well-defined group work strategy than collaborative learning. Five basic elements are defined by Johnson and Johnson (2013) to illustrate one of the structures that are put in place in cooperative learning, which is not evident in collaborative learning. These five basic elements have to be adhered to in order for any group work or collaboration activity to be considered a cooperative learning experience. These elements are given as follows: (1) positive interdependence, (2) individual accountability, (3) F2F promotive interaction, (4) social skills and (5) group processing.

Positive interdependence

Positive interdependence is achieved when all students work together in such a way that one cannot succeed without the success of the other (Johnson & Johnson 2013:102). Students, therefore, work together in such a manner that they all need each other to complete the activity at hand (Joliffe 2007:3) successfully.

Individual accountability

Individual accountability is achieved when the individual performance is evaluated by the group, and each individual is required to contribute to the task in order to increase the success of the group (Johnson & Johnson 2013:105). It is also a measurement of whether the individual successfully contributed to the group's end result (Johnson et al. 2008:G:3).

☐ Face-to-face promotive interaction

Face-to-face promotive interaction is achieved when the group members constantly encourage one another through guidance and assistance, especially by sharing their resources with each other in order to successfully complete the task at hand (Johnson & Johnson 2013:106). Johnson and Johnson continued to state that promotive (F2F) interaction creates a feeling in the group that group members can trust each other as the promotive interaction helps to ease anxiety, especially sometimes felt during group activities.

☐ Social skills

Although one can easily assume that all students have the necessary social skills to successfully engage in cooperative learning, Joliffe (2007:40) noted that it is the responsibility of the lecturer or facilitator to develop these social skills. As Johnson and Johnson (2013:106) pointed out, putting individuals who do not possess the necessary social skills into a cooperative group together will cause cooperative learning to fail.

☐ Group processing

During cooperative learning, group reflection is vital (Johnson & Johnson 2013:107). Group processing gives the group an opportunity to reflect on two aspects: which actions of the members in the group were helpful or not and what actions to take or change in future cooperative learning sessions. Group members need to process the effectiveness of their efforts and also to determine to what extent the group made use of the correct skills required in the cooperative learning session (Joliffe 2007:40). Group processing assists students in the development of their metacognitive abilities (Johnson & Johnson 2013:108), and thus, it is no surprise that we intended to combine the use of cooperative learning with metacognition in this current research project.

When these five basic elements are considered and addressed during a teaching-learning activity, several researchers (Johnson & Johnson 2013; Mentz, Van der Walt & Goosen 2008) have found that learning is enhanced. Cooperative learning has been used in various forms (i.e. Jigsaw); however, within a practical subject (like CAT), this larger group strategy may seem difficult to achieve. It is in line with this that we proposed the use of pair problem-solving (as a cooperative learning strategy) in this current research project. Mentz et al. (2008) proposed embedding the five elements of cooperative learning into pair programming (with great success); however, as our investigation is not situated in a programming module but an Introduction to MS Excel module, we proposed using the term 'pair problem-solving' – implemented exactly like 'pair programming' (with the driver and the navigator) but students are not programming, they are problem-solving.

Within the flow theory, cooperative learning (in the form of pair problem-solving) holds several possibilities – the aim is to create an environment where students become so engrossed with their learning that they are not distracted by irrelevant stimuli. Working together on one problem helps students direct their 'self' with the help of their partner; furthermore, complexity is reached – an element that promotes flow (Csikszentmihalyi 1990:42) since students are given both determining opportunities (individual accountability) and integrative opportunities (positive interdependence and F2F promotion).

Although cooperative learning holds many advantages when one refers to SDL development, the combination of blended learning and cooperative learning increases the likelihood of developing students' SDL (Bailey & Lubbe 2020). Subsequently, blended learning will be discussed.

Blended learning

As early as 2015, Van der Westhuizen (2015) already noted that blended learning environments could promote SDL if implemented correctly. He found that blended learning environments provided students with optimal opportunity to especially engage in reflection and evaluation (both metacognitive aspects). Blended learning further stimulates students to adapt to different environments, which also can relate to an increase in SDL skills (adaptability). It was clear thus that incorporating blended learning (making use of the flipped classroom approach) in our research held possibilities for metacognition stimulation and, ultimately, SDL skills development. Because of its advantages, Porter et al. (2014) noted that an estimate of 80%–90% of higher education programmes would be delivered by means of blended learning in the future. Mitchell et al. (2020) confirmed the advantages blended learning holds, especially for lifelong learning development and addressing various learning styles of students and, in doing so, including more students more actively in the learning process.

Several definitions of blended learning exist (BR & Babu 2015; Cronje 2020). Friesen (2012) in Cronje (2020) dated the first definition of blended learning to 1999. Blended learning is a term sometimes loosely used for an educational approach that intentionally combines traditional, F2F classroom teaching with online learning (Castro 2019). It is in the combination that the strengths of social aspects of a classroom and the strengths of the technological 'e-learning' worlds are tapped into (BR & Babu 2015). Cronje (2020:120), however, mentioned a newer definition of blended learning. He defined blended learning as 'The appropriate use of a mix of theories, methods and technologies to optimise learning in a given context'. For this chapter, however, we will remain with the traditional definition of blended learning.

In defining blended learning in more detail, Friesen (2012) and Saragih et al. (2020) gave an account of the several blended learning models that exist.

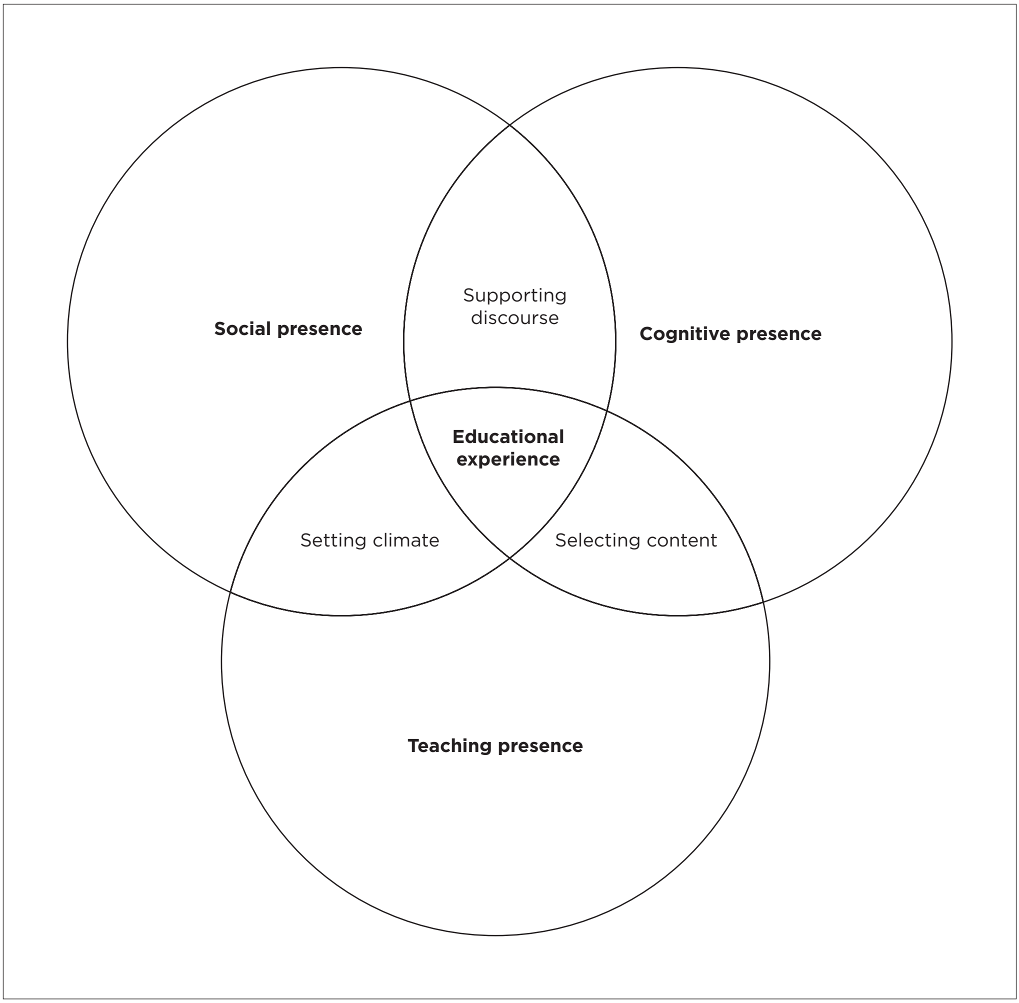
These models indicate that the 'blend' can move on a continuum of more online learning and less F2F learning *or* more F2F learning and less online learning. The models include the following:

1. The 'station rotational model': Online learning is embedded within face-to-face learning in a cyclical fashion (Friesen 2012; Saragih et al. 2020).
2. The 'lab rotation model': It is similar to the station rotational model but specifically uses a specialised computer laboratory with a flexible schedule to interact with the teacher or lecturer (Saragih et al. 2020).
3. The 'flex model': Students are mostly involved in online learning, but the lecturer is present in a F2F setting (Friesen 2012; Saragih et al. 2020).
4. The 'self-blending model': Students choose online learning courses, but these are completed in the F2F presence of other students and a lecturer (Friesen 2012).
5. The 'enriched-virtual model': Students are primarily engaged with online learning and intermittently with F2F learning (Friesen 2012; Saragih et al. 2020).
6. The 'flipped classroom': Students work through content at home that has been provided to them by the teacher or lecturer beforehand (Saragih et al. 2020).

In this research, the flipped classroom model/approach as a blended learning strategy was utilised as students were required to work through set online materials (individually) before entering the classroom in order to engage in a cooperative fashion during the F2F contact session. Specific attention to the CoI framework was also given.

When referring to blended learning, reference to the CoI framework is emanant (Szeto 2015) because of its importance in the design of the online part of Blended learning (BL). The CoI framework was developed by Garrison, Anderson and Archer (2000) in order to describe the methodology for investigating the 'potential and effectiveness of computer conferencing' (Garrison, Anderson & Archer 2010:6). The CoI framework (see ch. 1) posits that three presences are stimulated during a 'worthwhile educational experience' (Garrison et al. 2010:6). These presences are illustrated in Figure 3.1.

By using BL strategies (i.e. the flipped classroom method in the case of this research), the three presences noted by Garrison et al. (2010) should be stimulated (especially in the online section of the 'blend'). It was further clear that incorporating the flipped classroom approach into cooperative learning held greater possibilities, especially in being cognisant to attempt to stimulate the teaching presence and social presence – as was found by Bailey and Lubbe (2020). By bearing in mind the effective stimulation of the three presences in the blended learning environment, we set out to develop CAT students' SDL skills. It should be noted, however, that we did not measure the presence in this investigation (a limitation that needs to be mentioned).



Source: Garrison et al. (2010:6).
FIGURE 3.1: The Community of Inquiry framework.

The following section discusses SDL and its connection to metacognition, cooperative learning and BL. Self-directed learning, as with the other main concepts in this investigation, too can be directed by the flow theory.

Self-directed learning

Self-directed learning has its origins in andragogy (Knowles 1975). It is described as a process, a characteristic or an educational outcome (Long 2000). The most widely quoted definition of SDL is that of Knowles (1975), who defined it as:

> [*A*] process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identify human

> and material resources for learning, choosing and implement appropriate learning strategies, and evaluating learning outcomes. (p. 18)

With the flow theory in mind, one can easily draw similarities between SDL and flow as both have a specific goal in mind. Flow aims to reach the optimal experience, and SDL aims to reach the optimal learning outcome. By viewing SDL as an optimal learning experience where the 'self' directs all attention and attention then directs the 'self', we argue that SDL becomes a flow.

Within this view (as described in this conceptual framework) of metacognition, cooperative learning (used in conjunction with flipped classroom) and SDL (within the flow conceptual-theoretical framework), SDL needs to be enhanced. The question thus remains as to what effect this combination of strategies would have on second-year CAT students' perceived SDL ability would be? The subsequent section will discuss the empirical research conducted to answer the preceding question.

Empirical research

We aimed our empirical investigation at determining the effect of metacognitive questioning (infused into pair problem-solving as a cooperative learning strategy, used in conjunction with the flipped classroom approach) on second-year CAT students' SDL ability.

Research design and methodology

Four different paradigms are popular amongst researchers: post-positivism, advocacy and participatory research, constructivism and pragmatism. This research was guided by the pragmatist paradigm – focusing on *what works* (Creswell 2009). Within the pragmatist paradigm, a mixed-methods (QUAN-qual) methodology guided the empirical investigation as we primarily used quantitative measuring instruments (self-directed learning instrument [SDLI]) (Cheng et al. 2020) and the cooperative learning questionnaire, but also used a qualitative instrument (semi-structured interviews) to verify quantitative results.

Measuring instruments

In order to elicit answers to the primary research question, we measured the second-year CAT students' perceived self-directed learning ability (using Cheng et al.'s SDLI; Cheng et al. 2010) at the onset of the module and again at the end of the module (after implementing the intervention). The SDLI consists of 20 questions that in turn, are divided into four constructs: 'Learning motivation; Planning and Implementing; Self-monitoring; and Interpersonal communication'. Furthermore, we also asked students to complete a questionnaire (focused on cooperative learning) at the end of the module. The cooperative learning questionnaire was developed by the Research Focus Area Self-Directed Learning. Cronbach's alpha was calculated for both these measuring instruments, of which both showed internal reliability (SDLI: >0.6 for all constructs; cooperative learning questionnaire: 0.8). Finally, some students were randomly selected to participate in semi-structured interviews voluntarily. The semi-structured interview was guided by open-ended questions pertaining to the definition of SDL of Knowles (1975).

Population and sampling

As we were focused on determining the effect of our intervention (metacognitive questioning used with pair problem-solving [cooperative learning] in conjunction with the flipped classroom method [BL]) on second-year CAT students' perceived SDL abilities, we conducted the research in one of our CAT classes. These students are pre-service teachers who were enrolled in a BEd degree, and all selected CAT as one of the major subjects. The class consisted of 8 male and 26 female students, of whom the majority (*n* = 32) of the students were Caucasian. No exclusion criteria were implemented, and all students in the class were invited to participate voluntarily in the research. Of the 32 students in the class, 26 completed the SDLI, and 28 students completed the cooperative learning questionnaire. This second-year CAT module entails an introduction and advanced spreadsheets content, with specific applications in Microsoft Excel and Google Sheets and is taught by one of the authors.

Research process

Pre-test

At the onset of the investigation, all students were asked to complete the SDLI in order to measure the students' perceived self-directed learning ability. Students then had the opportunity of completing the CAT module (approximately 10 weeks).

Intervention

The flipped classroom, as a BL strategy, entails having students prepare for class, work through the material (provided by the lecturer), watch YouTube videos (provided by the lecturer) and gather resources (themselves) online before entering the classroom. This part covered the online part of the 'blend'. To cover the F2F part of the 'blend', students attended contact sessions in class. Subsequently, the F2F session will be discussed. In this CAT module, students worked together in pairs (implementing pair problem-solving incorporating the five elements of cooperative learning) where they were asked to solve problems posed to them and apply the solutions in Excel.

During the F2F contact sessions (every scheduled session), pairs were divided into two roles, driver and navigator (as is the case in pair programming). After each lesson, students were asked to send the lecturer an email stating what worked really well during the lesson (the pair problem-solving) – this email was used to stimulate group processing (one of the cooperative learning elements). Pairs were also asked to complete a metacognitive questioning checklist (asking students to tick whether they completed some specific tasks in each of the three metacognitive phases: Planning, Implementing and Evaluating) that required them to reflect on their thought processes during the pair problem-solving.

Post-test and semi-structured interviews

Once the semester was completed, students were once again asked to complete the SDLI. The students were also asked to complete the cooperative learning questionnaire. Seven students were asked (randomly selected) to participate in a semi-structured interview in order to get a better insight into their experience with students. The questionnaires, along with the semi-structured interviews, yielded interesting results. The results from this empirical investigation are discussed next.

Data analysis

Quantitative SDL data were analysed by implementing the paired samples *t*-test statistical tests. As the cooperative learning questionnaire was only given once (at the end of the module), only descriptive statistics is available. These tests were conducted by the North-West University's statistical consultation services. Qualitative data were analysed (by us as researchers) by coding and re-coding verbatim transcripts in ATLAS.ti. Once emerging codes had been created, categories were identified, and in turn, categories formed themes (specifically focused on SDL and cooperative learning). Interrater reliability informed the trustworthiness of the qualitative data analysis.

Results

From the empirical investigation conducted, several interesting results came to the fore. A limitation worth mentioning here is that we did not measure the stimulation of the three presences of the CoI framework – we thus cannot make any deductions regarding the flipped classroom or online part of the 'blend' in our class.

Furthermore, as mentioned, we implemented a QUAN-qual methodology, and thus, we will discuss the quantitative investigation followed by the qualitative investigation.

Quantitative investigation

In order to heighten our sense of what results were obtained, we divided the group into 'below median' and 'above median' (regarding their SDLI results) as it makes more sense to establish whether students who were not necessarily self-directed had become more self-directed after the teaching-learning strategy, as intervention, was implemented. In Table 3.1, the SDLI results of students who during the pre-test scored below and equal to the median (median = 80) are displayed, whereas Table 3.2 illustrates the SDLI results of students who scored above the median during the pre-test.

From Table 3.1, it is evident that the SDLI-total for students who scored below or equal to the median had an increase with large practical significance between the pre-test and the post-test. As noted in the table, significant practical differences are indicated with an asterisk. A small practical significant difference/effect size ($0.3 > d < 0.5$) is indicated with one asterisk, a medium effect size ($0.5 > d < 0.8$) is indicated with two asterisks and a large effect size is indicated with three asterisks ($0.5 > d < 0.8$). Apart from the SDLI-total,

TABLE 3.1: Self-directed learning instrument (below and equal to median).

Construct	*n*	Pre/Post	Mean	SD	*p*	*d*
Learning motivation	13	Pre	3.5256	0.29538	0.004*	1.56***
		Post	3.9872	0.38767		
Planning and implementing	13	Pre	3.7051	0.43116	0.005*	0.89***
		Post	4.0897	0.32358		
Self-monitoring	13	Pre	3.6923	0.27298	0.005*	1.13***
		Post	4.0000	0.14434		
Interpersonal communication	13	Pre	3.6923	0.44668	0.069	0.73**
		Post	4.0192	0.45025		
SDLI-total	13	Pre	72.9231	3.32820	0.000*	2.29***
		Post	80.5385	4.96010		

Key: *n*, number; SDLI, self-directed learning instrument; SD, standard deviation.
*, Small; **, Medium; ***, Large.

TABLE 3.2: Self-directed learning instrument (above the median).

Construct	*n*	Pre/Post	Mean	SD	*p*	*d*
Learning motivation	13	Pre	4.3205	0.35001	0.361	0.37*
		Post	4.4487	0.51543		
Planning and implementing	13	Pre	4.4744	0.32522	0.446	0.32*
		Post	4.5769	0.40606		
Self-monitoring	13	Pre	4.2885	0.46599	0.029	0.62**
		Post	4.5769	0.43761		
Interpersonal communication	13	Pre	4.3654	0.64239	0.397	0.27*
		Post	4.5385	0.46599		
SDLI-total	13	Pre	87.3846	5.36250	0.098	0.60**
		Post	90.6154	8.54925		

Key: *n*, number; SDLI, self-directed learning instrument; SD, standard deviation.
*, Small; **, Medium.

we also observed mostly a large practical significant difference between the pre-test and post-test in most of the constructs – it is only the interpersonal communication construct that had a medium practical significant difference between pre-test and post-test.

Table 3.2 illustrates that the students who scored above the median (on SDLI-total) also had a practically significant difference between the pre-test and the post-test; however, it showed only a medium-significant difference. As noted in the table, significant practical differences are indicated with an asterisk. A small practical significant difference/effect size (0.3 > *d* < 0.5) is indicated with one asterisk, a medium effect size (0.5 > *d* < 0.8) is indicated with two asterisks and a large effect size is indicated with three asterisks (0.5 > *d* < 0.8). Apart from the SDLI-total and the self-monitoring construct (both with a medium practical significant difference), we also observed a small practical significant difference between the pre-test and post-test in all the other constructs.

From these two tables (illustrating quantitative results), it becomes evident that the intervention (combination of pair problem-solving, metacognition and flipped classroom) benefited the students who scored lower in SDL at the onset of the module as compared with those who scored higher.

To establish students' experiences of the cooperative learning environment, they were also asked to complete a cooperative learning questionnaire at the end of the module. Table 3.3 illustrates the results of the cooperative learning questionnaire. A discussion on the table is then provided subsequently.

In Table 3.3, 'KQ' represents the cooperative learning question number. The reason for omitting Questions 1 and 2 is because they are focused on the biographical information of the student. All questions except Questions 12, 13, 14, 21 and 23 are positively loaded (with a minimum value of 1 and a maximum value of 5). One can, therefore, calculate students' notion of cooperative learning in the CAT class by adding the positively loaded questions' mean scores and subtracting the sum of the negatively loaded questions' mean scores. By adding the positively loaded questions and subtracting the sum of the negatively loaded questions, the possible minimum score for the cooperative learning questionnaire is 12, and the possible maximum score for the cooperative learning questionnaire is 60. When referring to the results of this current investigation, the CAT classes' average cooperative learning score was 67.107 positive and 16.143 negative and therefore 50.96 out of a possible 60 score. It is thus sufficient to state that the general notion of the experience of cooperative learning (in the form of pair problem-solving) in this CAT class was positive.

Qualitative results were also gathered to corroborate the quantitative results. In the subsequent section, the qualitative results are discussed.

TABLE 3.3: Cooperative learning scores.

Question	*n*	Mean	SD
KQ3	28	3.679	0.6696
KQ4	28	4.107	0.6853
KQ5	28	3.929	0.8133
KQ6	28	3.964	0.8812
KQ7	28	3.893	0.7373
KQ8	28	4.000	0.7698
KQ9	28	4.000	0.9428
KQ10	28	4.071	0.8997
KQ11	28	3.821	0.7724
KQ12	28	3.321	1.0203
KQ13	28	3.679	1.0560
KQ14	28	2.929	1.1198
KQ15	28	3.750	0.9670
KQ16	28	4.321	0.6118
KQ17	28	3.857	0.8034
KQ18	28	4.036	0.7927
KQ19	28	3.786	0.7868
KQ20	28	4.000	0.6667
KQ21	28	2.643	1.1292
KQ22	28	3.929	0.6627
KQ23	28	3.571	0.8789
KQ24	28	3.964	0.5762

Key: *n*, number; SD, standard deviation.

Qualitative investigation

Qualitative results were obtained by analysing data on ATLAS.ti™. From the codes, categories and themes identified, Table 3.4 was created. Emerging codes (informed by literature and research aims and questions) guided the analyses. A discussion on what can be deduced from the table is given subsequently.

Table 3.4 illustrates the vast number of responses drawn from the interviews that were focused on either SDL or cooperative learning. As evident from the quantitative results, not all was positive regarding SDL or cooperative learning; however, the fact that positive results were also evident in the qualitative results corroborates the notions from quantitative results.

The categories that are written in italic indicate a border crossing between the qualitative categories and the SDLI constructs. As this chapter is focused on reporting the development of these participants' self-directed learning ability, only categories relating to the SDLI constructs will be elaborated on.

Learning motivation

From the interviews, it became evident that the learning motivation of several students was determined by their interests. *Interest as a driving force to work*

TABLE 3.4: Qualitative results from semi-structured interviews.

Code	Category	Theme
Negative experience Positive experience Pair programming versus individual Prefers individual work Previous group work versus group work in CAT classroom	Experience of pair problem-solving	Cooperative learning
Group selection Aid provision Learn from others Role selection Advantage of group work	Cooperative learning *Interpersonal communication*	Cooperative learning
Active learning Lecturer provides aid Suggestion for teaching strategy	Teaching strategy	Cooperative learning
Interaction Communication Conflict Learn patience Listening skills Confidence Social skills	Social skills *Interpersonal communication*	
Implementation of pair programming Wrong implementation	Pair problem-solving	
Hardcopy versus softcopy Resources	Resources	Self-directed learning
Understand work better Disposition Learning strategy Preparation	Learning success *Planning and implementing*	
Interest as driving force to work Enjoyment Learning goals Teaching influence Marks as driving force	Motivation *Learning motivation*	
Individual responsibility Positive interdependence Responsibility for learning	Responsibility *Self-monitoring*	

was noticed by the majority of participants. One participant stated: 'I am not interested in other subjects as I am in CAT as I intend to become a CAT teacher one day.' (Participant 1, 04 November 2015)

The *enjoyment* of the module also plays a role in students' learning motivation. One participant blatantly stated that: 'This class was much nicer than previous classes where I had to work alone.' (Participant 3, 04 November 2015)

As students were required to formulate the *learning goals* in their own words, they also had an opportunity to practice this skill. The CAT students in this research are all pre-service teachers, and therefore, it was heart-warming to hear that the class had influenced their future teaching practices (*teaching influence)*: 'I think this is definitely the way I will teach one day when I teach' (Participant 4, 04 November 2015) – this indicated that the participant was motivated to learn new ways of teaching. Unfortunately, it is still so that students' learning motivation is influenced by marks (*marks as a driving force*), but fortunately, only one student mentioned this as a motivator for their learning: 'My previous marks weren't that good so I put in a little more effort this semester as I wanted to do better' (Participant 1, 04 November 2015).

From the above-mentioned quotes and categories, it seems that students' learning motivation (albeit positive or negative) was influenced by this module and how the module was presented.

Planning and implementing

With the module focusing specifically on implementing pair problem-solving, where students are also required to complete the metacognitive awareness checklist, it was not surprising that the interviews yielded many references that indicated that students' planning and implementation had been addressed. Some students made mentioned the fact that they *understand the work better* after the module has been implemented in such a manner, especially as they had the opportunity to learn from others: 'So I will say that the fact that I have a deeper understanding helps me to formulate it better' (Participant 6, 06 November 2015). Furthermore, one student also noted that the module had changed his *disposition* in that he surprisingly had a positive disposition towards group work. Some of the students elaborated on how this class had changed their *learning strategy* in that they are now more willing to research solutions, learn for tests and do the metacognitive awareness checklist (even in other subjects): 'Yes, I think my learning strategy has changed from the previous semester because I will rather go sit and practice in Excel at the hostel' (Participant 1, 04 November 2015); furthermore, another student noted that they prepare for these classes (as required from the flipped classroom approach) as the class is more interesting: 'I would say I definitely prepare more for this class' (Participant 2, 04 November 2015). From this, it seems that the students' planning and implementation of what is learnt had been influenced greatly by the metacognitive awareness checklist (especially if they are willing to implement it in other subjects too) and how the module is taught.

Self-monitoring

From the interviews, it became clear that students felt that they had the opportunity to accept *individual responsibility* through participating in pair problem-solving: 'Through the practical work in the class, you realise where you still need more practice' and 'We could not do some of the work, so I was interested in looking up other resources because I wanted to get it right' (Participant 2, 04 November 2015).

Apart from the fact that the pair problem-solving helped students increase *individual responsibility*, students also noted aspects illustrating that *positive interdependence* occurred: 'You feel responsible for the other person's marks' and:

> 'You have to focus the whole time because when that person stops working [*as a driver*] you have to fall in – you have to focus the whole time and think of the problems that they [*the driver*] experiences because you can encounter the same problem.' (Participant 1, 04 November 2015)

Apart from the pair problem-solving influencing students' ability to self-monitor their work, it seems that the metacognitive awareness checklist also allowed students to reflect on their work and in doing so monitor how they solved the problem given.

☐ Interpersonal communication

As would be expected, pair problem-solving influenced students' interpersonal communication greatly. The fact that the lecturer chose the groups and rotated the roles (*group selection* and *role selection*) forced students into an uncomfortable situation where their interpersonal communication would be tested: 'What helped me a lot was that [the lecturer] divided us into groups so we could work with different personalities'; 'Here in CAT I looked forward to working with someone I did not know' (Participant 2, 04 November 2015).

A number of students also mentioned how the pair problem-solving gave them the opportunity to *learn from others* and that it provided them with aid (*aid provision)*: 'There were many things that I did not know before that I learnt from others'; 'I myself learnt and I learnt from other people' and 'A lot of things I would not have been able to do if I had to do it by myself [...] it helps a lot to communicate' (Participant 3, 04 November 2015).

Although one student experienced *conflict* during one of the pair problem-solving sessions, it is still noteworthy that they had the opportunity to learn to resolve conflict. Several students specifically stated that the pair problem-solving had developed their *communication* skills: '[I learnt] to communicate better' and 'If something isn't right, [I learnt] to say "listen here, I do not like this idea, let's rather try another idea"' (Participant 6, 06 November 2015).

Several students also made mentioned the fact that the pair problem-solving taught them *listening skills*: 'To put others' views above yours and to listen'; *patience*: '[I learnt] a lot of patience, because you do not always work with someone that's on the same level as you' and *social skills*: 'We all got to know each other and communicated more' (Participant 3, 04 November 2015).

The greatest advantage was that students felt that their *confidence* levels had increased with this module: 'The exam was much easier than before, I don't think because the work was easier but because I could understand it better [and] I could help her [another student]' (Participant 1, 04 November 2015).

From the results stated above, one may derive that pair problem-solving had positively influenced students' self-direction in learning (evident from the quantitative and qualitative results). In the section to follow, we discuss the results by interweaving the qualitative and quantitative results.

■ Discussion of results

Students in this era are faced with coping with an ever-changing world. They need to possess 21st-century skills especially in a computer-related subject (such as CAT). Self-directed learning development and 21st-century skills have been linked, and therefore, we set out to determine the effect of metacognitive questioning infused into cooperative learning on second-year CAT students' SDL development. What we learnt was that the metacognitive questioning infusion into the pair problem-solving definitely informed students' experience of the module (as evident from the interviews); however, the pair problem-solving and having the opportunity to work with other students seemed to have had a greater impact on students' SDL.

During this research, it became evident that students had an opportunity to develop their learning motivation. From the quantitative results, a large practical significant difference was evident in the lower SDLI group, and in the higher SDLI group, a small practical significant difference was evident. Students' learning motivation had increased (according to SDLI results), and from the interviews, it was clear that the way the lesson was constructed gave them an opportunity to increase their learning motivation. Working with another student increased their enjoyment of the class, that in turn increased their motivation for attending the class – these results are corroborated by Liebenberg, Mentz and Breed (2012), who also found that cooperative learning increased the enjoyment of a class. As mentioned by several students in their interviews, this combination of strategies gave them the opportunity to enjoy the class and be more motivated to attend the class; however, the metacognition questions (which were infused into the cooperative learning) gave students the opportunity to learn to formulate their own learning goals and in doing so increase their motivation. Giving students autonomy over their own learning increases not only their learning motivation but also their SDL overall.

What really made this research insightful was the fact that students would probably not have increased as much in planning and implementing if it had not been for the inclusion of the metacognitive questions. Forcing students to make use of the metacognitive questions to plan their solutions and afterwards reflect on what they had done gave them the opportunity to increase their SDL ability in terms of planning and to implement. In both the low and high SDLI groups, significant practical differences were observed. The interviews with the students also yielded that they felt that the class had forced them to reconsider their planning and preparation for the subject. In this research, it was evident that both the metacognitive questions and the cooperative learning played a role in increasing students' planning and implementation – the metacognitive questions focused more on the planning and the cooperative learning on the implementation – but interweaved that it had the most positive influence.

Another aspect of SDL that may not have been developed as much in the class if the class was not structured to include both the metacognitive questions and cooperative learning are self-monitoring. A significant practical difference between the pre-test and post-test on the SDLI for both low and high SDLI groups was observed. In the interviews, students continuously focused on how the class had increased their sense of responsibility. Mentz et al. (2008) also found that cooperative learning increases students' sense of responsibility. Furthermore, having the opportunity to reflect on their cognitive processes during problem-solving (as directed by the metacognitive questions) gave students the opportunity to monitor their thought processes and inform future solutions. Infusing the metacognitive questions into cooperative learning also gave students the opportunity to experience how others monitor themselves – an opportunity that could have influenced students' self-monitoring.

Although one would expect that interpersonal communication would increase the most (statistically) when students are given the opportunity to work together with other students, students in this research had the smallest practical significant difference in interpersonal communication (although the low SDLI group still had a medium practical significant difference and the high SDLI group had a small practical significant difference). In the interviews, it became clear that students experienced that the class gave them the opportunity to develop their interpersonal communication. It is surprising that the quantitative findings did not show such a large increase as one would expect; however, it is positive that students still experienced that the class gave them the opportunity to improve their interpersonal communication through the development of social skills and conflict management, listening skills, etc. One of the greatest advantages noted in the body of scholarship regarding cooperative learning is the development of interpersonal communication (Johnson & Johnson 2013). Although the use of the metacognitive questions could have directed some students' lines of communication, it did not prove to have directly increased their interpersonal communication skills.

The most important result that was evident in this research was the SDLI-total. The low SDLI group had increased with a very large practical significant difference (2.29), and the high SDLI group increased with a medium practical significant difference (0.60), indicating that students' SDL had increased significantly after the intervention.

Conclusion

This research set out to determine the effect of metacognitive questioning infused into cooperative learning (used in combination with the flipped classroom approach) in developing second-year CAT students' SDL. What we found was that both the metacognitive questions and the cooperative learning (in the form of pair problem-solving) had played a positive role in the development of these students' SDL. The inclusion of the flipped classroom approach ensured that students worked through the material online (outside the classroom) and came into the class more prepared and ready to engage in a more meaningful cooperative learning contact session. In an era where students need to keep up with the ever-changing world and need to possess 21st-century skills, our research indicates that metacognitive questions infused into cooperative learning (used in conjunction with the flipped classroom approach) hold a great advantage for CAT students in a MS Excel module. Although we only tested this intervention in one class, it is worth mentioning that similar results may be possible in other circumstances. Giving students the opportunity to direct their cognition, work individually online outside the classroom, work with others to problem solve in the classroom and then reflect on their solutions and cognitive processes develops their self-directedness in learning.

Chapter 4

Self-directed learning with technology for fourth-year Engineering Graphics and Design students

Albert Kemp
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Christo van der Westhuizen
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Abstract

Engineering Graphics and Design (EGD) is a course offered at the university that teaches students to communicate on a graphical level in which essential knowledge and problem-solving skills are needed and where students should be responsible for their own learning activities in EGD. The study examined and defined students' SDL skills with technology in EGD about self-managing and intentional learning skills. The study was conducted using a quantitative approach, and a questionnaire was used to

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obtain data from 48 fourth-year EGD students (purposive sampling) on their SDL skills when using computer-aided design (CAD) and LMSs before the intervention and after. The Cronbach's alpha test results estimated that the students' self-management skills obtained during the intervention were unreliable. The intentional learning skills showed a significant difference as they had a large effect size. These findings imply that students may not have understood the questions about their self-management skills, but the use of CAD and LMSs during the intervention improved the students' intentional learning skills. It is recommended that more attention be paid to improving students' self-managing skills when using CAD and LMSs for students to become self-directed learners who take the initiative and responsibility for their own learning in a blended learning environment.

Introduction

We are part of the knowledge age in which there is a great demand for a workforce able to use critical thinking, innovative thinking and creative skills to solve problems effectively; today's society should make critical decisions to educate these 21st-century skills (Bereiter 2005; Muhammad 2019). Students for the 21st-century workforce are seen as individuals who should be able to acquire the required knowledge and skills to solve problems actively. Such students are regarded as active and motivated members of society (Lapek 2018). Active learning occurs when students are self-directed, inspired by their need to solve actual or personally relevant problems while using their higher cognitive skills. Self-directed learning development is one of the strategies that could be implemented in teaching and learning to promote these 21st-century skills (Choi, Jakob & Anderson 2017; Geng, Law & Niu 2019; Toh & Kirschner 2020). Karatas and Zeybek (2020) suggested that SDL is described as lifelong learning, independent learning, having control over one's own learning and having the ability to evaluate one's own learning process. If students can solve their own problems independently whilst actively obtaining the necessary knowledge and skills, they are active, motivated students. As a result of the information revolution of the 21st century, individuals need to focus on solving real-life problems (Sima et al. 2020). Furthermore, students should be prepared to learn independently and manage their own learning processes to become self-directed lifelong learners (Lantolf, Thorne & Poenher 2015). According to Teo et al. (2010), there is a relationship between SDL and ICTs, and ICT may directly impact SDL because it has facilitated access to both information resources and online expertise. It is important for SDL that students can access a variety of unrestricted assortment of information that will serve their learning needs and interests. This involves gathering, saving, processing, and displaying data, as well as communicating with fellow students and experts worldwide without the need for layers of formality, and it can all happen at the touch of a button (Teo et al. 2010). The integration of ICT in education has not advanced as expected, and there is an urgent need for universities and the government to integrate ICT in education to train aspiring educators effectively (Department of Basic Education [DBE] 2015; Padayachee 2017). There is a global trend toward e-learning in education, which need to be addressed, and the surge and fast development of ICTs have become key challenges for students to keep up with new knowledge, skills and technological innovations now, even more during the COVID-19 pandemic, where schools and universities had to adapt their teaching practice to a more online mode where possible (Valverde-Berrocoso et al. 2020).

Blended learning could be the approach to adhere to the move towards e-learning in education. BL is seen as an approach that encourages the skills of the 21st-century student as it involves the use of ICTs as learning tools to obtain knowledge on their own instead of merely attending classes (Sriarunrasmee, Techataweewan & Mebusaya 2015). The difficulty in predicting possible changes brought about by the rapid development of ICTs affects students' preparedness to meet future demands. It is, therefore, important for educators to adapt the EGD curriculum to train students to use ICTs as a medium to improve their SDL skills, specifically with the use of LMSs and CAD in a BL environment.

The research described in this chapter was part of a larger study that primarily focused on the use of advanced ICTs in EGD to improve spatial visualisation skills; the secondary purpose of this study was to determine fourth-year students' SDL skills with ICTs in EGD concerning self-managing and intentional learning skills when using CAD and LMSs. The reason for mentioning this is that the primary research that was done might have affected the results obtained during the secondary research. For the research in this chapter, the fourth-year EGD students completed the SDL with Technology Scale (SDLTS) that was adapted to fit the specific research context, and the instrument aims to measure students' SDL with ICT skills. Given the above, the following research question was formulated: To what extent do ICTs such as LMSs like the Depot™, eFundi™ and CAD software enhance the self-management and intentional learning skills of EGD students in a BL environment?

As a first step towards answering the research mentioned earlier, a literature review was conducted to develop a conceptual framework for improving students' SDL skills through using ICTs in an EGD BL setting. Following the directives, students' self-management and intentional learning skills needed to be assessed during the intervention.

Conceptual and theoretical framework

The social constructivism theory and experiential learning theory were used as the theoretical grounding for this study. Social constructivism supported the building and constructing of the students' own knowledge when solving the EGD and CAD problems. Furthermore, the experiential learning theory was important to this study as the students used their experiences of EGD, the use of CAD and instructions on the LMSs the Depot™ and eFundi™ to solve problems concerning the practical assessment task (PAT) and mechanical assembly drawings.

Engineering Graphics and Design

For many years, people have been communicating ideas to express themselves, and present information with the use of images and drawings and different societies used different methods to communicate; therefore, a generic method was needed to communicate with drawings worldwide (Goetsch, Rickman & Chalk 2016; Morling 2010). In South Africa, it is known as EGD, as described by Department of Basic Education (2005):

> Engineering Graphics and Design integrates the cognitive and manipulative skills that are used to design and communicate graphically. The subject combines lines and symbols to render services and design processes and systems that contribute to economic growth and enhanced quality of life. (p. 9)

The Department of Basic Education (2011) furthermore defined EGD as:

> Engineering Graphics and Design teaches internationally acknowledged principles that have both academic and technical applications. The emphasis in EGD is on teaching specific basic knowledge and various drawing techniques and skills so that the EGD learners will be able to interpret and produce drawings within the contexts of Mechanical Technology, Civil Technology and Electrical Technology. (p. 8)

Engineering Graphics and Design, therefore, relies on drawings as a means of communication on a universal level in the engineering drawing world, where without speaking a word, crucial information with regard to Mechanical, Civil and Electrical can be communicated through the use of drawings. Draughtspeople had to rely on 'traditional' drawing equipment for many years, such as a drawing board, T-square, triangles, compasses, rulers, pencils and so forth to communicate on a graphic level (Joelson 2011). Currently, our world has become one where computers are used to solve many problems quickly and accurately; in the engineering drawing world, it has largely been accelerated and computerised through the use of different CAD software (Goetsch et al. 2016; Morling 2010). Computer-aided design plays an integral role in communicating ideas and designs with its drawings; CAD is used during the engineering design process, where problem-solving is used to design and evaluate the entire problem-solving process in EGD.

The role of ICT in education may be seen as a method to equip educators and students with the necessary 21st-century skills, such as the opportunity to be part of an online community of practice with access to online content, making the learning process more student-focused, enabling self-learning and discovery and promoting critical thinking and problem-solving skills (Meyer & Gent 2016; Muhammad 2019; Valtonen et al. 2021). Computer-aided design furthermore relates to advanced ICTs, such as 3D CAD and 3D printing. These advanced ICTs are used to create prototypes in the final stage of the engineering design process to test whether the design will work (Rozmus et al. 2020). The Department of Basic Education (2011) declared that CAD plays an integral role and is mandatory in EGD when implementing the PAT, whose primary purpose is to apply the engineering design process to a relevant problem and give students the opportunity to solve it through the application of the engineering design process and through the application of 2D CAD and 3D CAD drawings. The abbreviation 'PAT' was used throughout the study to familiarise student educators with the terminology used in schools, as the main focus was not on assessment from the student educators but on the engineering design process to solve problems in EGD. The engineering design process is, therefore, designed to create an opportunity for students to develop the abilities to integrate and apply critical thinking, innovative thinking, creative thinking and problem-solving skills in an environment with access to a broader spectrum of resources. The engineering design process contributes to students' ability to demonstrate the acquired levels of 21st-century EGD, CAD and problem-solving skills (DBE 2011).

Blended learning

According to Alammary, Sheard and Carbone (2014), BL is not seen as new terminology; it has been in use for more than two decades, and different definitions and meanings of BL have been developed; the absence of a single definition leads educators to understand BL in different ways and guide them through designing and developing teaching courses in their own understanding of the concept. Krause (2007, cited in Balfour et al. 2015) defined BL as:

> Blended learning is realised in teaching and learning environments where there is an effective integration of different modes of delivery, models of teaching styles of learning as result of adopting a strategic and systematic approach to the use of technology combine with the best features of face-to-face interaction. (p. 4)

Blended learning can, therefore, be seen as the planned integration of the normal F2F classroom experience with computer-mediated and online learning that require the combined presence of the educator and students (Garrison & Kanuka 2004; Graham 2006). In this chapter, BL, therefore, refers to a combination of F2F, e-systems and ICTs. For the educator to implement BL successfully, the educator has to review their teaching approach to enhance the teaching and learning experience; this accentuates the educator's role of being a facilitator of learning rather than the main source of knowledge (Kai 2019). The educator now has the role of implementing BL in the classroom that should accommodate students with different educational needs and help them succeed to enhance their own academic success (Medina 2018). Most learning today is seen as BL, and typical learning activities used are a combination of live learning and SDL, which is supported by ICTs (Hofmann 2018).

Self-directed learning

Researchers and scholars around the world depend on different concepts and definitions for understanding the essence of SDL (Van der Walt 2019). Knowles (1975), who is often considered the founder of SDL, explained SDL in its broadest meaning as:

> A process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

Garrison (1997) furthermore described SDL as:

> An approach where learners are motivated to assume personal responsibility and collaborative control of the cognitive (self-monitoring) and contextual (self-management) processes in constructing and confirming meaningful and worthwhile learning outcomes. (p. 18)

Candy (2004) suggested that the phenomenon of SDL is very old and that it was and still is the main approach in which most individuals learn what they need or require to know before the appearance of any formal educational systems. Stewart (2007) recommended that SDL is an ongoing process and that educational systems such as schools and universities should adapt and develop lifelong learning perspectives to prepare students to engage in different SDL processes. This will entail transferring the responsibility of the learning process from the educator to the student to a more shared learning process (Merriam & Baumgartner 2020). Grow (1991) suggested that the educator is responsible for directing students from the traditional method of learning to better self-directed methods. Therefore, it is important to distinguish between the skills students obtain during SDL and the responsibilities of the educator to enhance SDL skills amongst students.

Educator's role in self-directed learning

It is possible for educators to lead students to SDL when they progressively aim to develop a more advanced learning environment without discouraging the student with too difficult tasks or activities; there should be progression in the development of activities without students' knowledge (Gillies 2007; Grow 1991). This correlates with Knowles (1975), who believed that the key role of an educator should be to act as a facilitator of learning instead of the main source of knowledge for students, and educators should rather observe students' progress during teaching and adapt students' learning in such a way that they learn without knowing it. The notion of the educator's primary purpose in teaching should be to facilitate learning through a diverse set of teaching and learning resources, adapt teaching to peer learning and encourage constructive interaction; in essence, this establishes the importance of the educators' responsibilities to enhance SDL amongst students (Grow 1991; Hiemstra & Brockett 2012). The importance of the educator who prepares students in fostering SDL should not be discarded as it not only guides students to direct and manage their own learning but also describes to students what is expected from them from the educator's side (Oswald 2003; Thornton 2010). The educator should also apply and facilitate different teaching pedagogies and teaching strategies in the teaching environment, which plays a part in engaging students in SDL whilst also keeping in mind that students' attitudes and behaviours in the classroom atmosphere may differ and that the teaching practice should be adopted accordingly (Francom 2009; Grow 1991; Kidane, Roebertsen & Van der Vleuten 2020). Educators in higher education are faced with the challenging task of designing and developing suitable curricula that enhances SDL (Nasri 2019).

Self-directed learning and the student

The educational benefits of SDL skills are numerous, and SDL must be implemented in education to ensure that students are committed to taking responsibility for their own learning and being actively involved in the learning process in order to acquire problem-solving and critical thinking skills, which occurs when students are self-directed to learn for themselves by their demands to solve authentic or personally meaningful problems (Heikkilä & Lonka 2006; Robertson 2010). Knowles (1975) classified different competencies that are required by a self-directed student: the student should relate to peers in group work and see them as a source of information to identify different learning needs and be able to convert these learning needs into learning objectives which will assist in solving these needs in a realistic way with the help of the educator and peers. Additionally, students should associate the educator as the facilitator of learning and not the primary source of knowledge;

therefore, students should be creative in selecting their own learning resources and methods to obtain new knowledge. The self-directed student should be capable of collecting, demonstrate and validate these learning resources with their different learning objectives in mind. Dweck (2008) and Cazan and Schiopca (2014) indicated that the perspective in which students approach learning is importantly influenced by the students' own personality characteristics; SDL characteristics are not preset but can be developed with different exercises. Dynan, Cate and Rhee (2008) portrayed that students should have the ability to determine, identify and explain different solutions for real-world problems to engage in SDL. Finally, SDL is seen as a method to enhance the way in which individuals learn and can be reduced, restored and further developed (Guglielmino 1977).

Self-directed learning with technology

With accelerated changes in globalisation and technological progression worldwide, it is repeatedly debated that SDL is an important skill to survive in the 21st century. Countries worldwide are committed to changing their education practices to prepare future citizens as self-directed students who solve problems and reflect and take responsibility for their own learning (Chen, Chen & Tsai 2021). There is a relationship between SDL and technology; the use of technologies may have an impact on SDL as the student now has access to a vast range of information resources and online expertise; students access a wide and unlimited range of information for their learning needs that will enable them to collect, demonstrate and validate different learning objectives that are important to SDL. The use of ICT incorporates the capturing, storing, manipulating and displaying of information to solve problems and gives students the opportunity to make contact with fellow students and experts in their specific field of study around the world at the press of a button (Bonk et al. 2015; Caravello et al. 2015; Teo et al. 2010). Studies done by Teo et al. (2010), Dawson et al. (2012), Rashid and Asghar (2016), and Khalid, Bashir and Amin (2020) indicated that ICTs and SDL have a strong relationship and that the use of ICT promoted SDL skills. SDL with technology refers to the use of different ICTs for the purpose of teaching and learning that supports students in taking responsibility for the planning, implementation and evaluation of their own learning processes (Lee et al. 2014; Sumuer 2018). At the time of the study, different SDL measurement tools were developed over the years; however, only one included technology as an element in supporting SDL, the SDLTS developed by Teo et al. in 2010 (Demir & Yurdugül 2013; Demir et al. 2014; Sumuer 2018). Thus, to fill the gap in the literature, the SDLTS was adapted with EGD in mind. The SDLTS intends to determine the self-management and intentional learning skills of students whilst using ICTs.

Self-management and intentional learning

Garrison (1997) described that self-management is concerned with controlling and managing external activities in such a way that it may have an impact on the learning process, adopting learning objectives, managing resources and taking responsibility for students' own learning to achieve learning objectives.

Costa and Kallick (2004) believed that self-management is the students' commitment and willingness to engage in external learning activities with the understanding that they will achieve if they take control of their own learning process regarding enacting the learning goals and managing their learning resources and support. These activities should constantly be assessed and negotiated by the student with achievement in mind (Zhu, Bonk & Doo 2020).

Intentional learning has been part of education for years, and the term is used across multiple disciplines, although there is no uniform definition of intentional learning (Mollman & Candella 2018). During a concept analysis of intentional learning, Mollman and Candella (2018) defined intentional learning as:

> [*A*] process used by learners to gain the abilities to self-direct, self-regulate, and actively engage in learning, which enables them to master their goals. Through this process, learners become intrinsically motivated and confident in their ability to learn, which builds the foundation for intentional learning competence, including being lifelong learners. (p. 108)

In essence, it seems that self-management and intentional learning are interdependent on each other; for the sake of the study, Teo et al.'s (2010) description of self-management and intentional learning will be used as a reference. Self-management was described as the students' ability and willingness to manage their own learning, whilst intentional learning was seen as the students' own consent to thoroughly reach and acquire information (Demir & Yurdugül 2013).

Methods of instruction

Teaching strategies can be seen as a method of instruction during contact sessions with specific objectives in mind (Orlich et al. 2012). The specific objectives in mind were to determine methods of instruction that will get the student actively involved in the learning process whilst obtaining problem-solving and critical thinking skills whilst relating to peers as a source of information and seeing the educator as the facilitator of learning and not the main source of knowledge. Integrating ICTs with teaching, problem-solving and collaborative group work were chosen as methods of instruction.

Integrating information communication technologies

The use of ICTs worldwide is fast-increasing and has progressed over the last 20 years; the ever-changing progress of technologies and advanced methods to support SDL are continuously developed; whilst institutions embrace SDL and use it in their learning approaches, ICTs will keep on developing (Sharpe & Kelley 2014). In addition, ICTs assist educators in offering students an effective and deep learning experience that enhances students' problem-solving skills whilst building content knowledge efficiently (Mahmud et al. 2018; Triana, Zubainur & Bahrun 2019). The following ICTs will be used in this study:

Learning management systems

Learning management systems are described as software applications on an e-learning platform that is beneficial in organising, presenting, tracking, reporting, administration and facilitating digital content in education courses (Agaci 2017). LMSs are seen as a valuable tool for students, as it is a system where module information is organised, and the student has access to it anywhere and at any time as long as they have Internet access, and educators can easily see what students' progress is in the online environment. A link can be made between students' usage of LMS and the grades they achieve (Arenas-Gaitán, Rondán-Cataluña & Ramírez-Correa 2018; Cheng & Yuen 2018; Kvon et al. 2018). Amandu, Muliira and Fronda (2013) believed that LMS could be used to successfully promote, motivate and sustain SDL amongst students. During this study, the following LMSs will be used to make content available for EGD students: eFundi™ and the Depot™.

3D modelling

Bower et al. (2018) described 3D modelling as modelling done in 3D CAD and with 3D printers. They furthermore found that these ICTs enhanced students' creativity and critical thinking skills. Liu et al. (2020) found that the use of 3D modelling in education has the ability to foster SDL skills amongst students as 3D modelling with the engineering design process fosters critical thinking skills and problem-solving skills. During this study, CAD and 3D printing were used as ICTs. Computer-aided design is a software that is effectively used for drawing, drafting, designing, developing, modelling and manufacturing various components in the engineering drawing fields (Sharma & Dumpala 2015). 3D printing is an ICT that is capable of joining material layer by layer through a series of cross-sectional layers to create a 3D model. 3D printers can support innovative ways of new learning experiences for students through the engineering design process, making and solving authentic problems (Trust & Maloy 2017; Wohlers & Gornet 2014).

Problem-solving

Problem-solving is the process of finding a solution to a meaningful real-world problem, the process steps including:

- identifying and defining the problem
- formulating a strategy
- allocating and organising relevant information with necessary resources and guidance
- instruction to solve the problem.

Students can develop content knowledge and problem-solving skills (Biggs & Tang 2011; Sternberg, Sternberg & Mio 2012; Wilson 2018). Research has shown that problem-solving and learning in small groups can foster SDL amongst students (Kocaman, Ugur & Dicle 2009; Yuan et al. 2012).

Collaborative group work

Collaborative group work is seen as a method that encourages students to work together in an educational setting where they rely on each other for support, as they are subjected to different perceptions in solving a problem whilst working together, thus collaborative group work. During group work activities, students are in a setting where they have to use critical thinking skills to contemplate the relevant problem or learning content whilst comparing their opinions to those of their peers, the lecturer and other sources (Biggs & Tang 2011; Jacobs, Vakalisa & Gawe 2016). Kim and Yang (2020) believed that when students are working in groups, it might foster SDL as students interact with each other and exchange important information during group cohesion.

Research methodology

The study was designed to explore the use of ICTs in EGD to improve SDL skills of fourth-year EGD students in a BL environment. A quantitative design was used during the study. Data were collected through a questionnaire. The SDL with technology was measured by the SDL scale (Teo et al. 2010), which was adapted to fit the specific research context. It is a seven-item, two-factor self-report instrument using a five-point Likert scale (ranging from 1 for strongly disagree to 5 for strongly agree), measuring self-management (two items) and intentional learning (five items).

Research objectives

The main objective of this study was to discover to what extent do ICTs such as LMSs like the Depot™, eFundi™ and CAD software enhance the self-management and intentional learning skills (as SDL skills) of EGD students in a BL environment.

Participants

The research was set in a South African University in the Faculty of Education. The study was designed around an undergraduate fourth-year BEd EGD module (EGDD421). The study investigated the key research question: To what extent do ICTs such as LMSs like the Depot™, eFundi™ and CAD software enhance the self-management and intentional learning skills of EGD students in a BL environment?

Convenience sampling was used, and EGD student-teachers registered for the fourth-year module (EGDD421) were used, as they were available and accessible when the research was done. The study had approval from the school, faculty and university and involved the lecturer (researcher) and the fourth-year class of $n = 48$ registered for the module EGDD421.

Data analysis

Data were collected with the use of the SDLTS pre-test and post-test before and after the intervention (cf. 'Self-directed learning with technology scale pre-test and post-test'). Data were analysed by the Statistical Consulting Services of the North-West University with the Statistical Package for Social Sciences version 24.

Ethical consideration

Written informed consent was obtained from all EGD student-teachers involved in the study. The necessary ethical clearance (NWU-00532-17-A2) was obtained from the Faculty of Education Ethical Board and Committee and the Registrar of the University. All of the participants were informed that they had a choice as to whether they wanted to participate and had the right to withdraw from the research at any time, and the data collected would only be used with their permission.

Blended learning module design

In this section, the EGD module structure, EGD module development and implementation of the intervention of the EGD module to enhance SDL with the use of CAD and LMSs in a BL environment are discussed.

Background of the Engineering Graphics and Design module

In this study, the fourth-year BEd EGD student group of 2018 was introduced to a new practice where the use of LMSs was introduced to assist in the training of CAD in EGD. There were 48 students registered for this course. Students had contact sessions twice a week for 11 weeks.

In the current EGD module, students normally redraw and copy hand drawings in 2D CAD and in 3D CAD, and the first real knowledge and skills application of drawings were made. The LMS eFundi™, an online tool, was primarily used to upload drawings that were done in class or as homework. The use of in-depth 2D/3D CAD and LMS software such as the Depot™ enhances SDL skills. During the planning and designing phase of the intervention, the entire module had to be restructured to implement technologies such as CAD, 3D printers, LMSs and PAT in terms of students' self-directedness towards technology.

Engineering Graphics and Design module structure

Before the intervention, this module was solely based on teacher-centred facilitation; the lecturer explained the steps on CAD to create a drawing, and the online presence was only administered through LMSs such as eFundi™ to upload resources for the students. This did not adhere to strategies to improve SDL amongst students. Students furthermore focused more on doing drawings on the drawing board and not on CAD; in the four-year cycle, only one semester was allocated for the use of CAD. With the new BEd curriculum (Further Education and Teaching phase) in mind, the lecturer had to redesign the structure of the module for the implementation of the new EGD module in 2020 to enhance online presence and SDL. The following components were considered in redesigning the module in:

- contact sessions
- planning and design of intervention
- implementation of the intervention.

Contact sessions

Each contact session was carefully planned using a BL approach to improve active learning amongst students, which focused on the improvement of SDL. During these sessions, self-management and intentional learning skills and problem-solving skills were incorporated with enhancing SDL in mind. Methods of instruction such as the use of ICTs, problem-solving and collaborative group work were also integrated during the contact sessions. Students had instructional videos and subject-specific research they had to prepare, and they had theoretical online tests on the Depot™, which students had to complete before coming to class to take part in class discussion and completing the drawing activities.

Planning and designing of the intervention

During the phase of restructuring the EGD module, comprehensive and detailed planning was necessary to combine the use of CAD, LMSs, drawing activities, engineering design process and teaching strategies to enhance SDL skills in a BL environment. The intervention was planned according to the specific time allocated by the university in the second semester. The semester consisted of 11 weeks, with two contact sessions per week, which added up to 22 sessions. Box 4.1 shows the intervention design used in the study and is subsequently discussed in the next section.

BOX 4.1: Intervention design.

Intervention design		
Design principle		**Implementation guideline**
Constructive alignment of module	To constructively align a module, Biggs and Tang (2011) described that one should focus on the aims and objectives of TLAs, assessment tasks and grading	Following Biggs and Tang's (2011) guideline to constructively align a module Following a BL approach with the combination of F2F, online systems and ICTs (Friesen 2012; Garrison & Kanuka 2004; Graham 2006)
Aims & objectives		Aims and objectives guided students to know exactly what is expected from them after each lesson
Teaching-learning activities (TLAs)	Administrative aspects	When designing TLAs for the intervention, the researcher should keep the following in mind: • Method of instruction • Facilitator • ICTs • Skills
	Method of instruction	ICT Problem-solving Collaborative group work
	Facilitator of learning	Lecturer Student (self) Student (peer)
	ICTs	LMSs: eFundi™ and the Depot™ 2D CAD 3D CAD 3D printing
	Skills	ICT skills Problem-solving skills SDL skills
Assessment tasks	Assessment outcomes	Students should know what is expected from them
	Assessment strategy	Feedback should be given as soon as possible after each task
	Submission of assessment	Students should know when to submit assignments
	Assessment criteria/grading	Students should know how their assignments will be assessed/graded

Key: CAD, computer-aided design; SDL, self-directed learning; BL, blended learning; LMS, learning management system; ICT, information and communication technologies.

□ *Aims and objectives*

New aims and objectives for the intervention had to be in line with the current module outcomes of the EGD module as stated in the BEd yearbook of the faculty. The module outcomes could not be changed, and the aim of incorporating technologies in the module to foster a blending learning environment that enhances SDL skills was divided among the 22 sessions. The objectives the students should achieve at the end of a session were carefully planned.

□ *Module alignment*

Assessment activities such as theory tests, CAD drawing activities, PAT and teaching strategies that foster SDL skills and problem-solving skills were developed so that students would be able to reach the module outcomes in accordance with the regulations of the tertiary institution and be able to reach the objectives of each session.

□ *Communication of module information*

The module aims, objectives and outcomes were made available on eFundi™ so that students knew exactly what was expected from them to reach the objectives in each session and achieve the module outcomes at the end of the semester.

□ *Content of module*

The content used in any curriculum plays an important part in determining what has to be taught and how the different skills should be obtained in the learning cycle. Different resources and strategies had to be evaluated, and the availability of the resources was determined, such as ICTs used, method of instruction, development of activities and feedback to students.

□ *Information and communication technologies used:*

- **Learning management systems:** Two different LMSs were used: firstly, the institutions LMS eFundi™ (self-management) and the LMS with regard to training CAD, the Depot™ (intentional learning). The two LMSs were used for the two main purposes of enhancing students' self-management and intentional learning.
- **eFundi™:** The institution uses the LMS eFundi™, and students are normally acquainted with the use of this LMS as it is used from their first year of study. It can be argued that not all lecturers use this LMS to its full potential, and it was, therefore, advised to be the online learning tool in the new BEd curriculum that was implemented in 2018. During this study, the following tools were activated on eFundi™: Announcements (when the lecturer

needed to communicate important information to students); resources (for students to receive extra study material); assignments (where students submitted drawing activities and received their feedback); messages (for students to communicate directly with the lecturer on a more individual manner); chat room (for students to discuss EGD/CAD/PAT with each other) and statistic tool (to determine students' online participation).

- **The Depot™:** The Depot™ LMS is the official online learning tool for the CAD software used in this EGD module. The primary purpose of this LMS is for students to learn and master 2D and 3D CAD. On this LMS, the following tools were used: Sessions (sessions consisting of videos, important theory and online tests that were used for preparation for EGD classes or used as revision after classes); session assignments (where students submitted drawing activities and received their feedback) and lesson report tool (used by a student to see their overall progress when completing the sessions). All necessary resources were made available on eFundi™ and The Depot™. This assisted in moving to a paperless module when doing CAD in EGD. All of the applicable resources and assignments could be downloaded onto the students' computers, smartphones or tablets in class via free WiFi to view offline at a later stage when they might not have any Internet access. Students were furthermore encouraged to make use of other online resources to complete assignments as some aspects of the CAD and drawing activities were left out intentionally in attempting to improve SDL amongst students.
- **3D modelling:** 3D CAD software was used to complete drawing activities, and the PAT, whilst the 3D printer was used to print the prototype designed in the PATs.

☐ *Specific methods of instruction during this study*

The specific methods of instruction used during this research were using ICTs as means of instruction, problem-solving and collaborative group work.

☐ *Development of activities*

The different activities used in this module were carefully planned and designed with the following in mind: Use of CAD, use of LMSs, use of 3D printer, SDL and methods of instruction. It was furthermore important for students to know precisely what was expected from them during each session and drawing activity; all learning outcomes and assessment standards for each session were communicated during the class activity and were available on the LMSs.

☐ *Drawing activities*

Mechanical assembly drawing activities were designed to test the theory of mechanical drawings, converting the question in 2D CAD (Figure 4.1) to a 3D

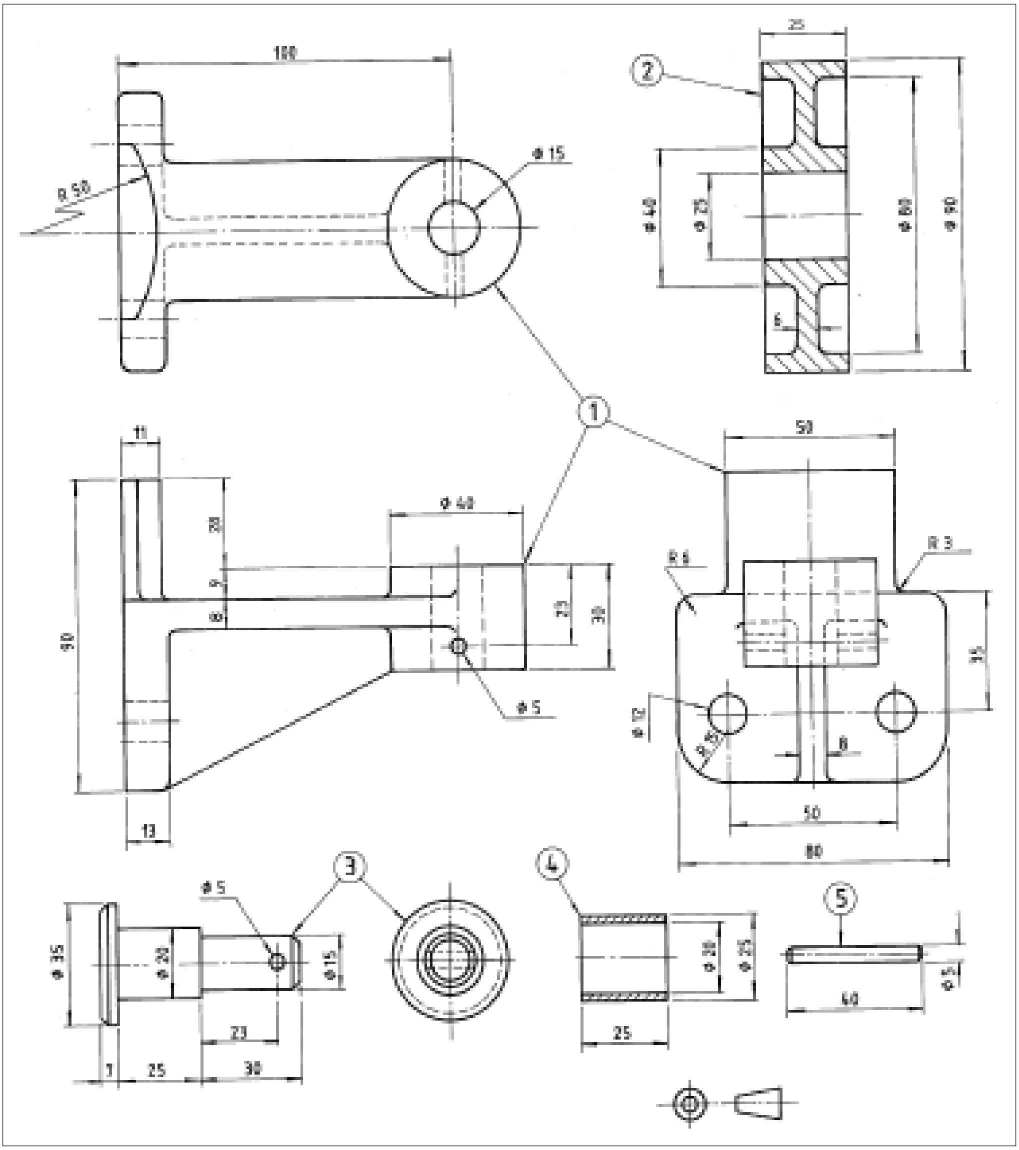


FIGURE 4.1: 2D drawing.

CAD drawing (Figure 4.2), testing 3D printer skills (Figure 4.3) and also testing the mechanical drawing theory, CAD functions and theory of CAD.

Figure 4.1 and Figure 4.2 show the progression and skills obtained during the drawing activity to use an ICT technology CAD and move from a 2D drawing to a 3D drawing. Figure 4.3 shows the final stage of the activity, where a 3D printer was used to create the prototype, and students were then able to test the functionality of the model with regard to design, tolerance, movement and friction.

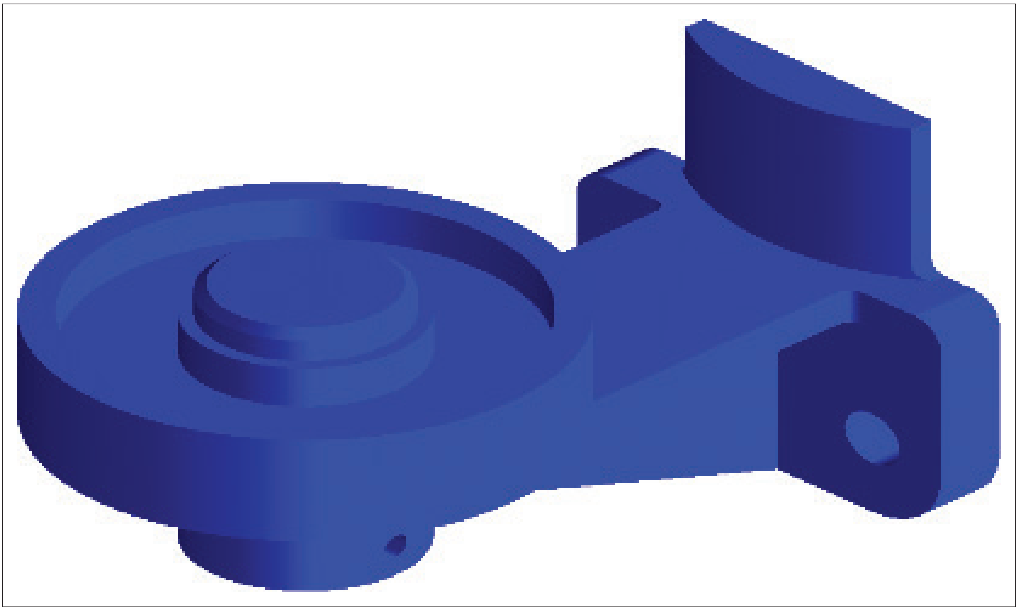
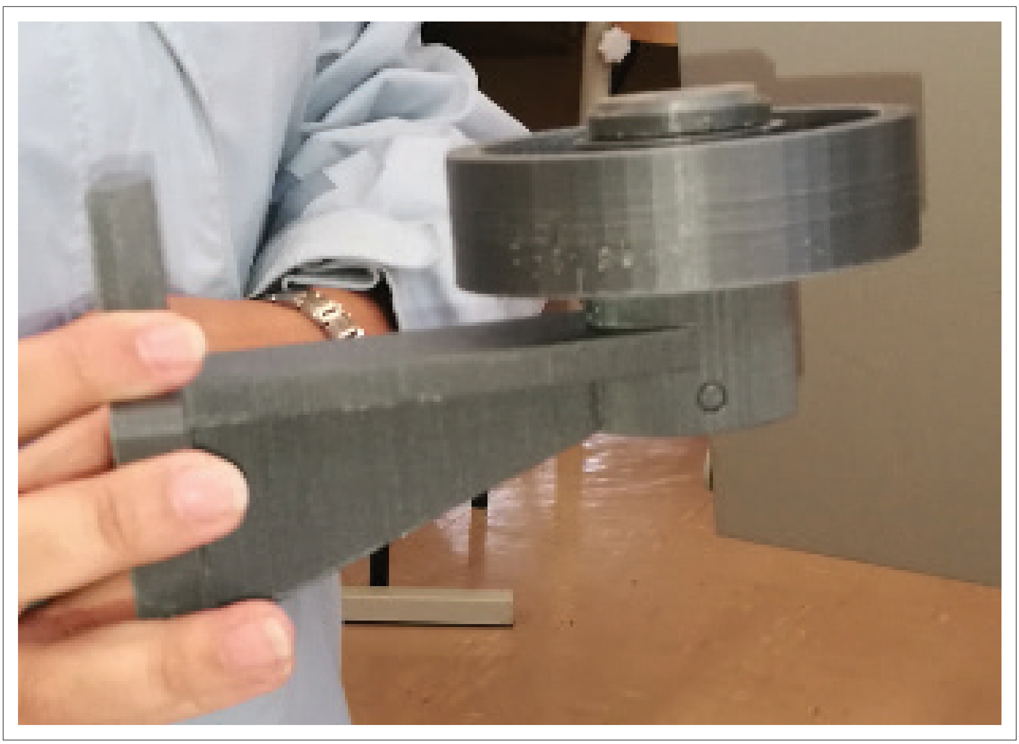


FIGURE 4.2: 3D drawing.



Source: Photograph taken by Albert Kemp, exact date and location unspecified, published with permission from Albert Kemp.

FIGURE 4.3: 3D printed model.

☐ *Practical assessment task:*

The PAT used was designed with a specific problem in mind, which students had to solve with the use of the engineering design process. The assignment was structured with SDL skills and problem-solving skills in mind; students had to do research to generate different ideas to solve the problem and practice new CAD skills to draw the final solution in 3D CAD and print the final solution with a 3D printer. PAT was given to the students, and each scenario and phase were explained and discussed; students then had to use the engineering design process steps to solve the problem (DBE 2011):

- problem identification and the formulation of a design brief with a list of specifications and or constraints (Internet, eFundi™ and the Depot™)
- conducting research and generating graphical ideas and concepts (Internet, eFundi™ and the Depot™)
- selecting the best solution within the context of specifications and constraints (2D CAD Internet, eFundi™ and the Depot™)
- presenting the final solution with working drawings (3D drawings)
- evaluation of the whole process (3D-printed prototype).

Students worked in groups and received the PAT (one of the assignments done during the intervention) with the following limited details:

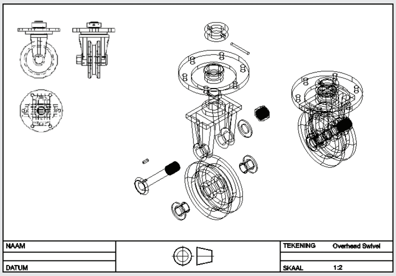
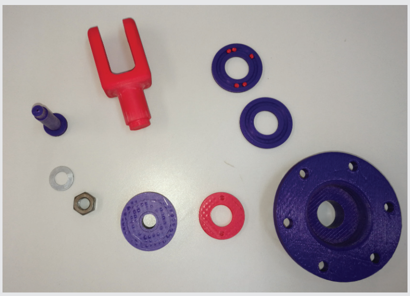
- **Problem:** There is a need for a basic mechanical pulley system in the mechanical workshop to hoist moderate-weight items.
- **Instruction:** Design a turning pulley system that should be in a fixed position and be able to swivel 360°. The pulley system should consist of the following minimum items: support piece, T-piece, pulley, lock plate, bearing, bush, bolt and nut. Determine that material should be viable with regard to material strength and friction between parts.

Box 4.2 shows the final solution for the problem set in the PAT. It also shows who facilitated the learning, which method of instruction was used, what technologies were used and which possible skills were obtained during the assignment.

☐ *Feedback to students*

Feedback with regard to drawing activities, PAT and progression in the use of CAD was given on a weekly basis on the LMSs and during the class activities. This also assisted students to understand the EGD and CAD theory better and to improve in the next activities.

BOX 4.2: Students' solution to problem.

<table>
<tr><th>PAT</th><th>Facilitator</th><th>Method of instruction</th></tr>
<tr><td rowspan="3">
</td><td>Lecturer</td><td>ICTs
Problem-solving
Group work</td></tr>
<tr><td colspan="2">Possible skills attained:</td></tr>
<tr><td colspan="2">CAD skills
ICT skills
SDL skills</td></tr>
<tr><td colspan="3">Technologies used: LMSs, CAD, 3D printer</td></tr>
<tr><td></td><td colspan="2"></td></tr>
</table>

Key: SDL, Self-directed learning; LMS, learning management system; ICTs, Information and Communication Technologies.

Implementation of intervention

Table 4.1 shows the intervention that took place in the EGD classroom in the 11 weeks of Semester 2. During the first lesson, students had to write the SDLTS pre-test to determine students' self-management and intentional learning skills. During Weeks 1–6, students had to work through Sessions 1–10 to master the 3D CAD software; before each session, students had instructional videos they had to watch before coming to class, and after the class sessions, students had to complete the theoretical tests on the depot to test the knowledge obtained during the sessions. The different ICTs used during the sessions are also indicated, and the possible SDL skills and problem-solving skills are obtained. For the rest of the semester, Weeks 6–7 show that students had to draw isometric drawings where the 3D CAD skills, EGD skills, CAD theory and EGD theory obtained during Sessions 1–10 were

TABLE 4.1: Implementation of intervention.

Week	Teaching-learning activities	Facilitator of learning	ICTs	SDL skills	Problem-solving skills
1	Pre-test SDLTS	Lecturer	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
	Session 1	Lecturer			
2	Session 2	Lecturer	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
	Session 3	Peer/Group	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
3	Session 4	Peer/Group	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
	Session 5	Self	LMSs/3D CAD	SDL skills	Problem-solving skills
4	Session 6	Self	LMSs/3D CAD	SDL skills	Problem-solving skills
	Session 7	Self	LMSs/3D CAD	SDL skills	Problem-solving skills
5	Session 8	Self	LMSs/3D CAD	SDL skills	Problem-solving skills
	Session 9	Self	LMSs/3D CAD	SDL skills	Problem-solving skills
6	Session 10	Self	LMSs/3D CAD	SDL skills	Problem-solving skills
	Isometric 1	Lecturer	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
7	Isometric 2/3	Self	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
	Mechanical assembly 1	Lecturer	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
8	Mechanical assembly 2	Self	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
	PAT 1	Peer/Group	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
9	PAT 2	Peer/Group	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
				SDL skills	Problem-solving skills
10	PAT 3	Peer/Group	LMSs/3D CAD/3D Printer	SDL skills	Problem-solving skills
				SDL skills	Problem-solving skills
11	Post-test SDLTS			SDL skills	Problem-solving skills

Key: CAD, computer-aided design; ICTs, information and communication technologies; SDL, self-directed learning; LMSs learning management systems.

used to complete the new activities. This is seen as the progression from learning the 3D CAD software to implementing 3D CAD to completing the isometric drawings, which consist of only one component that needs to be drawn. Students from the rest of Weeks 7–8 had to use knowledge and skills obtained from Weeks 1–7 to complete the mechanical assembly drawings, where students had to draw die of different components and assemble them at the end; students' drawings now progressed from one single component being drawn to more components, which had to be assembled.

☐ *Observations made during the intervention*

Researchers observed that students tend to ask fewer questions when the lecturer facilitated the teaching-learning activities (TLAs) (Sessions 1–2); during the collaborative group work, students helped each other and asked fewer questions (Sessions 3–4). During Sessions 5–6, where students had to take responsibility for their own learning, there were more questions from the students, but during Sessions 7–10, the students' questions became less. The assumption can be made that students now understand that they should be more responsible for their own learning and that they are capable of working on their own and taking control of their own learning. During the isometric and mechanical assembly drawings, few questions were asked as students now had the capabilities to use CAD and the 3D printers on their own, and the type of drawings tested was known to them. Students knew exactly what was expected of them during the three PATs and assisted each other, and did their own research to solve the problems during collaborative group work. These observations were confirmed during the data analysis of the SDLTS pre-test and post-test.

Table 4.1 shows that from the last lesson in Weeks 8–11, students received specific engineering design process assignments, where students had to identify a specific problem, formulate different solutions to the problem with the design brief and specifications in mind and choose the best solution, design it in 3D CAD and lastly print a scale model of the design, and the model was printed and evaluated to see whether it was a viable solution. During the last lesson, students completed the SDLTS questionnaire as a post-test to determine whether their self-management and intentional learning skills improved during the intervention.

Data collection and analysis

Results of quantitative data

Self-directed learning with technology scale pre-test and post-test

Participants were given a pre-test to determine their SDL technology skills before the intervention and a post-test to determine whether there was an improvement in their SDL technology skills after the intervention. The adapted SDLTS was developed to determine whether students had self-management and intentional learning skills. Questions 1 and 2 determined the students' self-management skills, and Questions 3–7 focused on their intentional learning skills.

In Table 4.2, the results of the pre-test and the post-test are compared to determine how the students completed the questionnaire before and after the intervention.

Reliability of self-directed learning skills

To determine the reliability of the data analysis to establish the self-management SDL skills and intentional learning SDL skills the students were supposed to have obtained after the intervention had been implemented, the Cronbach's alpha test was used. When the statistical data were compared, the self-management SDL skill in Questions 1 and 2 was not a reliable value.

TABLE 4.2: Summary of results of the pre-test and the post-test of the adapted SDLTS.

Questionnaire		SDL skills	Pre-test						Post-test					
			Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)	Total (%)	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)	Total (%)
Q1	I go online to ask my lecturer questions on my EGD lessons when I am not in class	Self-management	20.8	22.9	29.2	18.8	8.3	100	10.4	4.2	31.3	35.4	18.8	100
Q2	I use the computer to share my thoughts and ideas about my EGD classwork (e.g. through multimedia, The Depot™, eFundi™)		10.4	16.7	29.2	25.0	18.8	100	0	6.3	18.8	41.7	33.3	100
Q3	I get more information on the Internet to help me understand my EGD lessons better		4.2	16.7	22.9	35.4	20.8	100	4.2	4.2	14.6	39.6	37.5	100
Q4	I use the computer to work with information for my EGD learning	Intentional learning	0	6.3	14.6	39.6	39.6	100	0	0	4.2	33.3	62.5	100
Q5	I practise skills that I learnt in class through drawing on CAD		0	4.2	16.7	43.8	35.4	100	0	0	6.3	25.0	68.8	100
Q6	I use the computer to become better at a skill that I am interested in (e.g. drawing skills)		4.2	0	22.9	47.9	25.0	100	0	2.1	10.4	16.7	70.8	100
Q7	I use the computer to get ideas from different websites and people to learn more about a topic		4.2	12.5	27.1	43.8	12.5	100	0	6.3	14.6	29.2	50.0	100

Key: EGD, Engineering Graphics and Design; SDL, self-directed learning; SDLTS, SDL with Technology Scale.

Table 4.3 shows the reliability of the self-management SDL skill determined with Cronbach's alpha test.

From Table 4.3, the assumption can be made that the reason for the negative value may be that the participants did not understand the questions. For Question 1, it may be because students normally attend class and do not need to go online to ask the lecturer any questions, or they might have relied on their peers for assistance. For Question 2, it may be that students do not really make use of The Depot™ and eFundi™ to share their thoughts and ideas about EGD, as they usually do this during class discussions and with the use of their own EGD WhatsApp group.

Table 4.4 shows that when Cronbach's alpha test was done on the data of Questions 3 to 7, the data were positive and therefore are seen as reliable. Thus, the intentional learning skills could render an effect size in Table 4.5.

In Table 4.4, the data for Questions 3–7, which determined the participants' intentional learning skills, were reliable. Table 4.5 shows the results from the paired *t*-tests for both the pre-test and the post-test for individual questions and for intentional learning skills.

☐ Effect sizes of self-directed learning skills

Table 4.5 shows the effect sizes of paired sample tests. As Table 4.3 indicated that the data for Questions 1 and 2 that should have tested students' self-management skills were not reliable according to Cronbach's alpha internal consistency coefficient; therefore, the effect size for the pre-test and post-test for Questions 1 and 2 were not calculated.

As shown in Table 4.5, the Cronbach's alpha internal consistency coefficient for the five questions, which tested students' intentional learning skills, was reliable; therefore, Questions 3–7 can be discussed in terms of effect sizes. Question 3 had an effect size of 0.44, which still is seen as an average effect

TABLE 4.3: Reliability of self-management self-directed learning skill.

Reliability statistics	Result
Cronbach's alpha	–0.13
Cronbach's alpha based on standardised items	–0.13
Number of items	2

TABLE 4.4: Reliability of intentional learning self-directed learning skill.

Reliability statistics	Result
Cronbach's alpha	0.78
Cronbach's alpha, based on standardised items	0.79
Number of items	5

TABLE 4.5: Paired sample statistics for pre-test and post-test of the adapted self-directed learning with technology scale.

Pair number	Question	Paired samples statistics			
		Mean	*n*	SD	Effect size
Pair 1 (Q1 & P1)	I go online to ask my lecturer questions on my EGD lessons when I am not in class	2.71 3.48	48 48	1.24 1.17	0.62**
Pair 2 (Q2 & P2)	I use the computer to share my thoughts and ideas about my EGD classwork (e.g. through multimedia, The Depot™, eFundi™)	3.25 4.02	48 48	1.25 0.89	0.62**
Pair 3 (Q3 & P3)	I get more information on the Internet to help me understand my EGD lessons better	3.52 4.02	48 48	1.13 1.04	0.44*
Pair 4 (Q4 & P4)	I use the computer to work with information for my EGD learning	4.13 4.58	48 48	0.89 0.58	0.51**
Pair 5 (Q5 & P5)	I practise skills that I learnt in class through drawing on CAD	4.10 4.63	48 48	0.83 0.61	0.63**
Pair 6 (Q6 & P6)	I use the computer to become better at a skill that I am interested in (e.g. drawing skills)	3.90 4.56	48 48	0.93 0.77	0.72**
Pair 7 (Q7 & P7)	I use the computer to get ideas from different websites and people to learn more about a topic	3.48 4.23	48 48	1.01 0.93	0.74**
Pair 8	Intentional learning pretest Intentional learning post-test	3.83 4.40	48 48	0.70 0.51	0.82***

Key: CAD, computer-aided design; EGD, Engineering Graphics and Design; *n*, numerical value SD, standard deviation.
Effect size: small effect* (0.2), medium effect** (0.5) and large effect*** (0.8).

size and shows that the participants' view on using the Internet to do research to understand difficult EGD drawings better was average. Question 4 had an effect size of 0.51. This relates to a medium practical significance that shows that the students used computers to work with the different EGD information, such as CAD. For Question 5, which shows that participants practised the CAD skills they learnt in class, the effect size was 0.63. This is a medium effect, which shows that there was a practically visible difference. Question 6, which determined whether the participants used the computer to improve their CAD skills because they were interested in CAD, had an effect size of 0.72; this can be seen as a large effect that was practically significant. Question 7, which determined whether the participants made use of the computer to do research on different websites to learn more about specific topics in EGD, had an effect size of 0.74; this can also be seen as a large effect, and therefore, there was a practically significant difference between the pre-test and the post-test. The most important effect size was the intentional learning of the students through Questions 3–7, which had an effect size of 0.82. This is a large effect that shows that there was a significant difference between the participants' intentional learning before and after the intervention.

Discussion of findings

Self-management skill

The self-management skill was rendered not reliable in Table 4.3 when Cronbach's alpha was calculated.

Reasons for this might be that participants misinterpreted, did not understand or relate to the specific questions; participants might not have had the opportunity to apply what was expected from them; during the larger study, participants had ample opportunity to direct questions to the researcher during F2F classes or participants asked questions to peers during group work and did not need to ask questions online when not in class or share thoughts and ideas through multimedia. The SDLTS instrument has been tested, validated and found reliable in other countries from secondary school level to tertiary level (Demir & Yurdugül 2013; Sumuer 2018).

Intentional learning skills

Table 4.5 shows that the results from Cronbach's alpha test calculated that the intentional learning skills that the participants had to acquire throughout the intervention were reliable. The effect size of the intentional learning pre-test and the post-test is practically significant as it has a large effect of 0.82. Thus, the intentional learning skills of participants were enhanced during the intervention. The conclusion can be made that the use of technologies had improved the participants' intentional learning as an SDL skill.

Limitations

The limitations identified in the study after the conceptual and theoretical framework, the intervention and the analysis of the data were taken into consideration and are discussed in the following paragraph.

Not much research has been done in the field of EGD education in South Africa at the secondary school and tertiary level; most of the literature used was obtained in the engineering research fields relevant to the drawings they use. EGD is a niche research area in education, and more research should be done in this area. The intervention was implemented in 11 weeks, and without any extra technologies used or the implementation of different teaching strategies, the EGD module is time-consuming as the students have to obtain the relevant CAD knowledge and skills in 2D/3D CAD before they can apply this new knowledge and skills in EGD too. Furthermore, the small population of participants (n = 48) might not represent the majority of the EGD students in the Further Education and Training sector. Finally, another limitation that was observed throughout the study is that whilst students' SDL skills (specifically their intentional learning skills) did improve, improvement in their self-management skills could not be verified as the Cronbach's alpha had a negative value. It seems as if the students did not understand the question as intended.

Recommendations for future research

If possible, it would be more beneficial if the implementation of advanced ICTs could be conducted over a longer period, not only in one semester, as EGD modules on secondary and tertiary levels have different topics that students should complete in the four-year cycle. Difficult drawing topics in EGD should be researched, and the implementation of SDL and problem-solving should be researched to help students understand these topics better. There are still many advanced ICTs that may lead to the improvement of SDL and drawing skills amongst students that could be tested, such as the use of 3D scanning, laser cutting and 3D animation. Research could be done to determine whether there is a difference in understanding of EGD according to gender, as it has been suggested that male students tend to do better in EGD than female students; this should also be done with regard to obtaining SDL skills in EGD. The SDLTS questionnaire could be used in EGD modules during COVID-19 to determine SDL skills in a solely online mode of teaching. A more in-depth SDLTS questionnaire could be developed for specific EGD technologies.

Conclusion

In the context of this study, SDLTS developed by Teo et al. (2010) was adapted for technologies used in EGD. The study was intended to examine students' self-management and intentional learning skills. The findings of the quantitative data revealed that students' intentional learning skills improved with an effect size of 0.82, which can be seen as practically significant as it has a large effect. Unfortunately, the self-management skill measurements were rendered unreliable, and data could not be used. Implementing the engineering process with a PAT activity takes more time for students to complete, but more skills and technologies are implemented in the learning process. Box 4.1–Table 4.5 may be used as a guideline to foster intentional learning skills in EGD whilst using ICTs in a BL environment. The research done in this study had an effect on how the new EGD modules were developed in a BL environment with the focus on F2F, computer-mediated and online learning whilst enhancing SDL skills.

Chapter 5

Blended learning as a catalyst for self-directed learning in universities amid the COVID-19 pandemic: Fourth-year students' experiences

Mncedisi C. Maphalala
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Mahikeng, South Africa

Sfiso C. Mahlaba
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Mahikeng, South Africa

Abstract

The outbreak of the COVID-19 pandemic at the beginning of the year 2020 led universities to transform to online teaching and learning to ensure the continuity of academic activities. With the relaxation of the lockdown rules,

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some students, including fourth-year students, were allowed to return to campus to engage in BL. Therefore, this study explored fourth-year Bachelor of Education students' SDL perspectives after engaging in the continuing BL environment at a South African university. The study followed the qualitative approach to employing the focus group method using thematic analysis. A virtual focus group discussion was conducted with 10 participants from a particular university in South Africa. The findings from this study indicate that students faced challenges with the digital divide and the non-conducive home environment for learning when they were learning through online platforms only. However, after the F2F component of BL was introduced, these challenges were alleviated, and students began to develop SDL characteristics and skills such as taking responsibility for their learning, identifying learning goals and learning strategies to achieve these goals. Students also developed SDL skills such as critical thinking, collaboration and problem-solving skills. Implications of this study are discussed, and conclusions are reached. We also discuss the limitations and contribution of this study to literature on BL and SDL and recommendations for future research.

Introduction

Normally, teaching and learning in South African universities are conducted F2F[2] with some communications, tests and assignments conducted online. Students would attend their classes in a lecture hall, and their lecturer would come and address them about the module content; they would ask questions and be answered F2F. Along with it, students would write their formal assessments in a controlled sit-down venue that professional invigilators invigilate to limit cheating. Students with laboratory work would go to laboratories and perform their experiments with real chemicals or pulleys whilst supervised by their lecturer. This normality of South African education in universities was disturbed by the rapid spread of a respiratory system-related disease named SARS-Cov-2 (COVID-19). The spread of this disease disturbed teaching and learning activities in universities and other sectors of human lives worldwide (Godber & Atkins 2021; Maphalala, Khumalo & Khumalo 2021).

The COVID-19 pandemic induced lockdowns in a plethora of countries around the globe; universities were closed down, and students and lecturers were told to quarantine within their homes. The situation caused teaching and learning activities to be halted whilst management mitigated a way forward to continue teaching and learning. Remote and online teaching and learning was the best solution (Mahlaba 2020). Remote learning is used in this study to represent the shift from traditional F2F learning into teaching and learning that occurs in an online environment in remote areas, and this shift was an

2. With the exception of the University of South Africa (UNISA) that focuses on distance education.

emergency one because it was unplanned and arose as a result of the COVID-19 pandemic (Khlaif, Salha & Kouraichi 2021). This emergency remote teaching and learning utilised e-learning technologies to ensure that teaching and learning activities were not disrupted during the COVID-19 pandemic.[3] This demonstrated clearly to most people that the advances in technology that have been flooding the education industry are not only significant but necessary for mitigation. The COVID-19 pandemic has revealed to the education industry that technology is one of the most important artefacts that can be utilised for teaching and learning. In fact, most institutions of higher learning depend and are still depending on technology to continue the activities of teaching and learning (Motala & Menon 2020). During this time, lecturers relied on Google meet, Zoom and LMSs to communicate with their students and continue teaching and learning activities.

Upon the ease of the lockdown restrictions, some students were allowed to return to their campuses for limited contact sessions and practical sessions; for instance, the University of KwaZulu-Natal confirmed, in the Communique of 07 June 2020, a return to campus under Level 3 Lockdown. Amongst these students were final-year undergraduate students in laboratory-based programmes who returned on track to complete their degrees in the 2020 academic year.[4] On 11 September 2020, the Vice-Chancellor of the University of Cape Town announced that in September 2020, under alert Level 2, a further 3100 students had been approved for return to campus, including final-year medical students.[5]

Most of the teaching and learning activities were still occurring in an online environment. However, some activities were conducted F2F with strict adherence to the COVID-19 regulations. This symbolised a move towards BL, a teaching and learning approach that fuses online teaching and learning with F2F teaching and learning (Hrastinski 2019). Most universities prioritise students with laboratory work and first-year students as the first ones to come back to F2F teaching and to learn on campus. Even though they could be well versed in university experiences, the rapid move to remote learning because of COVID-19 could cause adverse difficulties even for fourth-year students.

■ Problem statement

The sudden force to change to what Hodges et al. (2020:3) referred to as ‘emergency remote teaching’ at institutions of higher learning as a way to

3. Thus, remote learning emergency remote teaching and online learning are used interchangeably in this chapter.

4. See https://ukzn.ac.za.

5. See (https://www.news.uct.ac.za/article/-2020-09-11-students-return-to-campus-under-level-two)

keep teaching and learning going during the COVID-19 pandemic; has presented numerous challenges to both lecturers and students. This change required lecturers to become innovative in their online teaching methods that carried an element of self-direction, whilst students were also required to be resilient and self-directed in their learning (Mahlaba 2020). In particular, the COVID-19 pandemic required students and lecturers who can take responsibility for learning, set goals and work tirelessly towards achieving these goals using their own strategies (Mahlaba 2020). Upon the easing of the lockdown regulations, teaching and learning were conducted in a blended learning environment (BLE).[6] Students and lecturers needed to strike a balance between activities taking place in both F2F and online environments. Blended learning, according to Garnham and Kaleta (2002), should not be interpreted as simply adding technology to a traditional class but rather as a mix of the greatest characteristics of each platform to improve students' motivation and SDL possibilities with greater flexibility. So, BL in this study merged both online learning and F2F learning to create SDL opportunities for students. This means that even though students were taught F2F, they were also given opportunities to manage their own learning through engaging with learning content and activities in an online environment.

Previously, students were mainly dependent on their lecturers through F2F discourse for learning. Learning from their homes has induced different experiences for students. Remote learning has previously been considered difficult for first-year students who were mainly dependent on F2F interaction with their teachers for learning during their school years (Czerniewicz et al. 2020; Fruehwirth, Biswas & Perreira 2021). The move to remote teaching and learning with minimal F2F interactions after easing the lockdown regulations tested students' self-direction in their learning (Mahlaba 2020), which was deemed useful in ensuring learning success during the COVID-19 pandemic (Smith & Boscak 2021).

This study aimed to explore the affordances of the BL approach on fourth-year students' SDL. In addition, we investigated how BLE affected fourth-year students' learning amidst the COVID-19 pandemic. Characteristics of self-directed learners are described by Knowles (1975) in his definition of SDL and extended on in other research studies such as Mahlaba (2020) and Smith and Boscak (2021), respectively. Some studies also indicate some salient characteristics of self-directed learners, which were critical in this study. According to these studies, SDL is characterised by sharing of learning experiences and knowledge amongst students (Kalantzis 2003). In addition, students monitor and adjust their own learning (Edwards 2015); they exude intrinsic motivation and the ability to self-assess (King 2011); students initiate

6. See Section "Blended learning" for a conceptualisation of blended learning environments.

their own learning (Rogers 2004); students work collaboratively with peers and mentors to achieve learning their goals (Edwards 2015). These constructs were therefore used to frame the questions for the focus group discussion in this study. Thus, the study sought to answer the following research questions:

- What challenges did students experience during their online learning?
- How does SDL manifest itself in students' experiences of engaging with BL environments?
- What are the implications of the BL approach as a catalyst for SDL amid the COVID-19 pandemic in universities?

Theoretical framework

This section discusses the theoretical basis on which this study was founded and underpinned in literature. We begin with a brief history of the origins and effects of the COVID-19 pandemic. After that, we discuss BL and how it was enforced by relaxing the COVID-19 regulations in South Africa. Thereafter, we discuss the salient features of SDL and how they relate to this study. Finally, the theoretical foundations of the sociocultural theory are discussed and related to this study as the main theory that guided the discussion of the findings.

COVID-19 and its effects on higher education

The coronavirus disease, also known as COVID-19, is a newly discovered coronavirus and is a respiratory infection-related disease. The World Health Organization declared COVID-19 a pandemic on 11 March 2020, and South Africa's president responded by declaring a state of national calamity by imposing a countrywide lockdown. This meant that teaching and learning in universities were disturbed and the academic year had to be halted. The effects of COVID-19 on South African higher education were devastating (as elucidated in Mahlaba [2020]). Mitigations were made, and emergency remote teaching (ERT) was the solution adopted by universities to continue teaching and learning activities. Hodges et al. (2020:7) described ERT as 'a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances'. The Fourth Industrial Revolution has influenced different sectors around the globe, including education, which has been brought to the fore by the COVID-19 pandemic (Motala & Menon 2020). ERT became temporary and necessary because of an emergency crisis (Ferri, Grifoni & Guzzo 2020), whilst online and remote teaching and learning can be planned and implemented according to a particular plan (Hodges et al. 2020).

The emergence of ERT meant that both lecturers and students had to prepare themselves for this new normal rapidly. Universities had to make provisions to ensure that gadgets and Internet excess were available for both lecturers and students (Mahlaba 2020; Motala & Menon 2020). Even though universities mitigated the challenges of ERT by providing data and gadgets to students and lecturers, they still experienced numerous challenges, the most dominant being Internet connectivity, and Czerniewicz et al. (2020) summarised most of these challenges. Amongst other effects of the pandemic, Czerniewicz et al. (2020) argued that universities had to blur the lines of inequalities amongst students and show some elements of care during the pandemic. Furthermore, the repercussions of the pandemic-related sudden shift to online teaching and learning impacted students', lecturers' and managements' personal lives outside of work (Mohmmed et al. 2020). Thus, challenges related to the abrupt switch to ERT need to be considered carefully, and mitigation must be made to ensure quality in the education provided to students during the pandemic. The move to emergency remote teaching and learning (ERT&L) has caused several challenges for universities, lecturers and students. Ferri et al. (2020:4) summarised these challenges into three categories that are technological challenges, pedagogical challenges and social challenges. Even though their challenges are based on lecturers, they also apply to students in all universities that are following the ERT&L.

Blended learning

In general, the BL approach blends F2F education with online technology-mediated learning (Hrastinski 2019). The BL approach acknowledges that learning can occur in both formal and informal locales, and learning can be facilitated by both human facilitators and technological artefacts (Galvis 2018). Reasons why universities incorporate the BL approach in their teaching and learning plans vary from meeting students' learning needs (Vanslambrouck et al. 2018) to minimising dropout rates (López-Pérez, Pérez-López & Rodríguez-Ariza 2011). However, during the COVID-19 pandemic, most South African universities adopted ERT to mitigate the quality of education provided to students who had little experience with online learning. Furthermore, in the BL approach, students' technology readiness is critical in establishing and enhancing teacher presence for the students (Geng, Law & Niu 2019). However, the switch to online learning because of the COVID-19 pandemic cannot assure that students were technology ready because no training was provided before the switch. Thus, students might have felt very little teacher presence; hence, as in the study of López-Pérez et al. (2011), students preferred F2F learning more than online learning.

Awareness has been raised on how F2F instruction can be amalgamated with online teaching to engage students in lecture-controlled and self-controlled learning environments (Serrano et al. 2019). Students believe that the online component serves as a supplement in a BL environment but never replaces the F2F component (López-Pérez et al. 2011). The role of the teacher and the type of teacher who facilitates teaching and learning through BL has also received some attention in educational research. For example, the perspectives of BL specialists were used by Bruggeman et al. (2021) to explore the critical teacher characteristics for adopting BL. The two classes of attributes that were seen as crucial for BL teachers to possess are adaptive and maladaptive attributes (Bruggeman et al. 2021). Even though BL is not an 'all-in-one solution', research has shown that it is advantageous for both the lecturers and students.

The BL approach has shown to be useful in bridging the gap between lecturers' and students' interaction and also allows students to gain control of their learning in terms of the pace and approach to learning (Castro 2019; Serrano et al. 2019). Blended learning further allows students to direct their study patterns whilst working in a self-paced manner (Onah, Pang & Sinclair 2020). During the COVID-19 pandemic, BL approaches also allowed lecturers to make up for the lost contact time and the lost F2F practical work. Given that most lecturers did not have previous experiences with BL, a need arose from a systematic review for teacher professional development on how to teach using the BL approach (Philipsen et al. 2019). Despite it being advantageous to adopt the BL approach, there have been challenges associated with this approach. Firstly, the support and training provided to lecturers to facilitate teaching and learning in BL environments are critical to its success (Evans et al. 2020). Secondly, there has been a cost implication regarding full online teaching, which might have disadvantaged students from underprivileged societies (Mahlaba 2020). However, the introduction of BL with limited F2F interactions allows students to catch up on their learning and shortens the societal gaps. Thirdly, universities can face contextual challenges associated with the adoption of combined teaching and training, such as strategic, structural and support complexities (Graham, Woodfield & Harrison 2013).

Self-directed learning

Self-directed learning is a (Knowles 1975):

> [*P*]rocess in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

Self-directed learning is characterised elsewhere as (Gibbons 2002):

> [*A*]ny increase in the knowledge, skill, accomplishment, or personal development that an individual selects and brings about by his or her own efforts using any method in any circumstances at any time. (p. 2)

Self-directed learning rejects views associated with teacher-directed learning (TDL) and positions students as masters of their own learning who use any means necessary to achieve their learning goals. As Knowles (1975) mentioned earlier, as humans grow, they become less dependent on others and learn to do things on their own. Thus, humans have, as they grow up, an inherent need for being independent of both parental and teacher control (Knowles 1975), and SDL represents this independence. However, even amid this emancipatory process, humans still require and will always require assistance from others, characterising the SDL process as an unending one. Self-directed learning does not imply that TDL must disappear completely because it is also important for several reasons. TDL is important, for example, when introducing students to new knowledge and practices in a subject (Gibbons 2002). Thus, students who are still developing to be self-directed learners still require teacher presence even though it can be scaffolded. This is why BL approaches have a F2F component, which in most cases is controlled by lecturers and an online component that students control. The F2F teaching and learning approach informed by actively teaching and learning SDL development has larger chances of success than F2F teaching and learning that focuses only on the content of the subject (Murad et al. 2010). Self-directed learning has been shown to influence learning in blended environments and vice versa (Bailey & Lubbe 2020; Geng et al. 2019; Sarkar, Sharma & Raheja 2021).

The main tenets of SDL as articulated by Knowles's (1975) definition, are taking the initiative for learning, identifying what you need to learn, seeking resources and the best personal learning strategy and evaluating if learning has occurred. Thus, being self-directed in learning can be seen as a personality characteristic adopted by individuals out of their needs for learning. This is because of the fact that in SDL, students undertake the primary responsibility for designing, executing and assessing the learning process, and the student must have an intrinsic willingness to take responsibility for their learning (Brockett & Hiemstra 1991). However, as Brockett and Hiemstra (1991) articulated in their PRO model, SDL is affected by societal factors, including teaching methods. Hence, they argue that it is critical to understand SDL as affected by instructional strategies processes and learner self-direction as personality characteristics (Brockett & Hiemstra 1991). Self-directed students retain as much control over their learning process as possible. They aim to develop their self-management, self-motivation and self-assessment skills, and they continually challenge themselves to perform better (Gibbons 2002). Given that students were engaged in online learning during BL, their self-directedness is a critical element to consider and analyse regarding their success in learning.

The sociocultural theory of learning

Recently, research has been equating the notion of learning to participation. Lave and Wenger (1991) conceptualised learning as the process of a newcomer's legitimate peripheral participation in the practices of a certain community of practice. They believed that an epistemological premise of learning is the involvement in the cultural practices where any knowledge exists (Lave & Wenger 1991). In mathematics, Sfard (1998, 2006, 2008) conceptualised learning as participating in mathematical discourse instead of acquiring mathematical facts. These views of *learning* as *participating* emanate from challenges to the widely accepted views of *transmission* or *transfer* or *acquiring* of knowledge, which, according to Lave (2009), implies that knowledge is invariable. To combat this, Engeström (1987) proposed that learning be conceptualised as the process of transforming human activities and organisations. Conceptualising learning as participating is influenced by the sociocultural theory of learning as articulated by Vygotsky (1978) but does have historical tenets of the Marxist views towards learning. The sociocultural theory of learning posits that learning is a social process mediated by society (as a community of practice, cf. Lave and Wenger 1991) and culture (as the accepted norms and behaviours of the community of practice) (Vygotsky 1978).

The sociocultural theory believes that cognitive development occurs in two planes, firstly between people through social interactions where newcomers negotiate and renegotiate membership with old-timers in a particular society (Lave & Wenger 1991; Vygotsky 1978). Sfard (2008) referred to this part of learning as interpersonal communication. Secondly, cognitive development moves from the social plane to individualisation, where after deliberation with others in the social plane, an individual then chooses to internalise parts of the information that appeals the most to them and discards the information with less appeal (Vygotsky 1978). In Sfard (2008), this plane is referred to as intrapersonal communication. As such, learning takes place as interpersonal processes are transformed by students to become intrapersonal (Vygotsky 1978). Similar to SDL, where learners gradually take control of their learning with the help of the facilitator, the sociocultural theory of learning views learning as beginning with the help from others and is scaffolded to independent learning where the students are less reliant on others.

Research methodology

Introduction

This study aimed to explore the affordances of BL on fourth-year students' SDL. This section elucidates the research methodology that was adopted in achieving this aim and provides a clear motivation for why particular elements of the study were conducted in a particular manner.

Research approach and design

This interpretive study adopted a qualitative research approach to design its empirical investigation. This approach was chosen because it allowed the researchers to explore the experiences of fourth-year student-teachers in navigating SDL through BL as a result of the sudden transition to online learning forced by the spread of COVID-19 in South Africa. The qualitative approach assisted us in making decisions about sampling methods, methods of data collection and methods of data analysis (Creswell & Clark 2011). The qualitative research approach was chosen because it allowed us to explore participants' experiences after engaging with BL (Nieuwenhuis 2020).

The intervention

Participants of this study underwent an intervention amid the COVID-19 pandemic when the lockdown regulations were eased. The university where the study took place began to reintegrate specific categories of students back into F2F teaching and learning under strict COVID-19 regulations. These students were already involved with ERT, but the university arranged for them to attend F2F teaching and learning in a rotational system. In particular, student-teachers attended the F2F sessions when the lecturers needed them or when they needed the lecturers. There was no fixed schedule for attending. The F2F introduction, whilst they were simultaneously engaged with the ERT, introduced the BL approach. During these F2F classes, there was a focus on developing student-teachers' SDL to maximise not only their performance but also their learning experiences in their remote environments.[7] This process was monitored by the Heads of Departments (HODs), and lecturers were required to report to the HODs weekly. Class representatives and the Faculty Council also reported to the HODs on the progress of the F2F sessions. The Dean consolidated the reports from the HODs and reported to the management of the Deputy Vice Chancellor for teaching and learning weekly. Where issues were identified, the management and the Teaching and Learning Centre would provide support to either students or lecturers to improve the process.

Participants

The study included 10 fourth-year student-teachers from a particular South African university located in one of the rural areas of the KwaZulu-Natal province. These participants were purposively sampled because they held rich information about the phenomena investigated in the study. Purposive sampling was used to

7. Note that this does not mean that the content of the module was not taught as the F2F interactions were organised to give student-teachers opportunities to ask content-related questions from their lecturers.

select ten fourth-year student-teachers made up of six female and four male students. Purposive sampling is used when the researcher has to research participants that need to meet very specific criteria. Otherwise, their participation might not be useful to the study. Purposive sampling was used to identify and select student-teachers who had practical experiences of engaging in SDL-driven, F2F teaching and learning through BL approaches. Students needed to have accessed ERT through the university' LMSs (online) and must have attended F2F classes with their lecturers during the COVID-19 pandemic. All ten participants were asked to sign a consent form before participating in the study. Upon returning the signed consent form, student-teachers were asked to participate in one focused group discussion that accommodated all ten participants who agreed to participate in the study.

Methods of data collection

This study utilised a Zoom application focus group discussion with ten fourth-year student-teachers who participated simultaneously to collect data to answer the research questions posed. These carefully prepared discussions allowed for collecting participants' SDL-related experiences after engaging in a BL approach (De Vos et al. 2012). Udosen (2014) viewed focus group discussions as having the benefit of allowing researchers to discover the fundamental concerns about a particular phenomenon swiftly. Focus group interviews are also inexpensive, but they provide rich data with high face validity and flexibility levels. They provide a natural environment in which individuals may freely express themselves. One participant's ideas inspire others to participate fully in the discussions (Flick 2009). In various studies, the composition of the focus group discussion has ranged between 6 and 12 participants (Denscombe 2007; Morgan 1997; Patton 2002). Dilshad and Latif (2013) argued that if the number is less than six, the information gained may not be rich and adequate, and one or two persons may attempt to control the conversation. On the contrary, more than 12 participants are practically difficult to manage. The discussion in this study had ten participants who all participated simultaneously (Dilshad & Latif 2013). The focus group discussion was guided by the focus group discussion guide, which probed participants about their SDL experiences after engaging in BL.

Methods of data analysis

We used inductive thematic analysis to analyse the data from one focus group discussion following the measures suggested by Braun and Clarke (2006). They proposed six phases for categorising research data according to themes. We followed these phases: familiarising yourself with your data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes and producing the report (Braun & Clarke 2006:87). These data analysis measures allowed us to develop particular themes that allowed us to answer the posed research question in this study.

Findings

This section presents the main themes supported by the data from the participants that resulted from the analysis we conducted in the study. Firstly, we provide an intensive report on the findings from the focused group discussion and quote verbatim the responses provided by students during the focus group discussion. The report utilises pseudonyms to refer to participants. For example, in this report, Participant 1 is referred to as P1 and so on until the tenth participant. In the next section, we report on the findings according to three main themes: the first is related to the challenges students face during fully online learning during the COVID-19 pandemic. Secondly, we report how SDL manifested itself in BL environments when students partially returned to contact classes. Finally, we report on the teaching and learning approaches adopted by students during their BL experiences.

Participants' experiences with ERT and BLT&L approaches

The participants indicated different experiences with ERT and blended learning teaching and learning (BLT&L) approaches used in this study. From the participants' responses, there was a general feeling that they were not adequately prepared for fully online learning (ERT) during the pandemic. P9 felt that they were not adequately prepared to assume more responsibility for their learning because lecturers would make available all learning materials and explain this material in contact classes. This indicates that students switched to fully online learning with very low SDL skills, and they had to adjust on their own to ensure success in their learning:

> 'To tell the truth, our lecturers have never prepared us to take so much responsibility for our studies. They would prepare slides when they come to class, explain everything to us, and ask questions where we did not understand. We did receive assignments to do on our own, but when we were on campus, lecturers took us through what was expected and then allowed us to work online on our own, so we had clear guidance eventually.' (P9, student-teacher, 23 September 2020)

The sub-themes that emerged were related to digital inequalities and unfavourable home learning environments that are discussed below.

Students' experiences that indicated the existence of digital inequalities

The digital divide had excluded many students from meaningfully participating in fully online learning during the lockdown induced by the COVID-19 pandemic.

Students mentioned that they experienced challenges with access to digital devices such as laptops and tablets. They also mentioned that access to stable and reliable Internet connectivity and affordable mobile data bundles was also challenging. Participation in online learning was therefore low because of these challenges:

> 'One of the challenges that this country has to deal with is inequalities, and I can tell you that most students were left out of learning during the hard lockdown because they did not have data and laptops for learning. I used a cell phone to access online materials but could not download bulky materials with my limited data bundles, and sometimes I had poor reception in the area.' (P1, student-teacher, 23 September 2020)

> 'What I can say is that the online learning disadvantaged many students from poor backgrounds during lockdown. We struggled with connectivity and electronic gadgets for learning.' (P5, student-teacher, 23 September 2020)

However, P1 mentioned that when there was a return of specific student categories to campus for BL, students began to have access to unlimited WiFi, university computers, better coverage and connectivity required for a conducive remote online learning environment during the national lockdown. These were the same sentiments shared by P3, who was also worried that other students were still excluded from teaching and learning because they had not returned to campus:

> 'The situation is now better since we are on campus, we were provided with laptops, and we use stable university WiFi.' (P1, student-teacher, 23 September 2020)

> 'When learning became difficult for us at home due to lack of resources, we called our student leaders to engage with management to allow us to be back at the residences even though we could not attend classes due to COVID-19. As a result, we have now started to return to campus as fourth-year students, and we now have access to the university resources, and we are happy to be able to learn once again. However, a lot of students still have not returned to campus.' (P3, student-teacher, 23 September 2020)

Besides struggling with technological devices and stable Internet connections in their remote environments, students also indicated that they had challenges related to their home environments that negatively impacted their learning. These challenges are discussed below.

☐ Unfavourable home learning environments

The findings revealed that the support students would usually receive on campus was no longer available with fully online learning. Their dominantly overcrowded households created a non-conducive environment for learning during the COVID-19 pandemic. This was evident to students who are living in economically poor environments and households. As P4 mentions below, the situation was alleviated by the return to campus for students to participate in BL:

> 'University heard our cries and eventually allowed us to come back on campus to work in a better environment. However, it was challenging to study at home because there were a lot of disturbances, and I was sharing one room with my two brothers who are school going.' (P4, student-teacher, 23 September 2020)

In addition, P1 also confirmed that her home environment was often not conducive to learning because of the lack of rooms that allowed for conducive studying and completing academic activities. Because of her family size and lack of rooms, P1 mentioned that she had to wait for her family members to sleep before she could study or engage in any academic activity:

> 'Yes, I would say BL has made things easy for us now because we are based in our residences and from time to time, we have an opportunity to meet our lecturers in small groups. Working from home was very frustrating; some of us come from large families with very few rooms to allow you a personal space for studying and focusing on our work. I had to wait until everyone is asleep before I could study.' (P1, student-teacher, 23 September 2020)

P7 also indicated that the return to campus to accommodate some contact lessons were useful because of the number of learning resources they have at the university and also the supportive environment for learning afforded by the return to campus:

> 'Even though we no longer attend classes as frequently as we used to do, we are at the university where the environment is supportive with all the resources we need, such as the library, Internet, and computers available to us for learning. Yes, I can say blended learning is working well under the circumstances of COVID 19.' (P7, student-teacher, 23 September 2020)

P1, P4 and P7 specifically show the appreciation that the university allowed them to engage in BL by allowing them to return to campus, which was better than their remote environments. As such, these participants appreciated and saw value in BL during the COVID-19 for different reasons that aided their learning in ways that remote environments could not.

Manifestation of self-directed learning in a blended learning environment

Introduction

The findings revealed that SDL manifests itself in various ways in a BL environment. Findings from this study reveal that SDL manifested itself in the form of active learning, where students were actively engaging with the content on their own. In this regard, students mentioned that taking responsibility for one's learning was critical during the COVID-19 pandemic because they had to be less reliant on their lecturers. There is evidence of students mentioning that they had to look for sources of information and engage with their problems on their own, which is another critical SDL manifestation that was evident in this study. There was evidence that students often worked in groups that linked with cooperative learning and the identification of human resources for learning, which is an explicit SDL characteristic. Finally, students mentioned that BL environments exposed and developed some of their SDL skills. All these findings are reported below.

Independent, active learning and taking responsibility for learning

According to Maphalala, Mkhasibe and Mncube (2021), the:

> [*F*]indings reveal that students were not ready to play a central role in their learning when the emergency transition to online learning from face-to-face learning was imposed on them as a result of the spread of the virus. Instead, students were thrown into the deep end as they were unprepared for online learning or SDL. (p. 240)

As exemplified by the extract below, P3 explains how most students struggled to navigate SDL activities in online learning environments during this pandemic:

> 'Most of us struggled to study on our own without the lecturer teaching us; lecturers posted the slides and some notes, and we had to study on our own without somebody explaining to us. Finally, we realised we are going to fail and started on our own, trying to find answers from all sources and each other as students.' (P3, student-teacher, 23 September 2020)

Evidently, upon realising that they might fail the modules, P3 explains that they started to take responsibility for their learning by identifying both human and non-human resources for their learning. This is a critical step in transitioning from being reliant on the lecturers and the information provided by the lecturer to being a self-directed learner that is responsible for their learning. Furthermore, P6 articulates that the usage of the university LMS (Moodle) was not useful during the fully online teaching and learning process and allowed them to realise that they cannot only depend on lecturers for their learning but themselves and the other students. This means that P6 was able to recognise that relying on the university's LMS for learning was not effective and devised other learning strategies that could be useful, like collaborating with other students:

> 'This serious online learning thing is new to us. Yes, we're using Moodle, but it was for accessing learning materials and notices from lecturers. Some lecturers did not even use Moodle for teaching; they only relied on teaching in class and handouts. I think online learning forced us not to rely more on lecturers, but on ourselves and each other as students.' (P6, student-teacher, 23 September 2020)

The identification of particular learning strategies for individual learning is another critical characteristic of being self-directed in ones' learning. P3 further mentioned that engaging in BL was useful in having limited access to their lecturers and raising their self-confidence and awareness of learning strategies that aided their learning. P3 also indicates that BL raised their willingness to learn independently because of the realisation that relying on the lecturer only was not enough. In these utterances, P3 indicates that more students took responsibility for their learning after engaging in BL environments:

> 'With BL, it's better because we have limited contact with our lecturers, so we have to overcome challenges and organise our learning mainly on our own. The situation has built self-confidence in us; we are willing to learn on our own through various learning strategies such as watching YouTube videos, exchanging voice notes, small group discussions and sharing study notes amongst ourselves.' (P3, student-teacher, 23 September 2020)

Finally, there was also evidence that the fully online classes were not beneficial to students as they sometimes learnt nothing from them. P8 indicated that BL allows them more time to learn independently and at their own pace. They only went to contact classes to seek clarification on some areas in which they experienced difficulty in engaging with the content alone. This means that they were able to identify their learning needs and that they then sought the lecturers' intervention as a human resource for learning. Furthermore, P2 mentioned that BL allowed them to be independent in their learning and also to manage their learning by developing and maintaining a work plan for their learning. This is further typical of self-directed learners:

> 'We found BL to be beneficial because we have more free time to work at our own pace without rushing from one class to the next, and some of those classes are time wasting because you come out without learning anything. Now with BL, the little contact time we have is to clarify areas of difficulties.' (P8, student-teacher, 23 September 2020)

> 'The current arrangement of using face-to-face and online learning has given us much independence. However, if you do not take responsibility for your work, you are left behind because no lecturer will time-manage your activities. You must be able to develop your work plan and establish timelines and milestones for yourself. The lecturers just provide us with guidelines, materials and due dates for submission.' (P2, student-teacher, 23 September 2020)

In this regard, BL manifested itself as a form of a bridge for students' autonomy and independence in their learning. As articulated by P2, students mentioned that they had to develop and demonstrate personal responsibility and accountability for their own learning. The online component of BL requires the ability to work independently and without constant oversight and requires that the student has good time management skills. All these elements were raised by P2 as critical components of success in a BL environment. P5 indicated that they had to rely on themselves and take responsibility for their own learning because their lecturers were not always present to provide them with answers. Hence, they had to rely on themselves and other students:

> 'Our lecturers cannot provide answers to all the questions, so we have to rely on ourselves as students, read extensively, conduct research and consult other students to understand the content. Therefore, we had to solve some of the difficulties we encountered along the way.' (P5, student-teacher, 23 September 2020)

Self-reliance is one of the essential qualities needed in a BL environment because students have to engage in learning with minimal supervision by lecturers. Therefore, students had to be self-motivated and develop strategies for tackling the challenges along the way on their own. In this study, students also mentioned that SDL manifested itself in their decision to work with their peers to complete teaching and learning activities. This relates to the critical SDL component of cooperative learning, which students decided to engage with to enhance their learning.

☐ Voluntary collaboration between student-teachers

Collaborating with other students is critical in students' learning because they can identify their strengths and weaknesses and get help from other students with better abilities. Students who participated in this study felt that they learned better in groups because that allowed them to share ideas and information with each other. Students engaged in voluntary collaborative learning for various reasons that benefited their learning during the pandemic. This manifested itself as a result of taking responsibility for their own learning and also identifying and using the SDL pioneered teaching and learning approach during BL. For example, P1 indicated that they used technological applications (WhatsApp) to collaborate and share information using either chats or group calls. A critical finding, in this case, is that they were enjoying their learning, as P1 mentioned that they would make jokes about their challenges whilst learning from each other. This is a critical element of SDL that was afforded to these students by engaging in BL environments:

> 'I find it easy to learn when we work in a group. So we formed a WhatsApp group where we exchange ideas and answer certain assignments either as a chat or a group call. It is enjoyable, and we make jokes about the challenges that we have whilst we are learning.' (P1, student-teacher, 23 September 2020)

Because of the limited guidance and support from lecturers who just uploaded PowerPoint slides only in the LMS (Moodle), P5 indicated that they had to rely on group work to solve problems and appointed a representative to communicate with the teacher for extra guidance. This further suggests self-direction in students' learning:

> 'Some lecturers just upload materials online with very little guidance and explanation, so we have to work in groups to figure out the new information on our own so that if we get stuck, we can ask the class rep to communicate with the lecturer concerned.' (P5, student-teacher, 23 September 2020)

Some students indicated that they engaged in voluntary collaborative learning because they had limited time interacting with their lecturers. This practice has allowed students to share ideas, support each other's learning and assist each other in managing their learning schedules for better learning experiences. As seen in the quotations below, some participants saw that it is critical for everyone not to work in silos every time but also to share ideas with other students who are sharing the same module. The fact that students had limited F2F interaction with their lecturers during the pandemic strengthened their realisation of the importance of collaborating using any form of communication at their disposal in their learning:

> 'We see lecturers from time to time, and this has forced us now to rely on each other as students. We work together in groups with very little guidance from the lecturer.' (P4, student-teacher, 23 September 2020)

> 'We have learned to work in groups, share ideas on projects, assist one another in understanding the content and preparing for assessments together, manage our learning schedules, and share information via WhatsApp and emails.' (P6, student-teacher, 23 September 2020)

> 'You cannot completely work independently; from time to time, you have to share ideas with others in your class.' (P10, student-teacher, 23 September 2020)

Being independent in learning does not mean that self-directed learners isolate themselves from other students. On the contrary, as observed from the responses from the focus group discussion, networking and collaborating with people were seen by the participants as an integral part of their learning. It is clear from the data that self-directed learners were able to adapt to their new learning normal. In particular, they were able to identify their learning challenges and learning goals. After understanding their difficulties, they adapted by taking more responsibility for their learning and identifying learning strategies that would be useful for their learning in their new normal. These students were also exposed to some SDL skills because of their participation in BL during the COVID-19 pandemic. These skills are discussed in the following sub-section.

Exposure to self-directed learning skills

The findings reveal that the BL environment exposed students to several essential skills necessary for SDL. These skills include collaboration, peer-learning, critical thinking, active participation, self-reflection, acquisition of digital skills and teamwork. P2 indicated that the development of these SDL skills was a difficult process but became enjoyable as they adapted to the process of developing these skills on their own:

> 'The Blended learning approach adopted by the university preferred a limited face-to-face interaction with lecturers and more online learning, which enabled digital skills, working closely with other students for mutual learning and active participation in our work. I must say it has been a challenging experience, but we are adapting to it and beginning to enjoy it though.' (P2, student-teacher, 23 September 2020)

P4, on the other hand, felt that engaging with BL has allowed them to develop their creativity, problem-solving competency and critical thinking skills:

> 'We have been doing many activities online, such as quizzes, short take-home tests, and projects that required us to be creative and solve problems through

> critical thinking. One lesson I have learnt is that you cannot make it if you do not collaborate with other students and some of the activities are meant to be done as a group.' (P4, student-teacher, 23 September 2020)

Additionally, P2 highlighted that engaging in BL environments was crucial in their development of self-reflection skills. Specifically, P2 indicated that the online activities contained a section where they were required to reflect on their experiences with the project. Additionally, students developed their self-monitoring of their development of their learning and deep thinking about their learning progress:

> 'A number of activities that we do online have standard reflection questions that ask us to highlight challenging aspects of doing the project, how those challenges were overcome, what could be done better to improve the project. So we have gotten used to these questions, and they help you monitor your work and think deeply about the way you learn and attempt your learning activities.' (P2, student-teacher, 23 September 2020)

Consequently, engaging in BL environments allowed students to identify their learning needs, develop awareness to take responsibility for their own learning and select learning strategies that were useful in their learning during the asynchronous aspect of their learning. As such, engaging in BL environments allowed students to develop particular SDL skills. They were able to use these skills to adapt to the new normal of teaching and learning during the COVID-19 pandemic. As part of their SDL development, students indicated that they used different teaching and learning approaches for their learning. Despite that collaborative learning is another method of learning that was classified as part of the SDL skills manifestation, there were other learning styles evident in the students' learning.

Experiences relating to learning approaches

The last theme that emerged from this study's findings was that students used a variety of teaching and learning strategies when they were engaged in BL, all of which can be related to SDL. These approaches were useful for students when navigating learning in their BL environments. These learning approaches are summarised below, and a closer look at how students utilised them is explored.

The learning management system

The findings reveal that the university uses Moodle as its LMS. Consequently, the course material and other learning resources were made available to students using Moodle as part of the asynchronous BL component. Firstly, learning materials were made available on Moodle for students because they had left their learning materials on campus with the abrupt chasing of students from on- and off-campus residences. Hence, this sending of learning materials on Moodle was in response to this abrupt change in students' normal learning experiences. P8 mentioned that they used Moodle to obtain learning materials, communicate with other students and the lecturer and complete their assessment activities:

> 'When we went to lockdown in 2020, most of us left the study materials on campus because we thought we would return immediately and it did not happen. So our lecturers started sending learning materials online, which was difficult because most of us had challenges with connectivity. However, being back on campus, we now have the necessary tools to participate in online learning activities. For example, on Moodle, we can write an assessment, communicate with the students and lecturers, watch videos and learn many things.' (P8, student-teacher, 23 September 2020)

The findings also revealed that the LMS also assisted learners in realising that they could take responsibility for their own learning because most of their learning activities and learning materials were available on Moodle. This LMS also allowed students to attend in smaller groups that allowed for social distancing whilst others were engaged in learning activities using Moodle as their LMS:

> 'It was challenging to learn under remote learning with less interaction with our peers and lecturers and the lack of resources stalled our learning a bit. However, now that we are back on campus, we meet lecturers in small groups, we have access to WiFi, library, and more importantly, we have each other as students to learn in groups. This has helped us learn independently without relying on the lectures, and most of the work is on the Moodle platform.' (P10, student-teacher, 23 September 2020)

Despite the usage of the LMS, students also indicated that their lecturers also used WhatsApp®, Microsoft Teams, Google meet, as well as printed material that was couriered to students at the expense of the university. This also allowed students who could not access the LMS to engage with the teaching and learning activities:

> 'The support we are receiving has improved a lot since we are back at the university; we get handouts from lecturers, we have online meetings with Zoom and Microsoft teams and we have also formed WhatsApp groups for constant communication with most of the lecturers.' (P7, student-teacher, 23 September 2020)

☐ Peer-led learning, peer assessment and self-assessment

One student mentioned that they organised themselves into groups to engage in peer-led learning, where a student who is good with a particular topic would facilitate learning. P6 mentioned that:

> 'Some students know certain aspects or modules better than us, so we ask those students to assist us with those, so if they are confident to facilitate those areas but lack some information, we have to consult the lecturers.' (P6, student-teacher, 23 September 2020)

Besides peer-led learning, students also utilised peer assessment to obtain critical feedback about their assignments before submitting them to their lecturers for grading. In the same way, students also conducted self-assessments of their work before sending it to their peers for assessment, and as a result, students conducted both self and peer assessments. What made it possible for students to engage in these kinds of assessments before submitting the assessments was the availability of the marking rubric to the students:

> 'Most of the assignments or assessment activities that are given to students are accompanied by the rubrics that serve as guidelines for assessing the work. The rubrics explain what is exactly expected on all the aspects of the tasks. This makes our lives easier to assess our work or that of another student. When you know how you will be assessed you focus on important areas.' (P8, student-teacher, 23 September 2020)

These forms of assessment were hailed by students as encouraging them to take greater responsibility and control for their learning. In addition, these forms of assessment were helpful for students to continually assess their learning progress to determine their learning gaps and work towards the improvement of their learning:

> 'I don't have to wait for somebody else to tell me that my work is not up to standard, so before I hand in any assignment to my lecturer, I go through it to make sure that the answers are correct, and I consult Google or my books to verify.' (P4, student-teacher, 23 September 2020)

> 'P1 mentioned that peer assessment was beneficial for their learning because the other students critiqued and provided feedback on each other's work to find areas that might need improvement and enhance learning.' (P2, student-teacher, 23 September 2020)

On the other hand, the self- and peer-assessment utilised by students in their learning was useful in that they allowed students to reflect on their own work and improve their learning:

> 'I think getting feedback from your fellow students is very useful. Before I can submit any activity for assessment, I ask my group members to check my work and give me an honest opinion of what they think about it, and more often than not, they have valuable input to make which assists in improving my work.' (P1, student-teacher, 23 September 2020)

P10 also emphasises the value of both peer and self-assessment:

> 'Now that we do not constantly interact with lecturers, I have learned to assess my own work. It makes you see where you are weak to focus on those areas that need to improve. Where I was not sure, my classmates could assist or ask in the WhatsApp group chat if my thinking was correct.' (P10, student-teacher, 23 September 2020)

Discussion of the findings

Findings from studies such as Van der Spoel et al. (2020) revealed that the significance of technology in education has long been recognised, but the recent spread of the COVID-19 pandemic has exacerbated the need to integrate technology and technological artefacts in education. This heightened the need to implement technology during the COVID-19 pandemic and opened various opportunities. It also strengthened the need for the education sector to incorporate teaching and learning methods that relied on digital technologies. During the stricter lockdown rules in South Africa, students were engaged with fully online learning in their remote environments. However, findings from this study revealed that online learning presented challenges for various South African students who came from poor backgrounds and lacked the devices to engage with online learning and access to a stable Internet connection. These challenges were related to the technological divide, which included poor Internet connection, lack of access to appropriate technological gadgets and the lack of a conducive household environment for learning. These challenges were also highlighted as the main challenges that affected university students from poor South African backgrounds (Czerniewicz et al. 2020; Mahlaba 2020), and similar findings were observed in other countries as well (Azubuike, Adegboye & Quadri 2021; Catalano, Torff & Anderson 2021). In addition, the move to online teaching increased the need for students to take more responsibility for their learning (Rafique et al. 2021), but participants indicated that they had not been prepared to take so much responsibility for their learning before the pandemic.

As the spread of the COVID-19 pandemic was being contained, the South African government decided to relax the strict lockdown rules, and some students were allowed to return to campus for limited contact classes with their lecturers. This then introduced students to BL, where they were engaged in online learning as well as the limited F2F interactions with their lecturers. The introduction of BL proved to be useful for the participants of this study. Participants indicated that even though they were initially not prepared for online learning before the pandemic, engaging in BL led to the realisation of the importance of taking more responsibility for their learning. Additionally, the findings indicate that engaging in BL developed some of the students' critical SDL characteristics and skills that were useful in their learning. These skills include taking responsibility for their learning, developing critical thinking skills and problem-solving skills, identifying both human and non-human resources and evaluating their learning goals through self and peer assessment. There are several other studies that have reported similar results regarding the effects of BL on SDL. Geng et al. (2019) concluded that SDL directly impacts students' cognitive presence in BL environments. It was reported elsewhere that students in BL environments had higher encouragement for independent learning, and they engaged in self-study and reflection to enhance their learning (Kharb & Samanta 2016). In addition, similar to the findings from these studies, engaging in BL also enhanced students' motivation to learn (Bosch, Mentz & Reitsma 2019), problem-solving skills (Suprabha & Subramonian 2019), critical thinking skills (Jou et al. 2016; Şentürk 2021), collaborative learning skills (Geng et al. 2019; Sun et al. 2017) and SDL (Uz & Uzun 2018).

Another important finding of this study relates to students taking responsibility for their own learning in that they also utilised different learning approaches that were beneficial to them. In line with this finding, it can be stated that engaging in BL environments allowed students to realise the need to use various learning strategies such as engaging on WhatsApp with other students, collaborating in peer-led lessons and also utilising self and peer assessments. Furthermore, students also mentioned that if these learning approaches were not useful in achieving their learning goals, they would then consult with their lecturer during the F2F lessons for clarification of particular issues that prevented them from achieving their learning goals.

■ Conclusion

In this study, we investigated fourth-year students' experiences of engaging in BL environments and how that manifested their SDL skills during the COVID-19 pandemic through the sociocultural learning theory. Results of this study revealed that even though students may face challenges in ERT, their engagement with BL alleviated these changes and allowed students to develop SDL skills that were key to the continuation of their academic activities. The challenges faced by students with ERT included the technological divide and the non-conducive home environment for learning. However, with the inclusion of the F2F component to teaching and learning during the pandemic, students began to experience fewer challenges because they were allowed to return to campus. Their return to campus provided them with a conducive learning environment and eliminated the technological divide by providing them with stable Internet and access to digital devices.

Engaging in BL developed students' SDL skills as they began to take responsibility for their learning. Students taking more responsibility for their own learning as a result of engaging in BL meant that they could learn at their own pace, and they realised the significance of collaborating with other students using any online platform (Bralić & Divjak 2018). In addition, students developed SDL skills that are related to 21st-century skills, such as critical thinking, collaboration, problem-solving and reflective practice. Also, the students reported that they utilised different learning approaches to ensure that they achieved their learning goals, which is also a characteristic of a self-directed learner. This implies that universities should foster BL to continue teaching and learning activities amid the COVID-19 pandemic.

The findings imply that engaging in BL fosters the development of SDL characteristics and skills in students. These SDL skills and characteristics are useful in students' success in their learning. Thus, the finding from this study suggests that BL, where students are engaged with both F2F classes and also learning through online platforms, should be adopted by universities during the COVID-19 pandemic. This should be done to support student learning and alleviate the difficulties students face when learning using online platforms only.

The finding in this study revealed the challenges faced by students during ERT and also revealed the benefits of engaging in BL amid the COVID-19 pandemic. This study expands the literature on the effects of BL on students' SDL during the COVID-19 pandemic in South Africa, which has been sufficiently explored. Moreover, this study explores the experiences of engaging in BL from students who come from poor economic backgrounds, which have not been adequately explored in South African literature. This study then provides empirical evidence on how universities can adopt BL and support learners from poor economic backgrounds during their BL. Finally, the study contributes to the literature that explores the relationship between BL and SDL, specifically on how SDL skills can be fostered through BL during the COVID-19 pandemic.

The sample size was limited to only 10 fourth-year students in one university in a rural area. A different study conducted with more participants from various universities, including rural and urban contexts, might yield different results. Additionally, the study was conducted on a virtual platform because of COVID-19 restrictions, and also to save data, participants were asked to switch off their cameras to save bandwidth, thus improving the quality of the sound. This might be a disadvantage as facial expressions, body language and other non-verbal signals were not observed from the participants, and these are critical elements of qualitative research. This study may be extended to different universities from different contexts. Likewise, a different study can be conducted with a bigger sample size from various levels of study. Another limitation prevalent in the study was that in the group of 10 participants who were involved in the focus group interviews, some of them might have stayed in the background and not participated in the discussion although they were present.

Appendix A: Semi-structured interviews.

The focus group guide (with student-teachers)

The study seeks to answer the following research questions:

- What challenges did the student-teachers experience during online learning under lockdown?
- How does SDL manifest itself in students' experiences of engaging with BLEs?
- What are the implications of blended learning as a catalyst for SDL amid the COVID-19 pandemic in universities?
- What intervention measures can be put in place to enhance learning in the blended learning environment?

***We will begin our discussion by generally talking about your experiences with both online learning and face-to-face learning*.**

Theme 1: Experiences with both online learning (ERT) and blended learning

Probes:

1. Share with us your experiences with online learning during the lockdown as compared to your experiences with blended learning (What would you say are the advantages and disadvantages of each?)
2. What worked and what did not work and why?
3. Indicate challenges associated with online learning.

***I would like us to now discuss and share views on your self-directed learning (SDL) perspectives when engaging in the blended learning context*.**

Theme 2: Self-directed learning (SDL) perspectives in a blended learning context

Probes:

1. How did learning take place when fourth-year students returned to campus to combine face-to-face and online learning (blended/hybrid learning)?
2. How did your lecturers promote a student-centred approach in a blended learning class?
3. What self-directed learning activities and skills characterised learning when you returned to campus for blended learning? How?
4. What strategies do your lecturers use to promote self-directed learning in a blended learning environment? Also, reflect on Moodle usage as a Learning Management System.

5. Has blended learning exposed you to any self-directed learning skills? Can you identify a few?
6. Any challenges associated with blended learning?

***Now, let us move on to the implications of blended learning in fostering SDL during the COVID-19 pandemic in universities*.**

Theme 3: Implications of blended learning in fostering SDL during COVID-19 pandemic in universities

Probes:

1. How can your lecturers support you to engage in self-directed learning effectively in a blended learning context?
2. Do you think blended learning has a critical role to play during the COVID-19 pandemic?

***Let us now discuss your recommendations on how SDL can be enhanced in a blended learning environment*.**

Theme 4: Recommendations on enhancing SDL in a blended learning environment

Probes:

1. Any additional recommendations on how SDL can be enhanced in a blended learning environment?
2. Any additional information you would like to add regarding the discussion?

Closure

Thank you very much once again for sharing your views with us today. We really appreciate your thoughts, comments and suggestions. Your input will assist the faculty in implementing an intervention programme that seeks to enhance teaching and learning during this time.

Chapter 6

A flipped classroom approach to mathematics teacher training: Blended learning in support of metacognition as a self-directed learning skill

Celizma Lotz
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Corné Kruger
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Jako Olivier
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Mahikeng, South Africa

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Abstract

The substandard performance in mathematics learning in schools is often attributed to teachers' lack of knowledge and inability to keep up with the most recent pedagogical approaches expected from 21st-century mathematics teachers. It is widely acknowledged that teacher SDL supports metacognition that, in turn, holds value for sustained teacher self-development when they continuously reflect on their own learning in and from practice. In this way, teacher metacognition could play a crucial role in addressing the poor mathematics standards in South African schools. The question is asked as to how higher education institutions could support the development of metacognitive skills through SDL for pre-service mathematics teachers. According to the literature, the flipped classroom approach (FCA) as a form of BL has the potential to support metacognition as an SDL skill. An FCA was used to deliver a specific mathematics module within the first year of a Bachelor of Education (BEd) programme delivered by a higher education institution. It is recognised that the FCA itself does not foster metacognition but rather the way in which this approach is implemented. It was therefore deemed important to investigate how this approach should be designed, within a BL context, in order to foster metacognition and consequently also SDL with mathematics student-teachers. Qualitative data were collected from 12 first-year mathematics student-teachers and two lecturers in design-based research (DBR). Reflections by both the students and the lecturers involved were collected during two DBR cycles. Data were analysed through a metacognitive lens to provide guidelines for an FCA for metacognitive gains based on the lessons learned throughout the process. Prerequisites that emerged from the findings include the acknowledgement of the changed roles of students and lecturers in an FCA, efficient integration of technology in a blended setting, the need for more and clear feedback and scaffolding of SDL. The guidelines also highlight the relevancy of the level of mathematics content and the role of lecturer and student motivation in an FCA for BL if metacognitive gains are to be assured in this BL approach to mathematics teacher preparation.

Introduction

Because of advancements in technology in the 21st century, as well as the changing role and nature of education, there is a constant need to rethink education strategies. This transformation of education goals is also crucial in the context of teacher education (Cishe 2017) and specifically in the preparation of mathematics teachers, in light of the low mathematics standards currently experienced in South African schools (Taylor 2008; The Centre for Developmental Enterprise 2014). The role of teacher SDL (Beatty 2000; Slavit & McDuffie 2013) and teacher metacognition (Biggs & Tang 2011; Curwen et al. 2010; Downing 2010) in the transformation of education is emphasised in the literature.

Self-directed learning as a 21st-century skill enables the learner (in the context of this study, the teacher as a learner) to continuously adapt to the fast-changing education environment (Chalkiadaki 2018; Jaleel 2017; Tekkol & Demirel 2018). Self-directed learning is related to personal autonomy, self-management and learner control (Candy 1991) and plays a role in active learning through learner motivation, behaviour and metacognition (Zimmerman & Martinez-Pons 1986). The role of metacognition as SDL competence in support of lifelong learning is also evident in the literature (Dunlap & Grabinger 2003; Jin & Ji 2021).

In light of the value of metacognition as SDL skills, teacher educators in the South African context need to support prospective mathematics teachers to develop these competencies, not only to enable them to adapt to ongoing educational changes in the 21st century but also to serve as a drive to continuously improve their own practice through metacognition and lifelong learning, if they are to play a role in turning around the current poor mathematics standards. Biggs and Tang (2011) also highlighted the responsibility of higher education institutions to support students to develop SDL competence and the use of metacognitive learning strategies that will equip them to take control of their learning and thereby empower them as lifelong learners.

Blended learning is progressively viewed as the way forward to equip student-teachers with the relevant 21st-century educational knowledge and skills, including SDL (Bosch 2017; Bosch & Pool 2019; Olivier 2020a, 2020b; Uz & Uzun 2018) and metacognition (Acosta-Gonzaga & Ramirez-Arellano 2021; Aldalalah, Shatat & Ababneh 2019). Higher education institutions should therefore design and evaluate strategies that support student-teachers in this regard. Staker and Horn (2012) described BL as having two components: a lecturer-controlled face-to-face component and a flexible online component where students have control over the pacing and the time for accessing and completing the content provided online. Zainuddin and Halili (2016) noted that the FCA forms part of BL as an FCA integrates both F2F in-class learning with out-of-class learning where students watch online video lessons. In this chapter, the FCA, as a BL model, is suggested for mathematics student-teacher education to equip them as 21st-century mathematics teachers, with a specific focus on developing them as metacognitive and self-directed student-teachers.

The FCA is generally regarded as an instructional model (Hew et al. 2021) and a component of BL (Halili & Zainuddin 2015; Kurt 2017; Staker & Horn 2012; Thai, De Wever & Valcke 2017).

The literature furthermore confirms the potential of the flipped classroom as a form of BL to aid in the development of metacognition as an SDL skill (Kim et al. 2014; Naccarato & Karakok 2015). In a meta-analysis of various FCA studies, it was also found that this approach increases certain student cognitive functions as well as behavioural outcomes (Hew et al. 2021). However, it is acknowledged that the FCA itself does not foster metacognition but rather the way in which this approach is implemented (Lotz 2021; Van Alten et al. 2019). An investigation was, therefore, necessary to investigate how BL through an FCA should be implemented to foster metacognition and to provide guidelines for the most relevant features to be included in future FCA implementations for teaching and learning at an identified higher education institution, with a specific focus on equipping prospective mathematics teachers for practice.[8] This is an explicit problem as findings in the literature indicate the need for metacognitive skills (Flavell 1979) and that students have the potential to develop these skills with the necessary support (Callender, Franco-Watkins & Roberts 2016; Schraw 1998). Moreover, Geng, Law and Niu (2019) also referred to the limited empirical research in the field of BL in support of self-direct learning.

An initial implementation of the FCA for the teaching and learning of a mathematics module that forms part of the mathematics teacher education curriculum provided an ideal opportunity to investigate how this approach should be designed to foster metacognition and, consequently, the SDL of mathematics student-teachers at this higher education institution. Additional to this primary aim, the secondary aim was to suggest guidelines for an FCA implementation to promote metacognition at this higher education institution. The research was guided by a constructivist-interpretivist paradigm whereby the researcher's role was to understand and interpret the participants' experiences. This chapter is based on unpublished research conducted as part of a postgraduate study (cf. Lotz 2021).

The investigation was guided by the research question: *How should the flipped classroom as a blended learning approach for the teaching of mathematics student-teachers be designed to foster metacognition as an SDL skill?*

Literature review

Context

The development of SDL competence in initial teacher education programmes is set as the required outcome of South African teacher education programmes (DBE & HET 2011). In their report titled *Integrated Strategic Planning Framework for Teacher Education and Development in South Africa, 2011–2025*, the DBE and HET (2011, p. 99) expressed concern that 'few initial teacher education programmes have been designed to go beyond skills training to developing competences and reflective practice'.

8. See Chapter 3, Bailey & Breed for implementation of an FCA for metacognition in a computer-aided/-assisted; computer adaptive test (CAT) setting.

As indicated in the literature, critical thinking and problem-solving mastery can be improved through the support of students' metacognitive skills (Akyüz, Samsa Yetik & Keser 2015; Moonsamy 2014), whilst academic success can be predicted by the use of metacognition (Downing 2010; Winne 1996). The lack of metacognitive skills, such as the ability to monitor and reflect on their work, may hinder students from performing well (White & Frederiksen 1998), whilst research by Lester (2007) shows that the deployment of metacognitive behaviours is always productive. Curwen et al. (2010) advocated that student-teachers need to be supported to become reflective and collaborative teachers equipped with metacognitive skills.

There is overwhelming support in the literature for the necessity of metacognition in mathematics learning (Kramarski, Mevarech & Arami 2002). Moreover, Akyüz et al. (2015) and Moonsamy (2014) asserted that metacognitive skills improve critical thinking and problem-solving mastery as essential to mathematics. The body of scholarship indicates that the FCA, as a form of BL, has the potential to support students in developing metacognitive skills (Lai & Hwang 2016; Naccarato & Karakok 2015; Steen-Utheim & Foldnes 2018).

Blended learning through a flipped classroom approach

Central to this chapter is the notion that FCA is a form of BL; however, it is essential to unpack this concept thoroughly. Staker and Horn (2012) distinguished an FCA from traditional BL based on two aspects that set the FCA apart: firstly, in an FCA, a set schedule exists for the in-class and the out-of-class components, and secondly, the out-of-class component is used for introducing new concepts rather than completing homework.

Furthermore, the Flipped Learning Network (FLN 2014) defines the FCA as:

> [*A*] pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter. (p. 1)

The FCA helps to prepare students for tomorrow's challenges (Stanciu 2016) by supporting higher-order cognitive levels. This value of the FCA is grounded in the principles of a social constructivist approach to teaching in the 21st century (Ahmed 2016; Jarvis et al. 2014). Arguments for the implementation of the FCA for mathematics education are manifold (Bergmann & Sams 2012; McLean et al. 2016; Setren et al. 2021; Stanciu 2016; Zainuddin & Halili 2016). Naccarato and Karakok (2015) stressed that the flipped classroom is a pedagogical platform allowing educators to implement various teaching strategies based on their teaching goals, rather than seeing it as an all-inclusive learning model. The flipped classroom design principles, therefore, allow for adaptation to match the specific context and student needs. Krouss and

Lesseig (2020) agreed that there is not only one correct way to implement the FCA.

Steen-Utheim and Foldnes (2018) noted that one of the objectives of the FCA is to foster students' engagement and active learning. Analysis of the impact of flipped learning proved to be valuable and presented a positive impact on students' learning, such as motivation and engagement (Botha-Ravyse & Reitsma 2015; Zainuddin & Halili 2016). In a flipped classroom, new knowledge is constructed by linking in-class activities to previous knowledge received in video format (Bergmann & Sams 2012). In the FCA, the in-class component allows for opportunities to show understanding and clarify concepts, and the emphasis is on the collaborative reflection on previously viewed content (Ray & Powell 2014). This implies that the flipped classroom design strategies can be adapted according to different contexts and student needs.

The potential of the FCA as a form of BL to foster metacognition cannot be disputed (Al-Samarraie, Shamsuddin & Alzahrani. 2019; Limueco & Prudente 2019; Van Vliet, Winnips & Brouwer 2015). However, the way in which the FCA is implemented will greatly determine whether metacognition is indeed a learning outcome (Van Vliet et al. 2015). Therefore, a flipped-classroom implementation needs to be well-planned and well-executed for meaningful learning and, consequently, metacognition gains.

Self-directed learning and metacognition

There is consensus on the value of metacognition in academic learning (Apaydin & Hossary 2017; Chytrý et al. 2020; Van der Stel & Veenman 2010; Wang, Haertel & Walberg 1990). However, although metacognition is important, it is not sufficient for academic achievement (Gama 2004). A cognitive view of learning implies that learning is active in nature and consists of the mental processes of gaining, memorising and using knowledge (Woolfolk 2014). Metacognition is a form of cognition (Alias & Sulaiman 2017), and definitions of metacognition vary from basic descriptions to more complex explications. Whilst Campione (1987) described metacognition as the mere 'awareness' of one's own thinking, and Tarrant and Holt (2016) viewed metacognition as humans' knowledge about their thinking and learning, a definition by Flavell (1976), who initially devised this term, highlights the active role of humans in metacognition when he describes it as the active monitoring and regulation of any information processing activities as one has a cognitive transaction with the environment. Reference in this definition to active monitoring and regulation of one's own learning processes clearly links metacognition with SDL, where metacognitive regulation is a strategic process of controlling one's own cognitive activities (Apaydin & Hossary 2017). Students with well-developed metacognition are in a better position to select appropriate strategies to use in a given situation, and this sound judgement is seen as an asset of metacognition (Paris & Byrnes 1989). Learners (or students) who are aware that they are having trouble learning certain work or realise that they need help to understand a topic engage in metacognition (Flavell 1976).

Metacognition is approached as a necessary requirement and crucial skill to be acquired by teachers to facilitate meaningful learning (Aabla 2017; Chu et al. 2017; Valtonen et al. 2021) and to support the development of 21st-century skills such as SDL (Binkley et al. 2012; Chu et al. 2017). Loyens, Magda and Rikers (2008) accentuated that both SDL is essential to activate metacognitive skills. In this chapter, it is understood that self-regulated learning (SRL) supports SDL, and both concepts are regarded as important for preparing teachers as metacognitive lifelong learners that are requisites for successful teaching in the 21st century. Whereas SDL supports the student in identifying and reaching set goals (Knowles 1975), SRL refers to the concrete activities required in order to reach these goals (Bolhuis 2003). Therefore, metacognition is an important requisite for the further development of students' SDL skills.

The role of metacognition in SDL and lifelong learning has implications for the way higher education institutions support student-teachers in developing metacognitive skills. It is generally accepted that university students will increase their performance if they understand the learning process better (Biggs 1988; Downing 2010). Furthermore, teacher metacognition is a key factor in developing their learners' metacognition (Alias & Sulaiman 2017). The ability to prepare learners for an unpredictable future through being metacognitive, self-directed, lifelong learners (Guglielmino 2013) will depend on the way teachers themselves have these learning competencies. Therefore, teacher educators should pay heed to the ways in which they provide opportunities for prospective teachers to develop 21st-century skills that include metacognition.

The support in the body of scholarship for the need for metacognition in mathematics learning cannot be overlooked (Baten, Praet & Desoete 2017; Biggs 1988; Campione 1987; Schoenfeld 1992; Su, Ricci & Mnatsakanian 2016). Joutsenlahti and Kulju (2017:3) described mathematical thinking as 'an information process monitored by one's metacognition'. The crucial role played by active learning in fostering higher-order levels of learning like evaluation of knowledge and skills is accentuated by Heinerichs, Pazzaglia and Gilboy (2016). The ability for learners to evaluate their own mathematics learning processes through metacognition involves an active role in their learning when they take responsibility not only for their own learning but also as self-directed learners, as defined by Knowles (1975). Mathematics student-teachers should therefore be guided to set their own learning goals and monitor their own progress to reach these goals through continuous self-evaluation and analysis of their own learning through critical self-reflection and creating strategies to reach set learning goals.

Although the FCA is reported to support metacognition (Al-Samarraie et al. 2019; Limueco & Prudente 2019; Van Vliet et al. 2015), Rasheed, Kamsin and Abdullah (2020) described the various challenges encountered in BL that may also influence the way the FCA supports metacognitive gains. This research, therefore, set out to find guidelines on how to implement the FCA as a form of BL for metacognitive gains as part of mathematics teacher preparation at the higher education institution. Although the lessons learned through the case study related to this specific context, and no generalisations could be made, the findings can also be meaningful to other similar education contexts.

Methodology

Research design and paradigm

In this qualitative study, a DBR case study (Creswell & Creswell 2018) was employed to investigate participants' experiences of how the FCA to teaching and learning a specific mathematics module in the Bachelor of Education (BEd) Further Education and Training Phase programme supported the development of student-teachers' metacognitive skills. Directing the investigation, as suggested for DBR, the research questions have emerged from the identified problem. The study, hence, focused on the need for metacognitive skills and the way higher education institutes can foster students' SDL development as an important 21st-century skill.

This research adopted a basic qualitative approach (Merriam 2009) with the focus on participants' experiences of the way an FCA to the teaching and learning of mathematics should be implemented to support student-teachers' metacognitive skills. The cyclic implementation of the phases of the DBR, namely planning, implementation and evaluation, provided the opportunity to investigate how to implement and revise the FCA design features to improve support for metacognitive gains within the specific educational context. A constructivist-interpretivist paradigm directed the investigation and was deemed suitable for this qualitative research as the researcher and participants collaborated and co-constructed meaning (Creswell & Creswell 2018; Ponterotto 2005).

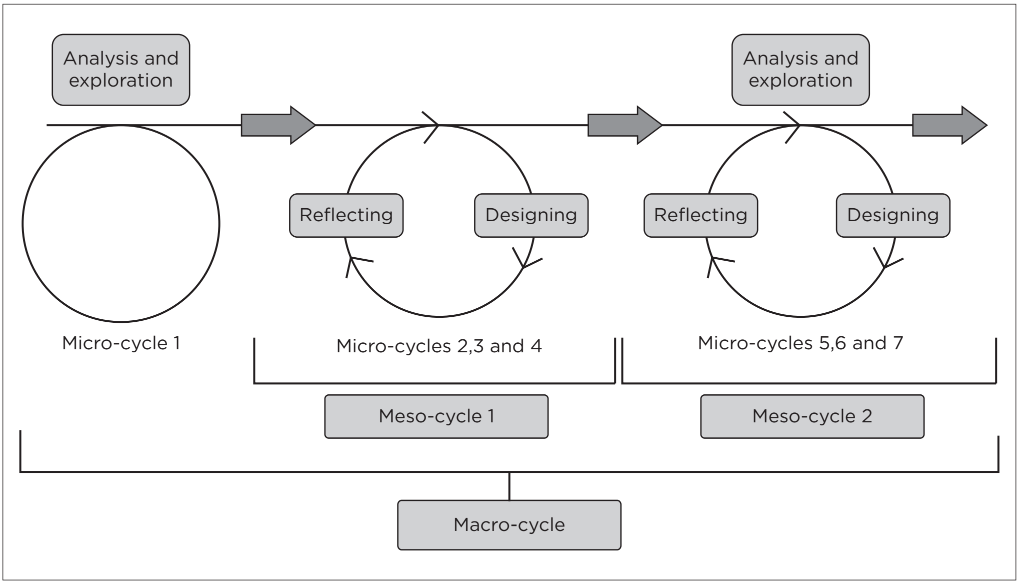
Sampling

Convenience sampling was employed for this research. This type of sampling relies on participants who are willing to participate and meet further criteria such as availability, accessibility and physical proximity (Etikan, Musa & Alkassim 2016). The inclusion criteria of the study population involved the participants being full-time first-year BEd students registered for a specific mathematics module, the current lecturer of the module and the former lecturer of the module. After an independent person, who had no connection to the study, explained the research goals to the student population, they were invited to participate. Twelve students were willing to grant written informed consent to participate in focus group interviews that provided an opportunity to gain access to students' lived experiences of their own learning through the FCA. For the focus-group interviews, the willing student participants were divided into two smaller focus groups to provide the opportunity to hear all student voices that could possibly have been a challenge in a larger group. The students were grouped into two focus groups based on their availability because of their class timetables, with eight participants in Focus Group 1 and four participants in Focus Group 2. A once-off semi-structured interview with the module's former lecturer was conducted. This former lecturer was consulted as an expert working in the field and served as an essential first step in the DBR (Herrington et al. 2007). Also, as part of the DBR cycles, semi-structured interviews were conducted with the lecturer currently responsible for the mathematics module. The current lecturer responsible for the mathematics module implemented the FCA voluntarily, and she provided access to valuable data about her experience of implementing the FCA during the previous semester. Furthermore, she provided valuable input on her planning and implementation of the FCA principles and also shared her own interpretation of the students' experiences of the FCA during the DBR process.

Data collection

Based on the DBR framework suggested by McKenney and Reeves (2012), this study implemented one macro-cycle consisting of two mesocycles and seven micro-cycles (Figure 6.1). As part of the DBR processes, data were collected through focus-group interviews, semi-structured individual interviews with both the previous lecturer and current lecturer of the respective module, as well as lecturer and researcher journals. The focus groups and individual interviews were conducted in person at a convenient time and venue. With the permission of all participants, a smartphone was used to make audio recordings of the focus groups and individual interviews for later transcribing into Word. The open-ended questions of the focus group and semi-structured interviews allowed for elaboration by participants to enrich the data on their views and lived experiences of the potential of the FCA to foster metacognition (Gill et al. 2008).

Based on the value of reflective journaling to inform educational improvements (Merriam & Tisdell 2016; Thorpe 2004), both the current lecturer and the researcher kept a journal throughout the DBR processes. The current lecturer was asked to keep a journal in which she noted down her reflections, views and observations of the flipped classroom implementations. Apart from guiding the lecturer in the continuous revising and improving the FCA strategies, the



Source: Adapted from McKenney and Reeves (2012).

FIGURE 6.1: A visual representation of the cyclic nature of the design-based research.

lecturer's journal also enriched the qualitative data by providing the researcher access to the lecturers' lived experiences as well as her reflection on and perception of student participants' experiences of the FCA.

Researcher journals are methodologically accepted in the constructivist-interpretivism paradigm (Denzin 1994). The researcher, therefore, also kept a journal that served as a diary in which the researcher made frequent entries as the research unfolded (Amankwaa 2016). In these entries, the researcher accounted for the logistics of the study, decisions being made and why, as well as personal reflections (Amankwaa 2016). Apart from its value in increasing trustworthiness in qualitative research (Ortlipp 2008), the researcher journal also provided a way to acknowledge the interaction of objective and subjective features openly and to incorporate them into a productive relationship (Newbury 2001).

In the macro-cycle, the three core processes of DBR were implemented, namely analysis and exploration, designing and construction, as well as evaluation and reflection (Plomp 2013). The process of analysis and exploration was implemented as a continual process throughout the macro-cycle, whereby data collected were analysed through constant comparison (Boeije 2002). In the first micro-cycle, a semi-structured interview was conducted with the previous lecturer of the mathematics module. The purpose of this micro-cycle was to analyse and explore the problem by obtaining information on the relevant mathematics module, the student population, as well as challenges related to student metacognition and SDL skills and potential suggestions to improve the student's development of these skills. As the previous lecturer did not participate in the design process of the DBR, micro-cycle 1 did not form part of meso-cycle 1. However, data collected in this initial micro-cycle provided important grounding for data collected in the first meso-cycle. Figure 6.1 provides a visual illustration of the cyclic nature of the DBR.

Each new meso-cycle had to consider the findings of the previous micro- and meso-cycles (Plomp 2013). Box 6.1 illustrates how the DBR principles, suggested by McKenney and Reeves (2012), were applied in this study and includes micro-cycles and the data sources that informed each micro-cycle, as well as the micro-cycles involved in each meso-cycle.

Box 6.1 illustrates that both the researcher and lecturer journals span over the whole macro-cycle and are not limited as data sources to any of the micro-cycles.

Data analysis

Qualitative data analysis is the process of coding, sorting and organising data to explain the study of interest (McMillan & Schumacher 2014), thereby condensing a significant amount of data to manageable and understandable proportions (Cohen, Manion & Morrison 2018). For this qualitative study, content analysis was used for data analysis. All data collected through interviews were analysed within and across micro-cycles, and non-verbal cues, such as gestures or refraining from participating, were also captured and analysed. Qualitative data collected through focus-group interviews with students and semi-structured interviews with the lecturer, as well as the

BOX 6.1: Designed-based research application showing data sources per micro-cycle.

Macro-cycle							**Development of guidelines: FCA design principles**
	Meso-cycle 1			**Meso-cycle 2**			
Micro-cycle 1	**Micro-cycle 2**	**Micro-cycle 3**	**Micro-cycle 4**	**Micro-cycle 5**	**Micro-cycle 6**	**Micro-cycle 7**	
Analysis and exploration	Designing and constructing	Evaluation and reflection	Analysis and exploration	Designing and constructing	Evaluation and reflection	Analysis and exploration	
Data sources				**Data sources**			
Semi-structured interview with the previous lecturer	Semi-structured interview with current lecturer/ collaborating with the lecturer on design principles	Focus-group interviews	Content analysis	Semi-structured interview with current lecturer/ collaborating with the lecturer on design principles	Focus-group interviews	Content analysis	
Lecturer and the researcher's journals							

Key: FCA, flipped classroom approach.

researcher and lecturer's journal, were typed into a Microsoft Word document for inclusion into the combined qualitative data set in ATLAS.ti™ (version 8.0).

Data collected throughout the DBR were analysed through a metacognitive lens with a specific focus on identifying ways to improve the way the FCA fosters metacognition. During meso-cycle 1, data were analysed concurrently with data collection and coding to improve the design (Feng & Hannafin 2005). Thereafter, a comparative analysis was done to compare data collected in meso-cycle 1 with data collected in meso-cycle 2 (Cobb et al. 2003). The comparative analysis led to a need to consult more of the literature as suggested for a DBR approach (Creswell & Poth 2018). As mentioned by Boeije (2002), a comparative analysis is supported in different ways, such as memo writing, reading and revisiting transcriptions, coding and making use of visual displays. Memo writings can capture 'your reflections, tentative themes, hunches, ideas, and things to pursue that are derived from this first set of data' (Merriam & Tisdell 2016:196). For this research, memo writing was captured as part of the researcher's journal. A holistic retrospective analysis was done after the DBR, focusing on all aspects of the study (Gravemeijer & Van Eerde 2009). For the retrospective analysis, we considered the lecturer participant's expertise to lessen researcher (single person) bias (Cobb et al. 2003) that was implemented during the reflection interview with the lecturer participant after the DBR.

As suggested by Sarma (2015), the trustworthiness, transparency and subsequent dependability of the analysis were enhanced by describing the sampling, data collection and methods for data analysis of the study in detail. Qualitative methodological data triangulation was incorporated, whereby data were collected through various methods and from multiple sources (Creswell 2012) and captured a more holistic picture of the study. A detailed description of the context and background was given to allow comparisons to be made and possible implementation of the guidelines in similar contexts. To support dependability, the researcher's journal also served as an audit trail during the research process and recorded significant activities, including dates, time and thoughts as they occurred, which may be valuable for the research process to support authenticity and consistency and provide other researchers with the opportunity to duplicate the study in the same way. According to Guba and Lincoln (1989), when the aims of credibility, transferability and dependability are all reached, it means that confirmability is established. The application of within-method triangulation and data triangulation, therefore, also strengthened confirmability.

Research ethics

For this research, as human participants were involved, ethical clearance was required, and the process of the Research Ethics Committee of the

Faculty of Education of the North-West University was followed. Research ethics clearance (NWU-00630-17-A2) was issued, and the study adhered to the university's guidelines. Permission to approach student participants enrolled at the higher education institution was attained from the gatekeeper of the institution. For the recruitment of participants, the aims of the research and what was to be expected of the prospective participants were explained by an independent person, disclosing any possible risks. Even though the study was considered low risk for participants, all data were handled confidentially, and the privacy of the participants was respected.

■ Findings

In meeting the primary research aim, core findings based on data collected from the participants as well as through the researcher journal, as analysed through a metacognitive lens, indicated prerequisites for effective FCA design to support metacognitive gains. Findings include acknowledgement of the changed roles of students and lecturers in an FCA, efficient integration of technology for meaningful teaching and learning, the need for more scaffolding and feedback, and the relevancy of the level of mathematics content for a flipped classroom as well as a lecturer and student motivation. The vital role of student motivation in learning (Bolhuis 2003) impacted all other components of the flipped-classroom implementation and the opportunity for metacognitive gains through the FCA.

As part of this discussion, some quotations from the data analysis (cf. Lotz 2021) are presented verbatim. According to the former lecturer, students lacked metacognitive skills, implying that before the implementation of an FCA, students may need support in developing these skills:

> 'One has to give them guidelines; you cannot just expect them to be self-regulated now that they are at university. They are not going to know where to start, so there really should be guidelines. This is the challenge; a lecturer will have to plan very carefully.' (Former lecturer, Female, Individual interview 24 April 2018)

When the current lecturer was asked where it was noticed that students employed metacognitive skills, the lecturer indicated that both the diagnostic test and the in-class group work activities are likely to support students in determining what they know and what they do not know – which relates to declarative metacognitive knowledge (Flavell 1979):

> 'They will say it helps them to see what they know then and what they do not know then and then they can, in that group with their group mates now… even if they do not understand something, ask someone.' (Current lecturer, female, individual interview on 10 September 2018)

The current lecturer also noted in her journal that a male student (not a participant in the study) experienced the FCA as supportive of learning:

> 'It's good and works for him because he can figure out what he knows and what not. He also learns from peers at his table.' (Current lecturer, female, lecturer journal entry 22 August 2018)

The current lecturer exhibited knowledge about metacognition as a determinant of the successful implementation of the FCA – as is shown in the quotation below:

> 'Let's say it's a bit of a more difficult concept, and they did not understand it well on the video, I think the fact to be able to know: "I did not understand this, I now have to think carefully about what I must ask." For me, that is metacognition.' (Current lecturer, female, lecturer journal entry 22 August 2018)

In the above quotation, the current lecturer mentioned an important benefit of the FCA: students need to employ metacognitive skills to plan, monitor and evaluate their learning process during out-of-class learning.

From the investigation, it became clear that various features of the FCA have the potential to foster metacognition, as suggested by Van Vliet et al. (2015), considering that it is well executed as it is not the FCA itself that has the potential to foster metacognition but how it is implemented. Also, the challenges concerning the implementation of an FCA for metacognitive gains became apparent.

A crucial finding from this research is the importance of understanding the changing roles in an FCA of both the lecturer and the students. Even though the FCA was explained to students before the course, students often did not grasp their role or the lecturer's role.

Moreover, Rotellar and Cain (2016) claimed that the paradigm shift in an FCA might be more challenging for educators than for students. The authors say that if an educator believes that being a good teacher is an innate ability, educators find it even more challenging to let go of their role as the deliverer of content. The following quotation by the current lecturer explains that she too might have had difficulty with the required changed role of the flipped classroom as described:

> 'They said yes, they pertinently told me every time; they think I should put up videos of the classes that I would then have explained in class because remember, I do not actually explain in class unless they ask me. Ask me about what they've watched. And then, the typical teacher that I am, then I say: okay, let me give you a lesson on this. Then I might expand a little more than they might have even asked, and that's why I thought I actually, because I know now what I really want to teach them in the videos, that the links and everything is actually a bonus and extra, but I teach them a basic lesson on what I feel they need for that lesson.' (Current lecturer, female, lecturer journal entry 06 November 2018)

Thus, defining the FCA to students requires a change of strategy. The findings indicated that students found that the FCA mainly entails self-study and unguided completion of tasks. Students voiced their need for support in the form of scaffolding for out-of-class learning to make objectives clear.

The finding agrees with Zack et al. (2015), who investigated a flipped classroom of an undergraduate mathematics course where students felt like it was expected of them to teach themselves. De Corte (2004) emphasised that an active view of learning requires scaffolding and does not suggest the absence of student guidance in their knowledge construction.

During the investigation, the critical role of the lecturer's knowledge and understanding of their role for a successful implementation of an FCA became apparent and is also highlighted in previous studies (FLN 2014; Fredriksen 2020; Lo, Hew & Chen 2017; Steen-Utheim & Foldnes 2018). We agree with Fredriksen (2020), who also advocates for more research on the lecturer role in an FCA, as it will impact the design's potential for metacognitive gains. Lecturer knowledge and skills of the student's zone of proximal development (ZPD), as suggested by Vygotsky (1978), and provision of differentiated levels of questions during in-class learning, influenced student motivation and possibly hindered the development of metacognition. Based on the findings, making the paradigm shift to a more student-centred approach by both the lecturer and the students are crucial as the change in roles might challenge their beliefs about mathematics teaching and learning. The lecturer tends to cling to her role as the content knowledge provider and finds it challenging to adapt to her new role. Emerging reasons for not being able to transform to a student-centred approach truly include lecturer workload and a belief that students may not be ready to take ownership of their own learning through SDL. Still, the lecturer acknowledged the need for a mind shift to ensure the FCA supports SDL and metacognitive gains. As teacher educators, Nogueiras and Iborra (2017) highlighted the importance of challenging your own beliefs whilst trying to challenge the students' beliefs. During the data analysis, it became apparent that prior subjection to the traditional transmissive and content-based approach to education may have hampered students and the lecturer in making the necessary paradigm shift. Such a traditional view of education might have hindered metacognitive gains that are crucial for education in an environment that entails new demands from students and educators (Candy 1991; Darling-Hammond et al. 2020).

The importance of the efficient integration of technology as part of the FCA was highlighted during the study. In concurrence with Kaur (2016) and Schrader (2015), who claimed that technology is regarded as the new mediator of learning that enhances learning and teaching methods, it was evident that integrating technology in an FCA needs to be meticulously planned. Skills of navigating online learning systems as the primary source of communication for out-of-class learning are critical. Out-of-class learning is again crucial for the success of the in-class learning activities (Kaur 2016). As the online LMS is the main source of communication with students concerning out-of-class sessions, lecturer expertise in this area plays a role in the success or failure of the FCA. The investigation did not specifically set out to collect evidence of out-of-class activities, but through experiences shared by the participants, it became apparent that deficiencies in the use of the LMS may have jeopardised the value of the out-of-class component of the FCA and, therefore, also the value of this approach in supporting the development of metacognitive skills.

Furthermore, informed by the findings, we concur with Lo et al. (2017), who recommended that the LMS be utilised to monitor students and how they learn in an FCA to understand student out-of-class learning behaviour better. The literature confirms the role of the LMS as a potential scaffolding context for SDL (Tredoux 2012), implying that the lecturer has the necessary skills and knowledge to organise and manage the LMS to contribute toward this aim.

Compared to data collected in the first meso-cycle, the lecturer provided more detailed information on the LMS as a stronger scaffold for learning that was implemented in the second meso-cycle. Students experienced this support as positive:

> 'What I liked about that particular lesson is, we got a notification that here are the "links" and that you should prepare for next lesson instead of [...] you do not always have the time to go open every single link and look, okay, where am I now, you know [...].' (Student participant, female, Focus Group 3)

Inefficient use of the LMS can demotivate student participation in out-of-class activities and hamper the opportunity for metacognitive gains.

The relevance of learning content for a successful FCA strongly emerged from the data analysis. The familiar content, the difficulty level of the content and the overlapping of content with another module played a big part in investigating the FCA for the mathematics module. Data collected from both the lecturers involved in the study and the student participants indicated that students failed to see the module's value. The majority of the students reportedly were not motivated to prepare for in-class learning because they were not challenged by the mathematics problem-solving tasks and could complete in-class learning activities without preparing for class:

> 'For me, these are not really new concepts, because in both the subjects we have now, in Mathematics, we do the same basic, and that's what you did at school. So, it's not that we're learning new concepts, I don't think it feels like I've had the flipped classroom feeling yet because I never went and found things out on my own, it's just… ah! I did this at school, so I understand what's going on here.' (Student participant, female, Focus Group 1)

Calder and Campbell (2016) as well as Kunnathodi and Sarabi (2017), also highlighted the role of challenging content in successful learning. Therefore, the level of problems posed for out-of-class activities required an adaptation in the design, especially as Bolhuis (2003) claimed that students would not be motivated if learning needs were not met. Rajaram (2019) recognised that lecturers unfamiliar with the FCA might experience challenges in providing meaningful activities, as was found in this study.

Apart from the need for student SDL skills to ensure successful learning in an FCA, Kim et al. (2014) confirmed that the students' changing roles in an FCA result in a need for more structured guidance by the lecturer to ensure a positive learning experience. Students lost motivation when they struggled to figure out what was expected of them in the out-of-class activities:

> 'Or maybe she can just for example hmmm [...] where you get the work, there where she puts the study units and summaries, putting the video there, instead of just listing videos, that what you need for that section [...] that the videos are with it.' (Student participant, female, Focus Group 3)

Another aspect that influenced student motivation was a lack of feedback, as explained by a student participant:

> 'Yes, because I think feedback is going to help quite a lot because at the moment it feels to me if you did not figure out the answer yourself, then [...] you hope it's correct and that it won't be in the exam.' (Student participant, female, Focus Group 3)

Therefore, two essential factors that possibly hindered student motivation and metacognition were insufficient scaffolding and feedback. Irrespective of sound PCK, the lecturer's applied competence in using the LMS to provide continuous support and feedback played a central role in student motivation and the successful implementation of the FCA for metacognitive gains, especially when students lack SDL skills, as reflected by the data.

Students had a positive experience regarding the active in-class learning opportunity as one of the FCA's main benefits (De Boer & Winnips 2015; Heinerichs et al. 2016) and indicated that they learned from their peers by comparing strategies. The lecturer also noted that active in-class learning provided her access to student thinking as they collaborated with peers, which allowed her to access student thinking. The in-class component thus offered the opportunity to support metacognition. However, the data analysis also exposed that some students lack the necessary SDL, SRL and metacognitive skills needed for successful out-of-class activities. Van Alten et al. (2019) also warned that a lack of student SRL might disadvantage student learning outcomes in an FCA. Apart from the need for the modelling of SDL skills for students (Jaleel 2017), this finding also implies that, for an FCA to foster metacognition, explicit teaching for metacognitive gains is essential, as found by Ku and Ho (2010) and Cunningham, Matusovich and Blackowski (2018). Teaching metacognitive skills as preparation for the FCA in support of metacognitive gains did not fall within this study's scope but should be explored through further empirical studies.

Discussion

A number of general trends could be identified from the findings. It is evident that students lacked metacognitive skills despite having demonstrated some knowledge of elements related to metacognition. Reflections on the side of both the lecturers and students showed the potential of an FCA to promote metacognition as an SDL skill within a BL context. However, employing the FCA with the intention also to support metacognition requires consideration of the roles of both the lecturer and the students, certain BL design principles, as well as considering the way course content lends itself well to learning tasks that require the application of metacognitive strategies through SDL.

An important finding from this research was the fact that both lecturer and students need to adapt their roles in the BLE consciously. It was also evident that more scaffolding and support, as was provided during the second meso-cycle, would be needed to make the FCA effective. However, to ensure that students experience the learning tasks as challenging, the lecturer will need to be well informed of the student's cognitive level, and the degree of difficulty of the module or course content in order to provide scaffolding that is within the student's ZPD as suggested by Vygotsky, Planning and implementing the FCA require thorough planning and continuous reflection and monitoring of students' cognitive progress. The lecturer should therefore be committed to the FCA and its grounding principles.

In terms of BL, the integration of technology needs specific attention. This also requires sufficient skills in using the LMS by both lecturers and students as well as carefully planned activities and content, especially when aiming to support metacognition. Functionalities within the LMS that can track student cognitive progress with regard to the FCA may also show promise.

Furthermore, an effective FCA requires appropriate and relevant content. In this regard, content planning should not just be approached intramodulary but also intermodulary in order to align content across different modules and even years. Within this context, the difficulty level of problems used outside of the classroom context needs to be carefully considered when planning the FCA learning tasks.

Student motivation emerged as an important variable that lecturers need to consider and manage. Here specifically, insufficient scaffolding and feedback emerged as key influencing factors. Active in-class learning opportunities were well received by students.

From the data, a number of recommendations were evident, and they are discussed in detail in the next section.

Recommendations

As learning needs are different and because of the FCA's flexible nature, a large variety of activities can be used for both in-class and out-of-class learning. Based on their findings of the review of FCA studies, Akçayır and Akçayır (2018) surmised that using appropriate activities for meaningful learning is essential. Requisites of a successful FCA, such as flexibility, student-centred learning activities and specific course requirements, might discourage some lecturers from implementing the FCA and, more so, explicitly aiming to use the FCA for metacognitive gains. As suggested by Zepeda et al. (2019), educators possibly need support concerning different kinds of instructional activities intending to foster metacognition. Based on the principles mentioned above, various metacognitive activities for an FCA are summarised in Table 6.1. The table contains the suggested principles described above, a practical strategy to achieve each principle and a strategy for the explicit fostering of metacognitive gains.

Limitations

Firstly, as stated before, this research is confined to a selected module at a selected university, and findings cannot be generalised to all contexts. Furthermore, it is regretted that the informal meetings with the lecturer were not included as part of the DBR because that could have provided further insight into the study's findings. Time constraints because of lecturer workload may have hindered critical reflection on lessons learned and how to improve

TABLE 6.1: Suggestions for explicitly teaching for metacognitive gains in a flipped classroom approach design grounded in the empirical findings and the literature.

No.	Principle	Strategy for meaningful application of the FCA for metacognitive gains	Metacognitive strategy
1	Explain the FCA to students, focusing on both student and lecturer roles	Spend time providing a thorough in-class explanation as well as an online video explanation providing for absent students; emphasise the importance of out-of-class learning (Ray & Powell 2014) and the benefits of in-class learning. Provide particular support for students to adapt to the new approach (Dhawan 2020).	Provide in-class reflection time on their roles in the FCA to promote student understanding. Sharing their understanding of their roles provides the opportunity for the lecturer to clarify any uncertainty or lack of clarity.
2	Explain metacognition to students, including the value and the aim of an FCA to support these skills	Metacognitive skills are important to be successful in an FCA. Therefore, students need to be supported in diagnosing their metacognitive needs to develop metacognition further. It is encouraged by Manasia and Pârvan (2014) to explain the importance of metacognitive skills as well as metacognitive teaching strategies to students.	Create awareness of their thinking by engaging students in their metacognitive development (Cunningham et al. 2018) and equip them to model metacognition to their learners one day.

Table 6.1 continues on the next page→

TABLE 6.1 (cont.): Suggestions for explicitly teaching for metacognitive gains in a flipped classroom approach design grounded in the empirical findings and the literature.

No.	Principle	Strategy for meaningful application of the FCA for metacognitive gains	Metacognitive strategy
3	Provide a well-designed online environment that includes quality and relevant video content, and that provides efficient scaffolding for and feedback on learning tasks	The online learning environment aims to support SDL and metacognitive gains. Therefore, for each out-of-class learning session: • State clear learning objectives (what must be completed). • Allocate specific videos that all students must watch and provide additional sources based on experience or diagnosed student needs. • Allocate worksheets and quizzes (principle 4) and provide a memo. Knowledge and skills concerning the online platform used are crucial. Consider an online forum for questions that can be answered by the lecturer, peers or in-class. Preferably use software that integrates all elements required for teaching and learning rather than stand-alone software (Denton et al. 2008).	Guide students by providing scaffolding for learning (Kim & Lim 2019; Rajaram 2019). Scaffolding can include time frames and reminders to draw students' attention (Dhawan 2020). Consider checkboxes that students can check as they complete tasks (Kirsh 2005). Include self-assessment as part of the out-of-class activity (Siegesmund 2017). Create tailormade videos and consider using software to build in specific prompts during the video and a mechanism to monitor who views the videos. Encourage students to pause and rewind videos for clarity.
4	Provide a worksheet or quiz with feedback as part of the out-of-class learning for students to use as preparation and for the lecturer to monitor student preparation for in-class learning (marks incentive depends on lecturer goals and views)	For example, a quiz on Google Forms scaffolds SDL and generates data to provide the lecturer with instant feedback regarding student answers to prompts and questions. Provide detailed memos on the LMS to allow students to check for understanding.	Reflective prompts. To say 'the quiz is to reinforce what you have learned' rather than 'to check for preparation'. Encourage intrinsic motivation (Lucariello et al. 2016). Encourage students to share their strategies of how they answered the question. Encourage students to diagnose their learning and adapt their strategy for out-of-class learning if they struggle with out-of-class quizzes and worksheets.
5	Modify in-class learning based on students' out-of-class learning	Motivate students by highlighting the benefits of preparing for the in-class activities as part of the FCA and actively engaging during sessions (refer to principle 1). Use quiz data and reflective prompts to identify trends in student misunderstanding or questions to modify in-class sessions. Address identified issues in-class before group activities are introduced. Provide differentiated questions based on out-of-class data.	Accommodate the students' ZPD (Shen & Liu 2011). Provide clear instruction (Boysen 2016). Provide space on the online platform where students can publish their work to compare methods and strategies.

Table 6.1 continues on the next page→

TABLE 6.1 (cont.): Suggestions for explicitly teaching for metacognitive gains in a flipped classroom approach design grounded in the empirical findings and the literature.

No.	Principle	Strategy for meaningful application of the FCA for metacognitive gains	Metacognitive strategy
6	Provide ample time, feedback and support for in-class problem-solving	Encourage active learning during in-class problem-solving. For an FCA to foster metacognition, 'student-teachers must get the opportunity to assess the task at hand, to evaluate their strengths and weaknesses, to plan their approach, to try and judge various strategies, and to reflect how far every approach and technique they purposefully experiment is working' (Kunnathodi & Sarabi 2017:27). Such a classroom environment takes time, and some students work faster than others. Accommodate all students' needs by providing differentiated questions.	Think-aloud protocol (Jacobse & Harskamp 2012). Assessing understanding requires not merely considering answers but also thinking and reasoning. Concept mapping. Explain think-aloud protocol to students, and whilst assessing, consider thinking and reasoning and not only the answer or solution. Assist students with problem-solving by questioning them and encouraging students to use words and drawings (Su et al. 2016).
7	Facilitate peer-assisted learning	Facilitating group activities in which students are guided to exchange ideas and strategies and discuss arguments.	Implement group work for in-class activities, give specific guidelines for groups and explicitly teach how to support each other. Provide reflective prompts to guide group work. Explain the think-aloud protocol to be followed. Lecturers should model metacognition.

Key: FCA, flipped classroom approach; SDL, self-directed learning; ZPD, zone of proximal development.
These guidelines, based on empirical findings and relevant literature, can act as a guide on how an FCA could be designed to foster metacognition in mathematics student-teachers.

on previous FCA implementations. However, after the first two meso-cycles, the lecturer demonstrated a better understanding of her role in an FCA. A third meso-cycle could have provided more time to streamline FCA design principles and to gain further insight into participants' experience of the FCA design after more design adaptations had taken place and could have provided us with the opportunity to ask follow-up questions regarding challenges experienced during meso-cycle 2. Therefore, more time and cycles should be allocated for a follow-up study.

Finally, incorporating more class observations into the research design could have strengthened some data analysis by allowing us to make stronger connections between focus-group interview discussions and first-hand data from in-class learning sessions. The fact that the mathematics module content was familiar, and content overlapped with another module, caused frustration for students and could have influenced students' ability to reflect on their learning. Hence, response bias might have occurred because of frustration with the module content. We could have explained the concepts of metacognition and FCA and the role of the student as a self-directed learner more thoroughly to participants rather than assuming their level of understanding. A more in-depth understanding of the concepts might have led to different responses to some of the interview questions. Also, assumptions were made concerning shared goals between the researcher and the lecturer regarding the FCA implementation, which led to a lack of clear communication on the part of the researcher.

Conclusion

In conclusion, after the implementation of an FCA as a component of BL, it is evident from participants' experiences and beliefs that certain design features could foster metacognition. As the research process progressed, the importance of motivation, the appropriate level of challenge, and the lecturer's critical role in an FCA became apparent. This study found that the importance of well-planned in-class sessions needs to be given equal consideration. Furthermore, even though some of the design features could not be thoroughly investigated as planned because of the familiar content that led to some students not engaging as part of the out-of-class learning as hoped, we are of the opinion that the FCA can be designed in such a way that both the lecturer and the students can benefit through its potential to foster metacognition in student-teachers. In conclusion, it is evident that through careful planning and iterative processes, an FCA to mathematics teacher training can contribute towards a BL that is supportive of the fostering of metacognition as an SDL skill.

Chapter 7

Academic flexibility to implement information communication technology in using blended learning: Post-COVID-19 era

Joyce P. Dhlamini
Research Unit Education and Human Rights in Diversity,
Faculty of Education, North-West University,
Mahikeng, South Africa

Abstract

This chapter discusses the use of BL as it is used in the creation of a situation in which teaching and learning occur when lecturers and students are physically separated from each other. It is a way of learning where there is a physical distance between the student and the institution. This promotes SDL in the institutions. The outbreak of COVID-19 in March 2020 called for a new approach in the education system, both in schools and tertiary institutions. The chapter includes a discussion on the implementation of BL for teaching and learning in the institutions of higher learning (IHL) environments

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considering their pedagogical costs. This is a matter of critical importance for most universities and the IHL regarding the development and the application of ICTs within their practices. The purpose of this research study was to investigate the flexibility of academic staff to make use of the available and relevant technology in BL and pedagogical technology in their teaching. BL uses a variety of technologies and emphasises interaction between the participants in learning. The theoretical framework underpinning this study is Transactional Distance Theory (TDT), which implies the dynamics of the learning process taking place between the lecturer, student and learning resource. The study employed a qualitative research design. This research employed convenient sampling where four university lecturers and 10 university students were interviewed. Major findings from this study revealed that universities have to make adjustments to adapt to BL in monitoring and evaluating the work of geographically distant students. Recommendations are made for lecturers to be accustomed to more conventional teaching modes to acquire new skills in order to assume to expand roles not only to teach students but also to organise instructional resources suitable in content and format for independent study for the BL design.

Introduction

It is no doubt that after the outbreak of the COVID-19 pandemic in South Africa, most IHLs were not ready to change their teaching and learning approaches. The universities that were predominantly F2F in their teaching approaches had to shift drastically to the new various online and remote teaching modes. Academics were not ready or prepared to be flexible towards the adjustment to new approaches to teaching and learning. However, this whole new approach to remote teaching had its own challenges, which were faced by different universities that had their own disparities, including their geographical environment and the poverty levels of their community. According to Carrion-Martinez et al. (2020), SDL is becoming highly relevant and expanding rapidly throughout the world, although there are challenges that are coupled to this SDL. In countries where poverty and inequalities still exist, most challenges are faced by students to reach out to effective learning through BL. On the contrary, academics were incapacitated to face the new approach, which did not give them any choice but to get engaged in the process of change (Makwembere, Matarirano & Jere 2021). This chapter discusses the flexibility of academics to comply with this radical change to online teaching.

The new approach to BL captured professional encounters and reflections needed to understand the effects of this drastic move to the new approach to teaching. However, there are existing disparities in South Africa that have a negative impact on certain groups of the community, which are highly hit by poverty. Most universities and other IHLs in South

Africa were facing their own different challenges depending on their geographical environment. Such differences were brought about by the poverty gaps within the institutions and their incumbents, which had their own challenges in coping with the change. MacIntyre, Gregerson and Mercer (2020) emphasised the importance of emotional support and coping strategies for academics in various institutions. As these academics are at the forefront of the new approach to teaching and learning, their morale is important for the best performance of the institutions.

This chapter investigates the flexibility and the readiness of academic staff to implement BL in their teaching and learning in the IHL. There have been various calls in South Africa for what might be termed status reports on the emergence of ICT in the educational context. Colas Bravo, De Pablos Pons and Ballesta Pagan (2018) stated that the use of ICTs with BL has the advantage of low costs procedure that allows access to the majority of students and lecturers. The Department of Education (DoE) also published a white paper on the development of e-education in 2004 (DoE 2004; Ngugi 2007). The implementation of technology in BL is already changing the organisation and the mode of pedagogic delivery in higher education institutions. The pedagogical and socio-economic forces have driven the institutions to change their curriculum delivery mode to include and incorporate technology in their teaching and learning programmes. However, e-learning is facing socio-economic challenges related to inequalities and a poverty gap within the society, including information access, greater communication and lack of synchronous and asynchronous learning. Other universities were implementing synchronous learning, which is the interactive two-way online or distance education that happens in real time, in this instance, with the lecturer. This includes educational videos, chat-based online discussions and interactive webinars where students would come together to share learning content. On the contrary, asynchronous learning occurs virtually online and through prepared resources, without real-time lecturer-led interaction (MacIntyre, Greger & Merce 2020).

Universities have moved towards a new era of embarking on blended teaching and learning mode, and this has affected both the students and the academic staff (Batanero, Cabero & Lopez 2019; Ngugi 2007). At the same time, there are various new policies and initiatives that are implemented in IHL that have a huge impact on all the phases of its incumbents. The fact that the application process for admission into a university has moved to an online application verifies a great migration towards the use of ICTs by all (Kimberly 2014). This process indicates the readiness of the university to implement ICTs. In recent years, there has been a groundswell of interest in how computers and the Internet can be harnessed to improve the efficiency and effectiveness of education delivery at all levels (Saykili 2018). Blended learning is aiming at applying ICT to enhance and support teaching and learning.

One can affirm that BL is gaining a firm foothold momentum in IHL around the world (Aguti 2006). Blended learning is a flexible learning mode that uses ICT resources, tools and applications, which may involve the use of the Internet, software, other media and telecommunication (MacIntyre et al. 2020). This new teaching and learning mode further focuses on accessing information, interaction amongst lecturers and students and the online environment. Collaborative learning and the production of open educational resources (OERs) become necessary. Universities, through OERs, provide access to digital knowledge resources for use by students using any connected device anytime and anywhere for their learning purposes (Bee & Bjokland 2004). A challenge of implementing BL at a university has been based on students with different skills in using ICT and access to the Internet because of their different geographical areas and other socio-economic situations.

Problem statement

Despite the continuing growth of positive use of ICTs in universities, there are still challenges facing the academic staff in the implementation of such technologies and BL:

- Are the students and lecturers ready for SDL?
- What is the present state of BL in the universities?
- Are the lecturers ready and flexible to implement BL for students from different socio-economic backgrounds?
- Have they received enough training to equip them with skills to implement ICTs for SDL?

University students come from different demographical areas, and they are also faced with different socioeconomic statuses; thus, BL continues to be present to cater to various sections of the communities. However, BL receives the priority to facilitate effective teaching and to learn in the institutions.

Research objective

This chapter's main objective was to investigate the flexibility and readiness of the academic staff to make use of blended learning in their teaching and learning programmes in BL environments. The staff are required as a strategic priority to support BL and SDL in their classes, and hence it is important to investigate how flexible they are and how equipped they are to use technology as an integral part of BL implementation. The implementation of the new mode of communication uses a complete shift to distance and, ultimately, e-learning in the university. It is thus required for the university to create certain strategies to support BL and SDL in their classes, and hence, it is imperative to investigate how flexible they are as flexibility is an SDL skill (Almanthari, Maulina & Bruce 2020). In addition, it is imperative for the institution to equip the staff to use advanced technology as an integral part of BL implementation. This implies a drastic shift in all the operations and systems at the institution. It is also aiming to discover the factors that are influencing and creating obstacles to the effective implementation of the model by the university lecturers (McInfosh & Varoglu 2005). However, owing to geographical conditions, financial considerations, family obligations or any other challenge, BL has become the best media of communication in the education fraternity.

Theoretical framework

The theoretical framework that underpinned this study is the TDT proposed by Michael Moore (1993). Transactional Distance Theory provides a theoretical framework from which to develop a successful distance learning environment by balancing the interaction of course structure, students and lecturers. The 3D model puts the emphasis on pedagogy more than the demographics of students (Moore 2006). The equivalency approach was also employed to measure the common elements in teaching, learning and learning material. These elements should offer rigour for distance learning. It is expected that lecturers and students, through e-learning, should experience quality teaching and learning. Equivalency theory stresses the importance of the equivalent value of learning experiences of the students studying through distance learning with the universities. Once the university decides to embrace both e-learning instead of F2F tutorial class mode, it should render teaching and learning experiences through equivalent value (Nage-Sibande & Van Vollenhoven 2012).

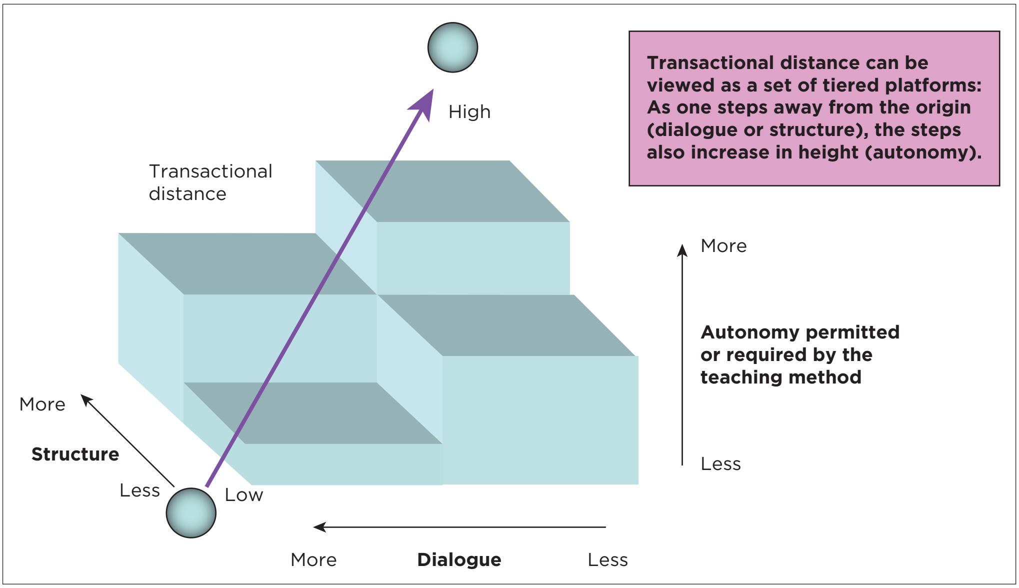
Transactional Distance Theory brings together the elements of structure, dialogue and method of learning. It also forms an interaction between the student and the lecturer. Furthermore, the theory also refers to the management of the teaching and learning relationship through SDL. Despite the flexibility of the BL approach, it also has its major disadvantage, which is the creation of a communication gap between a student-student and student-lecturer. It is the way in which distance and possible lack of communication can be manipulated. Cuong (2016) argued that TDT identifies that distance in distance education is not only geographical in nature but also psychological and pedagogical in nature. This argument means that lecturers and students are situated far apart from each other. However, teaching and learning content bring them together through BL.

Peters (2002) denoted the interplay amongst the condition faced by IHL, persons and configurations of behaviour in a learning situation. According to transactional theory, education is a transaction, and therefore, it is termed the distance learning process or e-learning. The psychological and communication gap between the lecturers and students is known as transactional distance (Peters 2002). On the contrary, Moore and Fodrey (2018) stated that Internet teaching and learning affect the nature of the teaching and learning approach in contrast to the conventional approach. After the outbreak of COVD-19 in South Africa, most IHLs had no choice but to embark on a distance approach to teaching and learning.

This chapter is more concerned with pedagogy than the distance between the student and the lecturer. The focus is on the flexibility of the academic staff to implement modules and courses that are offered at the university through BL. This theory will give direction as to whether academics are changing to include and incorporate the use of technology in their teaching and learning programmes. According to Martindale (2002) for transactional distance to be successful, it requires the student, the lecturer and a communication channel. However, the academic staff, including the lecturers, require a specialised instructional technique, which will equip them to manage distance teaching through BL.

The social constructivist theory relates to a 3D model as it tells us that we build new knowledge from the existing knowledge. This theory provides, unintentionally or intentionally, the foundation of the LMS (Swenson & Taylor 2012). In the same breath, the social constructivist theory applies BL in teaching and learning, thus enabling the lecture to reach the students who are physically far away from each other. The relationship between constructivism and pedagogy is emphasised by the 3D model in Figure 7.1; it is based on communication, and it encourages communal, collaborative and cooperative work that leads to the joint construction of new knowledge and understanding of the content by the student and the lecturers (Bravo, De Pablos & Ballesta Pagan 2018; Pritchard 2007). A learning management system is of great help to the students and the lecturers to develop a dialogue between students and lecturers and also between students and other students through e-learning. The learner-centred learning environment is developed to enable the student to assign meaning to the learning content. It is important to allow the students to establish meaningful learning for successful knowledge acquisition. The engagement of the student is then monitored and mentored by the lecturer with an intention to allow students to assign meaning to their learning content. The following table illustrates the 3D model and emphasises the collaboration and cooperative work on pedagogy.

The social constructivist theory serves as a core of the interactive learning and teaching. Paulo Freire (2005) referred to this interaction as co-intentional education, whereby both student and lecturer become equalised in the pursuit of knowledge. This will mean promoting a strong and trusted relationship between the lecturer, student and the learning content. The social constructivist provides the foundation of the LMS to be used by an institution; thus, it provides a convincing explanation of the enormous flexibility of academic teaching and also provides an insight into the pedagogical complexity of open



Source: Adapted from Moore (1993).
FIGURE 7.1: A 3D model of transactional distance.

distance learning (ODL) (Moore 1973). There have been numerous changes that have been implemented in the education system. Since the outbreak of COVID-19, education institutions have had no choice but to introduce e-learning in their teaching and learning modes. The implementation of BL by some IHLs had many challenges. Such challenges were related to socioeconomic status, including the poverty situation of the majority of students and learners in South Africa. Blended learning brings a dimension of creating a relationship between the curriculum and physical environment to students and lecturers (Villacis & Franco-Crespo 2019).

Conceptions of blended learning

A blended learning environment is essential to foster SDL in the institutions to enable flexibility in teaching and learning processes. The contextual significance of distance education is paramount. Thus, it remains imperative for this chapter to provide a contextual significance of distance education. It is noted that distance learning is sometimes referred to as e-learning, which is characterised by the physical separation of lecturers apart from students (Kafyulilo et al. 2015). This process of e-learning also involves the control of student learning (an SDL ability) rather than distance teaching and learning. It also implies disconnected communication between the student and the lecturer. According to Moore (ed. 2013), the disconnection between students and lecturers and resources can be bridged by the utilisation of interactive telecommunication.

Flexible learning is, in most instances, used with various other terms, including flexible delivery, open learning, resource-based learning, distance learning, independent learning and self-managed learning (Bravo, De Pablos Pons & Ballesta Pagan 2018). Carey and Trick (2013) and MacIntyre et al. (2020) emphasised that e-learning learning refers to the form of education in which the lecturer and the student are not in the same physical space, and everyone is expected to interact with the support of technology and Internet for learning. Therefore, the bottom line in e-learning is that it is characterised by minimal or absence of contact between the student and the lecturer. Qayyum and Zawacki-Richter (2019) stated that there is continued growth in student enrolment in open distance education. This increase occurs more in developed countries than in underdeveloped countries. In the same breath, Qayyum and Zawacki-Richer (2019) also supported the idea that distance learning occurs when the lecturer and the student are separated by physical distance, time or both. However, even in that distance situation, teaching and learning still take place. One of the requirements of distance education is the flexibility of the academics to provide learning through various self-enabling techniques such as self-learning platforms via technology and other postal means henceforth. Distance education lecturers are thus required to be self-directed in taking responsibility to keep up with the possibilities of teaching and learning innovations (Pitso & Baloyi 2015). The use of BL is becoming increasingly relevant and available in different areas of society (Carrion-martinez et al. 2020). It also has a positive impact on the lives of people on a daily basis.

Saykili (2018) concurred with this idea by emphasising that a blended approach toward teaching pedagogies supplements conventional campus-based education. Instead of gathering students in a lecture hall or in one place together, the lecturer is able to reach students anywhere they want to live and study. Green (2013) purported that the advantage of engaging in a blended teaching approach is that it allows academics to be flexible in reaching their students regardless of the distance that separates them and their geographical location. In other words, this approach reaches the majority of the students wherever they are. However, there is a challenge in underdeveloped countries like South Africa whereby poverty remains a stumbling block for some communities to be able to have access to the Internet (Chiu & Chang 2007; Collins 2013). As the outbreak of COVID-19 has revealed a lot of disparities between the communities, the poverty situation that exists within the majority of the people in South Africa has brought about challenges to access e-learning for some students in the country. This challenge to access affects the progress of the institution and the delivery mode of effective teaching and learning. COVID-19 can be regarded as a deprivation to some communities, which is bound to render quality teaching and to learn a difficult undertaking (Almanthari et al. 2020).

Keegan (2013a) denoted that there are six key features that comply with the BL approach. His views are supported by Almanthari et al. (2020):

- The feature defines distance education as it involves the separation of a lecturer and student, which differentiates it from F2F interaction like providing a lecture in a lecture hall.
- The effect of an educational organisation separates it from private study.
- The usage of technical media and print media unites the lecturer and the student and transmits the educational content of the module or course of study.
- The provision of two-way communication can be downward or vice versa. This means the process of allowing the academics to be flexible and engage their students in the learning process.
- The creation of a possibility of occasional meetings for both educational and socialisation purposes.
- E-learning enables involvement in an industrialised type of education. This includes learning that is no longer referring to the application of an individual person but engages a number of students at the same time through video conferencing and other online activities.

Keegan (2013b) and Almanthari et al. (2020) supported the technological advancement in BL. They considered that e-learning uses technological devices that are flexible to the students as compared with the old mode of teaching. The emphasis is on the strength of the two-way communication system that improves the level of content comprehension and reflection. The recent learning devices are experiential as compared with the old media such as print, radio and television (Aaron 2014).

Models of learning flexibility

Viewed within the modern technological context, one can state that education is increasingly becoming borderless through implementing BL, with the institutions competing for students from the same market. Nagy and McDonald (2007) and Bravo, Pablos Pons and Ballesta Pagan (2018) argued that students' choice and flexibility are no longer 'limited to curriculum with changing student cohorts also demanding greater flexibility in the way they access programmes and services' (Nagy & McDonald 2007). Different universities have embraced flexibility in their pedagogical programmes with the intention of attracting students to their institutions.

The harnessing of technology for learning fostered greater transparency in education processes in accord with the market perspective supporting or standardised non-discriminatory approach to education (Parker 2008). Blended learning has a greater advantage for both students and lecturers. Students are now able to access learning material in a manner that accords with their own mix of work-life needs (McDonald & Mayers 2005).

According to Kim (2018), it is appropriate, when implementing BL in institutions, to consider the frame of reference of the students. Such consideration could be made possible by using the proactive application of market-based strategies for teaching and learning. The implementation of BL has brought a lot of development to the lives of the communities by drastically transforming the way of life in the communities (Hamilton et al. 2003). It has also affected the development of the manner in which lecturers and students interact.

Blended learning tools assist in reducing social and economic inequalities that may exist in various societies. The use of technology in teaching and learning creates an interactive and accessible learning environment that can reach the majority of students regardless of physical distance. This is one of the major achievements of the UNESCO education goal to reach a large number of communities for sustainable development (UNESCO 2017).

Models for blended learning

There are three models of BL, as described by Valiathan (2020). There is a skill-driven model, attitude-driven model and competency-driven model.

Skill-driven model

The skill-driven model of BL, as it appears in Table 7.1, mixes the interaction between the lecturer and the student through emails, discussion forums and F2F meetings with self-paced learning. This model is based on the interaction with the lecturer as a catalyst to achieve the desired BL. This approach works best when the student and the learning content are at the application level to achieve a certain specified skill (Viliathan 2020).

Attitude-driven model

According to Valiathan (2020), an attitude-driven model is also known as a behaviour-driven model. This model blends traditional classroom face-to-face-based teaching and learning with online collaborative learning. This model's uniqueness is observed in the nature of its content as well as the desired outcome, which necessitates the inclusion of collaborative events for flexible involvement.

Competency-driven model

The competency-driven model includes learning that facilitates the transfer of tacit knowledge, which requires a competency-driven approach. Students in this approach absorb knowledge by observing and interacting with the content and learning activities.

TABLE 7.1: Three models for blended learning.

Model	Why	How
1. Skill-driven model	Learning specific knowledge and skills requires regular feedback and support from the lecturer or peer.	• Create a group learning plan that's self-paced but bound to a strict schedule. • Self-paced learning material with a lecturer-led overview and closing sessions. • Demonstrate procedures and processes through synchronous online, blended learning or a traditional classroom setting. • Design long-term projects.
2. Attitude-driven model	Learning content that deals with developing new attitudes and behaviour. Peer-to-peer interaction and a risk-free environment.	• Hold synchronous web-based meetings and webinars. • Assign group projects to be completed offline. • Conduct role-playing simulations.
3. Competency-driven model	To capture and transfer tacit knowledge, students must interact with and observe lectures during facilitation.	• Assign mentors. • Develop a knowledge repository.

Source: Valiathan (2020).

Responding to change and the subsequent impact on academic autonomy[9]

Anderson, Johnson and Saha (2012) stated that the introduction of technology in learning had evoked a continuing stream of change for academics. It is no doubt that BL has contributed to the development of society (including students and lecturers), drastically transforming the way technology affects the lives of certain individuals. Technology is becoming increasingly present in different areas of society (Carranza 2007; Ibujes Villacis & Franco-Crespo 2019). McDonald and Mayers (2005) promulgated that a number of IHLs have used and are still moving toward the implementation of BL in pedagogical engagement. However, the idea that 'advanced learning technology could provide both with more effective pedagogy and lower costs' has been largely dispelled through the last few years in which online learning has been conceptualised as the preferred mode of delivery of teaching and learning (Nagy & McDonald 2007:739). This model has low costs as both students and lecturers do not have to engage in physical travelling from home to the office. Also, on the basis that the students are saving costs on accommodation and other costs.

Zemsky and Massy (2014) stated that the hard fact about this new mode of learning is that e-learning took off before many people, that is, students and

9. See Nagy and McDonald (2007).

academics really knew how to use it. Many academics are still working through the pedagogy of flexible BL and the changes this mode of delivery has brought about in their professional practice. This is imperative for academics to equip themselves with the new communication skills that will enable them to teach their modules. McDonald (2007) purports many:

> [*S*]kills faculty had homed in face-to-face setting, no longer apply to online and some lecturers must unlearn certain teaching methods as much as they need to learn the new ones. (p. 738)

According to Almanthari et al. (2020), the implementation of technology exacerbated the multiple challenges that lecturers have encountered because of the move to online teaching and learning technologies, methodologies and contents, as well as the social and economic impact that COVID-19 brought to learning. This challenge has required academics to discover responsive ways of handling and adapting to cope with the unprecedented problematising of education outcomes that were brought about by the outbreak of the COVID-19 pandemic.

The impact of technology on content delivery

The Joint Information Systems Committee for Effective Practice with BL outlines below the approaches to learning perspectives, assumptions and associated pedagogy.

In the above table, the Joint Information Systems Committee (2014) suggested that the model to maintain interaction with the learning materials and with the added feature of interactivity with other students and academics in their learning process. This collaborative interactivity model acknowledges the importance of the construction of knowledge and allows flexibility in the new online teaching and learning. However, the academics are left with the challenge of creating teams amongst the students for collaborative learning. On the other hand, academics remain 'under pressure to address market imperatives by adopting a more student-centred approach' in using BL (Nagy & McDonald 2007:741). Also, the table portrays the approaches whereby the lecturer deals with the pedagogical environment of their students.

The shift from old to new learning paradigms has forced academics in IHLs to embark to change that embraces a new approach to teaching and learning. At the same time, students are facing financial and cultural tensions (Hinton 2003; Zobel & Hamilton 2002). Cultural tensions concepts mean the conceptions and approaches that are not transferable across different cultures that are affected by individual differences and their geographical environments (Montgomery & Canaan 2004; Villacis & Franco-Crespo 2019).

TABLE 7.2: Defining approaches to learning perspectives, assumptions and pedagogy.

Perspective	Assumptions	Associated pedagogy
Associative perspective	• Learning as acquiring competence. • Learners acquire knowledge by building associations between different concepts. • Learners gain skills by building progressively complex actions from component skills.	• Focus on competences. • Routines of organised activities. • Progressive difficulty. • Clear goal and feedback. • Individualised pathways matched to the individual's prior performance.
Constructive perspective (individual focus)	• Learning as achieving understanding. • Learners actively construct new ideas by building and testing hypothesis.	• Interactive environment for knowledge building. • Activities that encourage collaboration and shared expression of ideas. • Support for reflection, peer review and evaluation.
Constructive perspective (social focus)	• Learning as achieving understanding. • Learners actively construct new ideas through collaborative activities and or through dialogue.	• Interactive environments of knowledge building. • Activities that encourage experimentation and discovery of principles. • Support for reflection and evaluation.
Situation perspective	• Learning as social practice. • Learners develop their identity through participation in specific communities and practices.	• Participation in social practices of inquiry and learning. • Support for development of learning skills. • Dialogue to facilitate the development of learning relationships.

Source: Joint Information Systems Committee (2004) Effective Practice with blended learning (cf. Nagy & McDonald 2007:741).

Literature review

Distance learning model and the importance of blended learning

The universities employ the new business model to offer open and flexible higher education to all their registered students. Presently academic staff uses the dual-mode of delivery. The flexibility of time and space gains priority for effective teaching and learning in universities (Marginson & Considine 2000). However, Internet connection could be a problem for some students considering their geographical situation (Sult et al. 2013). This model allows online learning to grow, whilst in some instances, print material and face-to-face tutorial classes still take place in various regional centres. Dual-mode accommodates those students who do not have Internet facilities to have successful learning. Most universities have introduced distance mode in their delivery systems to expand opportunities for working adults and youth who had challenges accessing tertiary education through the traditional face-to-face mode (Mbwesa 2009; Nage-Sibande & Van Vollenhoven 2012). However, there are resources that are made available to some of the regional centres for students to access the Internet. Online learning refers more specifically to the use of the Internet and associated webpage applications as the delivery mode for the learning experience (Ngugi 2007).

The blended learning model represents an economically rational way of retaining the balance of ensuring that students who do not have access to the Internet are not marginalised or left out. Kimberly (2014) asserts that there are various challenges faced by students in their learning path. However, ICT remains the option for them through which they can register and resume their studies wherever they are. None of them should feel that the services provided in the mode they are following yield an inferior quality of education (Nage-Sibande & Van Vollenhoven 2012). It sees a shift to open distance and e-learning with corresponding implications for all operations and systems.

Kim (2018) stated that telecommunications-based technology is becoming the primary means of delivery of teaching and learning. He further mentioned the following reasons for the increasing importance of technology in teaching and learning in the institutions of higher education. Technology is becoming more powerful pedagogically; the costs of technological delivery are dropping dramatically; a much wider range of technology is becoming more accessible to potential distance education students; technology is becoming easier to use, both by students and lecturers and finally, open distance institutions find it increasingly difficult to resist the political and social pressures of the technological imperative.

According to Kim (2018), there are characteristics of distance learning in institutions. The quasi-permanent separation of the lecturer and the student such separation exists in most universities since the outbreak of COVID-19. In this instance, the physical separation gap of the student should be closed by the flexibility of the lecturer. They should develop learning materials and provide student support services that would bridge the gap of separation. The use of technical media-print, audio, video or computer and the Internet serves to unite the lecturer and the student to communicate by using ICTs (Ryan 2012). The provision of two-way communication is imperative to enable students to benefit from this process and even initiate dialogue during the learning process for better comprehension.

Institutional implementation of blended learning

Most of the universities in South Africa serve a huge number of students within and beyond the borders of South Africa, being responsible for many courses, each of which is revised every three years (Pityana 2008).

Universities are making use of a customised delivery system for learning known as blended teaching and learning mode. In this model, the entire institution's transactional environment with students is transformed so that all aspects of that environment are fully digitised. It is important that before the implementation of an e-learning project in the IHL, there should be a setting of the vision, and it must be flexible in course delivery to cater for all students, including those who cannot afford time for study because of work and family commitments (Hussein 2010). This became necessary after the outbreak of COVID-19 in 2020. The implementation of technology in the universities sees a complete shift to open distance and, ultimately, e-learning. The teaching and learning materials are provided in digital form to all the students, and this enables all registered students to have access to learning (Chiu et al 2007).

In implementing the BL, the main problem that could be experienced is the lack of access to the necessary technology infrastructure, and poor or insufficient technology infrastructure can lead to a little experience that can cause more harm than good to the lecturers, students and learning experience (Kim 2018). It is important that such a programme stays available at all times to allow access. In such a programme, a student can post their assignments to the university from the Internet without using other means such as a courier service, which are sometimes not available for economic reasons. That might delay and deprive the student's submission timeously, and the student might be penalised for late or non-submission of work.

The focus should be on creating communities of practice which are increasingly using advanced tools of technology for knowledge sharing (Hussein 2010). Some institutions have added to their teaching programmes e-tutors. The provision of e-tutors to the students affords them the opportunity to communicate with an e-tutor who is, in this instance, not their lecturer. This is the indication of additional support to students to access learning even when their module lecturer is not engaged with them F2F (Msila 2006). Students can communicate, ask questions about the course content and even request assistance where they do not understand their learning material. All students are allocated an e-tutor for each module without focusing on the demographical position of a student. Such advanced technology is cost-effective, supports both formal and informal learning, could reach a large number of students globally and could compete against emerging models of delivery such as massive open online courses (Clarke-Okah & Daniel 2004).

Blended learning is a method of imparting knowledge, skills and attitudes through extensive use of technology for producing high-quality learning (Peters 2002). It allows the lecturer to instruct large numbers of students at the same time. Saykili (2018) promulgated that planning for distance education, teaching and learning demands professional acumen to note the concord between pedagogy and technology. However, it is expected for lecturers to be involved in bridging the physical and temporal gap between them and the students that they are teaching. Transactional distance is a continuous process rather than a distinct variable.

Kim (2018) illustrated the application of conventional relationship in teaching in BL that forms the relationship between the lecturer and the students. The above illustration (Figure 7.2) shows a conventional learning situation as one of which person A (the lecturer) influences and guides persons B, C and D (the students) through e-learning technology. The theory shows how transactional distance relationships can influence the successful implementation of BL (Cuong 2016). The development of the study material should be engaging to the students in such a way that it closes the distance gap. However, the connection of conventional relationships by the academic staff should indicate the flexibility in implementing BL (McKeachie & Svinicki 2013).

Peters (2002) argued that the concept of the transaction was derived from Bently in 1949. It denotes the interplay amongst the condition, persons and configurations of behaviour in a situation. As education is a transaction, it is termed distance education. The transaction that happens between a lecturer and the student in a situation of separation of students and lecturers profoundly affects both learning and teaching (Maltz & Deblois 2009). During the teaching endeavour, there is a psychological and communication gap to be crossed with the potential to cause misunderstanding between the inputs of the student and a lecturer. This is a psychological and communication gap called transactional distance (Saykili 2018).

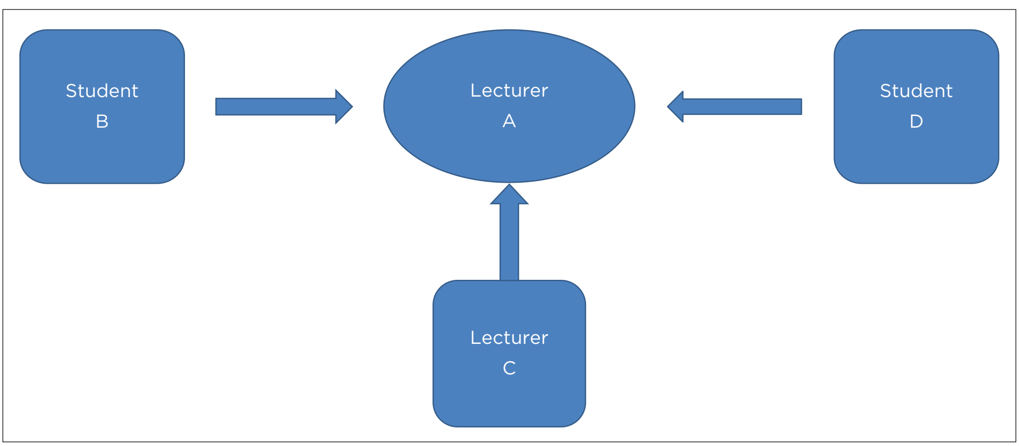


FIGURE 7.2: Conventional relationship.

Research methodology

A qualitative research approach was used to collect data for this research as the researcher was interested in getting direct responses from the participants (Hennink, Hunter & Bailey 2020). The qualitative research approach is congruent to this study as it targeted gaining information on the flexibility of the academics in the BL approach in their pedagogy. The research aimed to investigate academic flexibility to implement technology in teaching in a post-COVID-19 era, exploring and describing constraints and experiences faced by lecturers and students in education. Four lecturers were individually interviewed, and two focus groups of five participants in, each group with university students, were conducted to collect data. It is important to select information-rich cases for in-depth investigation from which one can learn a lot about the problem. That is, the aim of the study is based on the flexibility of the academics to implement BL in a post-COVID-19 era; hence, purposive sampling (Sharan & Robin 2019).

As qualitative researchers seek to understand the meaning of a phenomenon from the participant's point of view, it is important to select the sample that can be studied the most (Creswell 2014). This is known as purposive sampling (Sharan & Robin 2019). The drawn sample for this study consisted of males and females for all groups. The focus groups of university students were sampled in order to measure the implementation of blended teaching and learning and also used to discover whether the implementation of technology is helpful to the students. The groups comprised both males and females of various ages. There were a total of (n = 14) participants who participated in the focus group interviews.

Data collection

This research used interview guides as a source of data collection. There were two different schedules used. One was for the students, and one was for the lecturers. Semi-structured questions were asked. Because of the wide geographical distance of the student population, both groups were identified within the same province. These students who participated were registered for different modules and study fields at the university, as the focus was not on a specific module or department but on the readiness and flexibility of the academics for implementing the BL as the country was affected greatly by COVID-19.

The above biographical data of the participants indicates the selection of student participants ranged from the first-year students to the honours students. The same procedure applied to academics who participated in the research as in Table 7.3. They were not from a specific department, but they were from various departments within the university. Secondary data were

TABLE 7.3: Biographical data of participants.

Number of students	Year of study	Gender
2	First year	1 male 1 female
5	Third year	3 females 2 males
3	Honours	2 females 1 male
TOTAL: 10		**10 students**
4 lecturers		2 males 2 females

also used by gathering data from secondary sources, journals and Internet websites (Creswell 2014).

Findings interpretation and discussion

The aim of this study was to investigate the academic flexibility to implement BL in a post-COVID-19 era. The following flexible delivery model was used to determine whether the academic staff is implementing BL in their teaching and learning approaches. The following delivery model uses a complete shift to distance and, ultimately, e-learning in the university. There have to be adjustments made to monitoring and evaluating the work of geographically distant student.

Verbatim presentation of data was used for this research. The reason for using a direct quotation from respondents or participants in this chapter is based on the idea of ELdh, Arestedt and Bertero (2020). They asserted that providing authentic citations of spoken informants becomes the gold standard in qualitative research.

The above figure illustrates the flexible delivery model, which was implemented in this study, looking at the reliability and availability of ICT for implementation during the moments when the lecturer and student need to use it. Flexibility also depends on the policies that are formulated for the institution on how to use and connect to ICT. It is important that ICT at each institution provides necessary support to the users and tries to make it flexible for the users. It is important for the academics to formulate tasks that will be flexible for the students to use it. Sometimes the websites on the institution are not available for use; then, teaching and learning are disturbed. Different institutions function in their own way; therefore, it is important that staff training be provided (Maltz & Dedlois 2009).

Flexible learning implies the use of dynamics of learning processes that take place between the lecturer and the student and the implementation of

Key: ICT, information and communication technology.

FIGURE 7.3: Flexible delivery model.

the learning resource through BL. There has been a rapid growth in using technology in the IHL since the outbreak of the COVID-19 pandemic. Lecturers can now reach their students electronically through technology wherever they are (UNESCO 2017). However, the results proved that not all the registered students benefit from the programme because of their geographical area and the socio-economic challenges that they are facing.

Two students said:

> 'Access to learning has changed. In my area there are Internet connection difficulties. Most of the time we struggle to connect to Internet in order to retrieve study material that the university has sent to us.' (Students 1 & 2, 18 July 2020)

Three other students said:

> 'We have to travel long distances to town in order to get access to the area where there is electricity and Internet connection. When the laptop' battery is off, then it means we can't work. This is so inconveniencing and challenging for us to study.' (Students 3, 4 & 5, 18 July 2020)

This growth of providing blended and enabling all the students to access study and learning material online and at home or wherever they are has many challenges. Because of the pandemic outbreak, many students are deprived of access to their study material because of geographical situations. This challenge is highlighted by Sult et al. (2013) when arguing that Internet connection could be a problem for some students considering their geographical situation.

The formulation of policies associated with distance learning that does not consider the possibilities of different community structures for implementation of such policies still needs that the institutions should pay attention to them (Maltz & Dedlois 2009).

Two lecturer participants stated:

> 'When, we are preparing lessons for blended learning one is faced with the problem of the Website not available, meaning that it could take a day without getting access to the university website. It will then work negatively on our time management. They also mentioned that at that moment they are still experiencing challenges of developing tools for e-learning which will be suitable for all registered students.' (Lecturers 3 & 4, 11 July 2020)

This is brought about by the fact that there is sometimes a lack of access to the university website, whereby it becomes difficult for the lecturers to use the programme. Therefore, it warrants more support to the lectures for alternative options for handling such challenges to enable the implementation of the SDL.

Another two lecturer participants said:

> 'Since our students no longer write physical examinations but they write them online. This create additional load of work pressure on us as we have to examine assignments and examinations online. Previously it was better when hard copies were submitted. It was better managed and the process was fast. It was better for both assignments and examinations. Also the number of our students who write examinations has decreased. The challenge here the implementation of the tools in SDL.' (Lecturers 1 & 2, 11 July 2020).

It came out from the discussions that the lecturers need more training on the development of online lessons and assessments, as stated above, to administer SDL. They felt that the training that they had received was not yet enough to carry out the programme. However, several training sessions have been administered, but there is still a need for more.

The research conducted by Umrani-Khan and Iyer (2009) indicated that the use of ICTs to facilitate teaching and to learn in higher education institutions is accepted by various institutions. However, the focus is largely on setting the infrastructure and the e-learning content. This will determine the readiness of the staff to implement ICTs in blended learning without depriving students of the learning opportunity (Almanthari et al. 2020). It is necessary to consider the individual factors contributing to the implementation of ICTs in universities.

Three student participants said:

> 'Online learning is very difficult to us as students because sometimes it is not easy to understand the module content. Learning used to be meaningful previously as we used to have a lecturer on face-to face delivery of lesson. In that situation we would ask questions where necessary and get explanations of the lesson content. This have changed now since the outbreak of COVID-19, learning is now independent. Most of the time we read without understanding because online learning has challenges with connection for us.' (Students 8, 9 & 10, 25 July 2021).

Distance learning revolves around a learner-centred system with teaching activities focused on facilitating learning by the lecturers. However, it assumes expanded roles to organise and prepare to learn material study guides (Cuong 2016). The support of the administrative staff becomes important in assisting the academics in the implementation of BL as it requires technology. This shift in using teaching as a learning tool has an effect on curriculum delivery in the university. Blended learning has made life more different than it used to be before, and the pace with which such technologies have evolved is becoming fast that physical distances are so blurred (Andronie 2012). For lecturers to achieve the best results for their modules and courses when using technology based on BL, they need to structure and design their modules used in such a way that they supplement the lack of student-and-lecturer F2F interaction. Instead, the lecturer should be able to bring the conventional relationship to the learning process (Saykili 2018).

The outbreak of COVID-19 has necessitated lecturers to do thorough planning for implementing BL. Again, lecturers need to understand the theory of adult learning (Knowles 1984). This theory attempts to explain why adults learn differently from young learners and students, but more importantly, it acknowledges that adult reasons for learning are often very different from those of young learners. Knowles popularised the notion of andragogy which is learner-centred (Knowles 1998; Knowles, Holton & Swanson 2001).

It is disadvantageous to the students because sometimes they miss face-to-face contact lectures. Their comprehension of the lesson content is now limited. Sometimes, they learn without understanding the module content. However, it is imperative to adjust to SDL in order to implement BL in teaching. Blended learning has the advantage of access to many students regardless of their geographical area. It is one of the major achievements of the UNESCO goals for education to reach out to a number of communities for sustainable development goals (UNESCO 2017).

Lazou and Bainbridge (2019) concurred with the participants that devotion to studies poses a challenge to students when they are alone at home and also by roles designated to them by their families or the community.

According to Saykili (2018), there are learning strategies to be used by students in BL. The author categorises the strategies into three:

- cognitive
- metacognitive
- resource management.

Resource management is further divided into time, study environment, effort management and support of others. In SDL, there is a necessity for support from others. This suggests that students cannot just sail through without support from other individuals, including the family, when engaged in BL. In the 'Findings interpretation and discussion' section (cf. Figure 7.3), under the models for BL, the skill-driven model where other peer students assist each other to achieve the learning outcomes in SDL.

Pitso and Baloyi (2015) claimed that in online learning, the student becomes the pivotal stakeholder for the learning process to be undertaken and demands one to be in a position to be creative as far resource management is concerned. Resourced management comprises the students' preparedness to define goals to attain outstanding results in the course clearly.

Findings reveal that most student participants did not get support either from the institution or family towards coping with online learning after the outbreak of COVID-19. During the discussions with the lecturers regarding their readiness and flexibility to implement technology in BL, it was discovered that lecturers need to equip themselves with more strategies for successful flexibility in SDL. The 'constructivist pedagogy reveals that many academics feel that the focus on student-centred learning paradigm negates their central teaching role' (Nagy & McDonald 2007:740). On the contrary, most IHLs were using the traditional mode of teaching, which is further challenged by the institutional push for choices for students and their learning (cf. Almanthari et al. 2020).

A number of academics are faced with a lot of difficulties and challenges when they have to engage oratory skills, and when they are required to embrace online approaches to teaching and learning, they struggle to adapt. According to Garrison and Anderson (2013), online teaching and 'learning is a disruptive technology in the traditional institutions of higher learning because it threatens the sustaining technology of the lecturer. The flexible skills to be employed in this venture are different from that of a stereotypical physical lecturing environment, which used to happen in a lecture hall.

The new approach to teaching mode provides a context to fundamentally change the traditional transmissivity approach and F2F lecturing approach to the education fraternity.

Recommendations

Motivation and morale of academics

After engagement with the lecturers during the interviews, the researcher discovered that motivation for lectures is important. The role of the lecturers should move away from being expected with the knowledge to collaborate in a flexible learning process to be able to implement BL within their modules. The online support from the institution and any other relevant strategy which could be selected by that institution can play a major role in motivating lecturers. It should consist of forums, chat rooms, online news and email applications. This implies being more interactive than the knowledge databases. They should provide online support that offers a facile opportunity of asking questions and getting answers instantly. With reference to models of BL, it is discussed how BL could be successfully implemented in SDL (Valiathan 2020).

There should be a distributed knowledge database. This includes the totality of the tutorial letters and other materials loaded on websites, accompanied by explanations and interactive guidance for searching and identifying certain topics. It represents the most accessible and facile form of a library or bookshop. This distribution ensures a wide knowledge from all domains of activity, either for free within certain organised training programmes or organised payment.

Non-synchronic instruction should be introduced. It consists of individual learning based upon a computer network of the Internet type. It can be fully independent through the links with the outstanding materials from the database of knowledge. It can also include the communication between the student and the lecturer through news online and emails (Valiathan 2020).

Move towards creative and flexible methodology in self-directed learning

It came out from the interviews that lecturers struggle to make sense of the shift from the traditional F2F lecture method to the new normal of the BL mode of communication in SDL. This shift to flexible learning requires a push for flexibility and creativity in the development of the resources to implement for teaching in BL. Adequate support from the institution is important to equip the lecturer with the relevant skills needed to be able to cope with the demands for the SDL and the implementation of BL. It is thus necessary for the lecturers and students to have a deeper understanding of the concepts of BL and flexible delivery for the comprehension of the content. The move from traditional teaching to blended is a potential benefit to the students as they learn to use multiple technologies for BL that are available to them regardless of their geographical area, which is a recommendation from UNESCO to achieve one of the Sustainable Development Goals (UNESCO 2017).

Frame of reference of the students

It emerged from this research project that lecturers do face numerous challenges in the implementation of the BL when communicating with their students. It is also important to take into account the frame of reference of the students and their geographical environment when designing a new teaching methodology involving BL. On the other hand, the lecturers require a suitable platform to implement their flexibility and creativity in their teaching programmes in SDL. A student-centred approach to ICT is regarded as one of the appropriate modes of curriculum delivery in SDL.

Conclusion

There is ample evidence that BL can substantially increase enrolment (Fernandez-Batanero, Cabero & Lopez 2019; Pityana 2008) in Southern African IHL. Most universities are trying to improve the implementation of BL in their teaching and learning approaches. This has been made possible because of the diversity of students that are registered with the university. Such a massive student body has created a need for the training of lecturers to be able to implement ICTs in BL situations during their teaching and learning programme development. The lecturers need to be re-skilled in terms of the use of ICTs, with reference to the Section “Models for blended learning” as discussed above in their approach to teaching and learning (Almanthari et al. 2020; Kim 2018).

Chapter 8

Self-directed language learning in a blended learning environment: Perspectives of Sesotho sa Leboa and isiZulu student-teachers

Jako Olivier
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Mahikeng, South Africa

Matome M. Mabiletja
School of Language Education,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Emmanuel Ngwenya
School of Language Education,
Faculty of Education, North-West University,
Vanderbijlpark, South Africa

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Abstract

The benefits of SDL for language learning are evident from the literature, and it is clear that language learning is also unique within BLEs. However, little is known about self-directed language learning (SDLL) in BLEs, specifically in the context of African language learning at the university level. In order to address the gap in the scholarship, this chapter aims to determine the needs and perspectives of student-teachers enrolled in undergraduate Sesotho sa Leboa and isiZulu modules in terms of SDLL. This explorative qualitative study made use of open-ended questionnaires in order to determine how Garrison's dimensions of SDL, that is, motivation, self-management and self-monitoring, are reflected in current practices and can be supported in the future. This study involved 224 student-teachers studying isiZulu and Sesotho sa Leboa. The qualitative data collected for this research were analysed thematically and inductively in order to draw conclusions. This chapter makes recommendations for informing practices in the training of student-teachers, specifically in terms of the African language teaching context. This research is highly relevant in the context of under-resourced languages in online and BLEs in general and specifically with regard to African language teaching, and consequently, recommendations are made in terms of open pedagogy for resource development. This research determined that the selected student-teachers believed that there are many elements of SDLL present in their learning context. Yet, some aspects have been identified to support further SDLL. It was also found that the role of the conative value of linguistic identity should be exploited for SDLL in BL contexts.

Introduction

Blended learning is relevant to language teacher training, especially with an increased need for distance education and even measures related to the COVID-19 pandemic restrictions where such learning had to take place online (Albiladi & Alshareef 2019; Arkhipova et al. 2017; MacIntyre, Gregersen & Mercer 2020; Olivier 2021a; Tawil 2018). Moreover, BLEs have been considered within the language learning and teaching context for many years, specifically in terms of computer-assisted language learning (Mendieta Aguilar 2012), for example. Viewing language as an important resource in the education context is evident in the literature (Ndimande-Hlongwa & Ndebele 2017). In terms of SDL, language in itself also becomes an important resource, especially in blended and, by implication also, multimodal learning environments (Olivier 2020a), that can be utilised by students (Olivier 2020b). Within a social constructivist view of learning, it is important to consider that Vygotsky (1978) noted the importance of language in understanding a social world. Furthermore, this chapter specifically looks at SDL within the context of African language learning and language teacher training. In this regard, the relevance of SDL for an African context, especially in terms of the congruity between SDL and the African philosophy of Ubuntu, is clear (Du Toit-Brits, Blignaut & Mzuza 2021). Moreover, this chapter relates to not only the vast scholarship of SDL but also the discipline-specific SDLL in BLEs.

In this chapter, the focus is specifically on student-teachers studying at a selected South African university for the languages isiZulu and Sesotho sa Leboa in BLEs. Within this text, the spelling of the language name isiZulu is used in contrast to merely Zulu in order to be aligned with the Constitution of the Republic of South Africa (1996), hereafter the *Constitution*. Because of the fact that the language name Sepedi could be considered restrictive as it only refers to a dialect within the language Northern Sotho or Sesotho sa Leboa (Herbert 1992:2–3), hence the more inclusive Sesotho sa Leboa is used in this text.

A further key aspect of this research is the fact that learning is mediated through technology in BLEs and in the language context, also specifically in multimodal environments (Olivier 2020a). Blended learning environments are also described by Cope and Kalantzis (2017:1) as being 'e-learning ecologies'. Such contexts are similar in nature to 'an ecosystem, consisting of the complex interaction of human, textual, discursive, and spatial dynamics'. In these environments, openly licensed materials are often used, and therefore, we refer to the learning environments relevant to this study as multimodal open learning ecologies. However, towards creating such ecologies, it was necessary to explore student-teachers' views on their own self-directedness and the creation of resources, which relates to our problem statement. The research questions driving this research are as follows: (1) How are the dimensions of SDL reflected in current practices of African language learning in BLEs for student-teachers? And (2) how can SDLL be supported in BLEs?

■ Problem statement

Despite many publications on SDLL (Du 2013; García Botero, Questier & Zhu 2019; Haidari, Yelken & Cenk 2019; Ho 2019; Navarro & Thornton 2011), little research has been done on this topic within the context of African language learning and implications for BLEs and open education. The aim of this research is to specifically determine how Garrison's (1997) dimensions of SDL, that is, motivation, self-management and self-monitoring, are reflected in current practices of African language learning for student-teachers and how SDLL can be supported in the future within a BLE. In the study by Strydom (2020), it was found that language student-teachers did not receive sufficient support in terms of SDL, and a framework for English for Education was proposed. Hence, exploring the same issues in terms of African languages is necessary.

The problem being investigated in this chapter arises from a need to address challenges around epistemic and language distance that may also occur in BLEs. The concept of epistemic distance is proposed by Olivier (2021b) as it relates to the extent of knowledge deficiency. This deficiency is also then interpreted within the context of what Brockett and Hiemstra (2019) termed *situational barriers*. Whilst language distance relates to the distance between the mother tongue of the student and the language used in resources (Olivier 2021b), which in terms of BLEs often means that students have to be satisfied using online English resources because of the fact that few such resources exist in African languages (eds. Makalela & White 2021; ed. Salawu 2018). Despite some research being done on the role of African languages in BLEs (Makalela 2021; Mose & Lubua 2017; Olivier 2021b), there is a clear need for further research in this context, specifically in terms of SDLL. Consequently, this chapter explores the dimensions of SDL reflected in current practices of African language learning in BLEs for student-teachers as well as how SDLL could be supported in BLEs.

Literature review

Self-directed learning

The conceptual framework of this project relates to SDL and specifically SDLL. The concept of SDL is regarded as a dynamic process through which students take charge of their learning alone or through the help of others in identifying what they need to learn, setting their own goals and selecting resources – which can be either material or appropriate to others, then selecting and applying certain learning strategies and then finally evaluating the set goals (Knowles 1975). The emphasis on students taking control of their learning (Gibbons 2002; Merriam & Bierema 2014) as a central aspect of SDL is also relevant in language learning situations, and hence SDLL is the focus of this chapter.

An important aspect of SDL for this chapter is Garrison's (1997) dimensions of SDL, which specifically relate to motivation, self-management and self-monitoring (cf. Garrison 2016) (also see ch. 1, Van der Westhuizen & Bailey). The importance of motivation for learning is evident, and Garrison (1997:26) observed that it 'plays a very significant role in the initiation and maintenance of effort toward learning and the achievement of cognitive goals'. Moreover, motivation also encompasses 'perceived value and anticipated success of learning goals at the time learning is initiated and mediates between context (control) and cognition (responsibility) during the learning process' (Garrison 1997:26).

In terms of self-management, Garrison (1997:22) made the following observation: 'Self-management is concerned with task control issues.

It focuses on the social and behavioural implementation of learning intentions, that is, the external activities associated with the learning process'. Furthermore, the concept of self-monitoring relates to 'cognitive and metacognitive processes: monitoring the repertoire of learning strategies as well as an awareness of and an ability to think about our thinking' (Garrison 1997:24).

A central theme to SDL is student agency and students having choices in the process. In this regard, students would not only need to have access to different resources in order to choose appropriate resources (Knowles 1975) but also need to be exposed to different learning strategies (Victori & Lockhart 1995). The shift of agency from lecturer to student is relevant for what Cope and Kalantzis (2017:10) termed reflexive pedagogy within a context of e-learning ecologies, where 'the learner has considerable scope and responsibility for epistemic action'.

As noted before, this chapter specifically relates to SDLL; however, more generic aspects of the learning situation might also have implications for SDL.

Self-directed language learning in blended learning environments

Self-directed language learning specifically pertains to SDL within the language learning context. In this regard, research on SDLL has covered a number of aspects of language learning. Perceptions of students have been the focus of research (Du 2013), and this project ties in with this movement. The relationship between belief and action for the acquisition of SDLL skills is evident (Navarro & Thornton 2011). There has also been some research on SDLL in terms of the use of technology (Ho 2019), which shows insights into how this aspect is realised in BLEs. However, Du (2013) highlighted the fact that despite a lot of literature on learning strategies and foreign language teaching, SDL has received little attention in this sphere. Similarly, in the South African language learning and specifically African language learning context, this aspect in terms of BLEs is an under-researched area.

Many works on SDLL relate to autonomy in language learning. Despite the fact that there has been extensive work done on autonomy in language learning and especially also second language learning (Victori & Lockhart 1995), it is essential to note that the concept of SDL cannot merely be regarded as a synonym for autonomous learning. Importantly, 'learning a language is a social activity, and it is difficult to learn a language without the support of another person with whom to speak the language' (Grimmer 2017). This social activity extends beyond interacting but also to socialisation into language-related communities of practice (Grimmer 2017). Consequently, this also has implications for the learning of languages outside of the classroom context.

In this regard, Strydom (2020:32) observed that 'SDL forms an important part of using language meaningfully, especially outside the classroom context where the teacher does not form part of the learning process'.

This chapter explores the state of SDL amongst African language student-teachers and, as such, links up with the discourse prompted by Strydom (2020), who explored SDL amongst student-teachers studying English for Education.

Importantly, the context considered in this chapter relates to BLEs. Blended learning is generally interpreted as learning through a combination of both online and F2F modalities. However, for the purposes of this chapter, the definition proposed by Cronje (2020:120) is used, where BL is regarded as '[t]he appropriate use of a mix of theories, methods and technologies to optimise learning in a given context'. Because of the fact that the research population of this research are all distance education students, classes are conducted online and with support from the selected university's LMS. However, because of the nature of the language modules themselves, the learning is distinctly multimodal (Olivier 2020a) and also involve e-learning ecologies (Cope & Kalantzis 2017).

Context of African language teacher training in South Africa

The Constitution recognises 11 official languages, nine of which are regarded as indigenous African languages (RSA 1996). For the last several decades, there has been increased support for educating African children through and about their languages (Gina 2017). Consequently, the Department of Basic Education (DoBE) drew up a policy entitled, *The incremental introduction of African languages in South African schools* (DoBE 2013). This policy aims would be:

> [*T*]o improve proficiency in African languages; increase access to languages to all learners beyond English and Afrikaans and promote social cohesion, economic empowerment and the preservation of heritage and cultures. (p. 6)

As the African languages are the mother tongues for the majority of learners in rural and township schools, the shortage of qualified African language teachers in the Foundation Phase (FP) emerged (Nomlomo & Desai 2014). The Department of Higher Education and Training (DHET) also took the initiative to support FP teaching through an increase in institutions from which such programmes could be studied (Nomlomo & Desai 2014). In addition, bursaries for specialisation in African languages were also offered (Steyn, Harris & Hartell 2014). A service-linked bursary scheme was also begun through the Funza Lushaka initiative (Deacon 2015).

It is essential for the home language of learners to be strengthened as well as developed (Dornbrack 2009) in order to support additive bilingualism. In this context, capable teachers were also needed, and according to Deacon (2012), this involves appropriate teacher education and support for qualified teachers. An essential part of teacher training is work-integrated learning, which is an opportunity for student-teachers to put their academic knowledge into practice in a real world of work. However, in reality, language teachers, like many others, often choose to model their teaching on the experiences they had as learners (Jordaan & Pillay 2009).

Plüddemann, Nomlomo and Jabe (2010) alluded to the fact that under the Bantu education, African languages were given a minor role compared to English and Afrikaans and that marginalised them. The legislation further restricted the development of these languages prior to 1994. The Constitution (1996), the *Language in Education Policy* (DoE 1997) and other language policies, such as *The incremental introduction of African languages in South African schools* (DoBE 2013) public schools, emphasised the use of African languages at various levels of education including institutions of higher education. The DoE (2007) reported that there is a shortage of supply of scarce skills subject teachers, including African language teachers, in various South African schools. Various South African universities offer African languages as part of initial teacher education training, particularly in the FP and intermediate phase (IP) programmes. However, DoE (2007) marked that there is a significantly low enrolment of teachers who are competent to teach in mother tongue in FP programmes, and that of the number of graduates, very few were competent to teach in African languages in the FP.

One of the aims of the (DoE 2007:para. 2) in the *National Policy Framework for Teacher Education and Development in South Africa* is to ensure that 'teachers are properly equipped to undertake their essential and demanding tasks'. The question is: to what extent does teacher education prepare African language student-teachers to teach African languages or to teach in African languages? Furthermore, it is crucial to find out whether teacher education can train African language teachers to use a variety of teaching and learning methods that enables the student-teachers to create their own resources and use OER that are relevant to their learners. This creation of resources by students is highly relevant in the context of e-learning ecologies (Cope & Kalantzis 2017).

Literature confirms that there is little preparation for students to teach in African languages or to teach African languages as well as English (Wildsmith-Cromarty & Balfour 2019). The literature further indicates that there had not been sufficient modelling of how students should approach the teaching in and of African languages. Wildsmith-Cromarty and Balfour (2019:311) confirmed that the DoBE initiated an Early Grade Reading Study that aims to evaluate 'what works to improve the learning and teaching of African languages'.

There are various factors that affect the successful teaching and development of African languages in universities, such as the hegemony of English and the availability of study material in English, the lack of will by the government, the systematic exclusion of indigenous African languages in education, the perceptions and attitude of African languages speakers (Plüddemann et al. 2010). It was argued in Ouedraogo (2002) that the shortage of teaching material in African languages hinders the use and development of African languages in schools. This problem of shortage of material in African languages is driven by the reluctance on the side of the government to produce the material and the globalisation and economisation at the expense of the development of the African language. In addition, the International Institute for Capacity Building in Africa emphasises that African languages are absent from the Internet and that if this continues, it may cause people to not be interested (Ouedraogo 2002).

Teacher training for isiZulu

As stated before, the Constitution of South Africa requires that all official languages be utilised in all aspects of life as is practicable (Madonsela 2014). Similarly, the government needs to ensure that there are language policies that promote indigenous languages such as isiZulu and others within our multilingual national context (Zikhali 2016). The *White Paper for Post-School Education and Training* (2013) acknowledged the position of African languages in higher education and noted the threat it holds to linguistic diversity in the country and the vitality of the languages. Furthermore, this white paper supports the teaching of African languages across disciplines and even supports African language proficiency as a requirement for professional training. Because of the autonomy of universities, there is generally no generic curriculum for teacher education, and such curricula should just adhere to the national policy (Kwenda & Robinson 2010).

Teacher training in South Africa is informed by the *National Qualifications Framework Act* (No. 67 of 2008) and the *Revised Policy on the Minimum Requirements for Teacher Education Qualifications* (DHET 2015). According to Mpofu and Maphalala (2021:2), this policy presents 'knowledge mixes level descriptors, competencies and credit values that should be used to structure a BEd qualification'. IsiZulu forms part of modules offered in BEd FP, IP and Senior and Further Education and Training (FET) phase. The duration of the BEd degree is four years. On completion of the bachelor's degree, students can register for postgraduate degrees, starting from honours to doctorates.

There are diplomas and certificates at various institutions that are offered for teachers training in isiZulu, that is, a Grade R teaching diploma and a Postgraduate Certificate in Education.

The basic competencies for an isiZulu beginner teacher in any of the phases include 'subject knowledge, curriculum knowledge, PCK, knowledge of educational contexts, knowledge of learners, knowledge of educational values, knowledge of assessment and knowledge of reflective practice' (Mpofu & Maphalala 2021). The teachers of isiZulu (as others) are trained with the aim of preparing them to support their learners in mastering language skills across the curriculum (Kalinowski, Gronosta & Vock 2021). The skills that should be grasped by learners in the Home Language curriculum include listening and speaking, reading as well as phonics together with writing and handwriting in the FP (Govender & Hugo 2018), whilst in the IP, Senior and FET phases, learners are taught the skills identified in the curriculum: *listening and speaking*, *reading and viewing*, *writing and presenting* as well as *language structures and conventions*.

Teacher training for Sesotho sa Leboa

There is a serious concern about the shortage of teachers trained to teach through the medium of African languages in the FP (DHET 2015). The DHET (2015) confirmed that there was a decline in teacher education enrolment post-1994 because of restructuring and the closing of colleges of education in South Africa. There was a discrepancy between the demand and the supply of teachers in South African schools, especially the African language teachers. The shortage of teachers is more in African languages than in English and Afrikaans. Sesotho sa Leboa is amongst African languages that have a significant shortage of qualified teachers to teach through the medium of African languages or to teach African languages as subjects (DHET 2015). The decline in teacher enrolment negatively impacted the production of teachers in the country. As noted by Bernstein (ed. 2015), the shortage of African language teachers has a severe implication for the effectiveness of the development of literacy for African language learners.

The South African DHET supports the development of local African languages through initial teacher education. However, DHET (2015) maintained that many universities do not prepare African language teachers to teach these languages as subjects; instead, they teach them to teach through these languages. This means that many African language teachers who graduate from the universities are not qualified to teach African languages. Even though universities prepare teachers to teach through the medium of African languages, there is still a shortage of African language teachers who are qualified to teach through these languages. *The incremental* *introduction of African languages in South African schools* (DoBE 2013) increased the pressure on the initial teacher education to produce more African languages teachers as all schools must offer at least one African language to all learners at home language, first additional language or second additional language level (DHET 2015). Another challenge reported is the question of the ability of BEd programmes in various universities to prepare African language teachers adequately to teach in and to teach African languages (DHET 2015).

As mentioned in the preceding section, teacher training in South Africa is regulated by the *National Policy Framework for Teacher Education and Development in South Africa* (DoE 2007). The purpose of this framework is amongst other things to ensure that teachers are properly equipped to undertake their essential and demanding tasks. Teacher education comprises two complementary sub-systems, including Initial Professional Education of Teachers and Continuing Professional Teacher Development (CPTD). Initial Professional Education of Teachers is for beginners who want to obtain their initial professional qualification, whilst CPTD is for qualified teachers who want to enhance their existing professional qualifications. The initial teacher education in South Africa prepares teachers to teach in FP, IP, Senior and FET phases. Various universities in South Africa offer Bachelor of Education degrees FP, IP and Senior and FET phase as well as a Postgraduate Certificate in Education, which is to be replaced by a Advanced Diploma in Education.

At the selected university, only three teacher education programmes offer Sesotho sa Leboa, namely, Diploma in Grade R Teaching, BEd FP, and BEd IP in Distance education. For the student to be admitted to the FP and IP BEd programmes must obtain at least two language endorsements. Students must obtain English as a language of learning and teaching as well as a second language of learning and teaching endorsement based on language completed as Home Language or First Additional Language level in Grade 12.

Languages available to choose from as home language as per senior- or Matric certificate include Afrikaans, English, isiZulu, Sesotho sa Leboa, Sesotho, and Setswana, out of 11 official languages mentioned in the Constitution (1996). These languages are taught at three levels, namely home language level, first additional level and conversational language level. In the FP and IP, languages are offered through the medium of home languages except for the conversational language, which is taught through the medium of English. This study focuses on BEd FP, home language level only.

It is within the context of the teacher training for these two aforementioned languages in which the research for this chapter was conducted.

Methodology

Research paradigm and design

This research was underpinned by an interpretivist paradigm as the researchers aimed to research conclusions from different points of view in an empathic manner in order to '*verstehen*' (Tracy 2020:51) or '*go kwešiša*' collaboratively. Hence, as researchers, we acknowledge an immersion in the actors, in this case, student-teachers in selected African language modules, and their subjective experiences in a BLE.

A qualitative research approach was used in this research as there is a need to understand the needs of student-teachers in terms of SDLL in African Language BLEs and also gauge their perceptions and practices throughout the research process. This approach ties in with Merriam's (2009) view that:

> [*H*]aving an interest in knowing more about one's practice, and indeed in *improving* one's practice, leads to asking researchable questions, some of which are best approached through a qualitative research design. (p. 1; [*emphasis in the original*])

The use of qualitative research to explore SDLL is highly relevant as this is common practice in other research on SDLL internationally (Navarro & Thornton 2011).

Sampling

This research involved a purposive sampling strategy as the research participants were selected 'on the basis of their judgement of their typicality or possession of the particular characteristic(s) being sought' (Cohen, Manion & Morrison 2018:474). A sample of the wider African language teaching student population was drawn from different modules for isiZulu: n = 163 (6 classes) as well as Sesotho sa Leboa: n = 61 (4 classes). The inclusion criteria for this research would be that the students are studying African language modules for teaching purposes. The majority of students are enrolled in a distance mode of delivery; however, within the context of the COVID-19 pandemic restrictions in South Africa, even the contact students were learning through this mode when the data were collected.

Data collection

The data collection for this chapter involved an open invitation for voluntary participation to students in the selected classes. Students who provided consent to take part in the research then completed an open-ended questionnaire. The questionnaire was available in English, isiZulu and Sesotho sa Leboa. Ultimately 83 students studying in the aforementioned modules provided informed consent and provided responses. The mother tongues of the participants were not probed, but 64 participants responded in isiZulu, 15 in English and 4 in Sesotho sa Leboa.

Data analysis

The qualitative data collected for this research were analysed inductively (Cohen et al. 2018:1337; Saldaña 2011). To this end, the analysis involved deriving conclusions from the data rather than searching for predetermined codes established in the literature. The data analysis process that was followed involved translation of the responses into isiZulu and Sesotho sa Leboa from English, quality control of the translations, and then a careful reading of the data set by the researchers. The inductive coding followed as the content was marked thematically in terms of constructed codes. The quotations with similar codes were then grouped together, and coherent themes were then determined. Independent coding and a subsequent process of reaching a consensus between the researchers strengthened the trustworthiness of the analysis. A further method of ensuring trustworthiness is an audit trail. Merriam (2009:223) stated that an audit trail 'describes in detail how data were collected, how categories were derived, and how decisions were made throughout the inquiry'. Use was also made of a research journal as a vehicle for an audit trail, and the content above provides a concise overview of the process.

Research ethics

Throughout the process, ethical conduct and adherence to national and institution-specific ethical policies were ensured. Ethical clearance for this low-risk study was sought from the North-West University's Faculty of Education Research Ethics Committee prior to conducting the research. The relevant research data gatekeeper was approached for permission to do the research prior to recruiting the research participants. We aimed to ensure that in the research process, the benefits to the research participants will outweigh the risks. Research participants were recruited fairly and within the parameters set for this study. Participation in this research was totally voluntary, and only participants who willingly provided written informed consent took part. An independent person obtained written informed consent from the participants. Throughout the process, confidentiality was ensured, and the privacy of participants was respected. All data are securely stored in a password-protected environment for a period of seven years.

Findings

The discussion is presented in terms of the identified codes and overall themes. Responses have been presented either verbatim in English or as translated from isiZulu and Sesotho sa Leboa. In each instance, four identifiers are provided for each participant quotation: the participant number, question number and the date the entry was recorded.

Perceptions about self-directed learning in a blended learning environment

Positive view of self-directed learning

It is evident from the data that the student participants are positive about the fostering of SDL in the classroom within the context of BLEs:

> '[/]t helps not to be passive but rather active involvement in discussion and finding answer and also sharing of opinions as students.' (P13, Q1, 05 August 2021)

> 'It promotes my independent learning and motivates me to get deeper knowledge about my first language.' (P23, Q1, 08 August 2021)

> 'Self-directed learning helps in that you are able to identify what you need to focus on and setting the parameters for what you are going to use.' (P65, Q2, 10 August 2021)

Some understanding of what SDL entails is evident from the quotations above. The participants regard their role as being an active one in the classroom and that they have a responsibility toward other students. However, they also see how some learning can take place independently. Finally, the participants noted the importance of resource selection and careful planning in the use of such resources.

Sense of responsibility

There is a sense amongst the participants that they have a responsibility to take charge of their own learning in BLEs:

> 'I am responsible for my own learning, that it is up to me and down to me again to make sure that I have all the necessary tools to learn effectively and to ask for help where possible.' (P32, Q1, 10 August 2021)

Self-directed learning and the distance mode of delivery

It was clear that the distance mode of delivery within the BLE demands a lot more autonomy and individual planning on the side of students:

> 'I work in my own time and this means that I am able to identify areas where I need to apply myself more.' (P47, Q2, 10 August 2021)

Resources and self-directed learning in a blended learning environment

In order to support SDL in BLEs, adequate resources are necessary, and within the context of this research, this issue also seemed to be prominent. The student participants highlighted this issue as follows:

> 'I realised that this module required discipline and in research so that I could get relevant information from [*re*-]liable sources.' (P24, Q2, 08 August 2021)

As noted above, resources need to be reliable, and hence students need to be empowered with strategies to be able to determine the quality and nature of resources. The participants also noted agency in terms of finding and using additional resources in BLEs other than that provided by the lecturer:

> '[*B*]eing proactive in seeking knowledge from other sources in order to develop my studies.' (P46, Q2, 10 August. 2021)

It is significant that students feel that resources are sufficient and that where more are needed, they are able to find them. In this regard, the participants made the following remarks:

> 'The resources are very much available; I don't really have a problem in researching a bit for myself as well.' (P13, Q6, 05 August 2021)
>
> 'I was using books, other resources and the Internet.' (P71, Q2, 11 August 2021)
>
> 'Time: every little time I get I do my studies, at the moment the only friend that makes sense to me is my books and goggle [*sic*].' (P72, Q2, 11 August 2021)

Therefore, it seems that the participants not only consult their prescribed resources but also feel comfortable finding additional resources on their own. However, there are some participants who are satisfied with the prescribed resources, and it is evident that they do not desire to search for additional sources: 'In order to succeed, I focus on my books only' (P67, Q2, 10 August 2021).

In line with the literature, it is noted that for African languages, there are not that many resources available. This aspect was also highlighted by the participants:

> 'Resources are not enough in this language.' (P24, Q6, 08 August 2021)
>
> 'Sometimes I feel there are not enough resources for this language and our writers also use English [...] to express themselves, and this does not promote our language.' (P52, Q6, 10 August 2021)
>
> 'There are very few written resources in this language.' (P63, Q6, 10 August 2021)
>
> 'A presence of all isiZulu books online that will assist in our learning. There are very few books that are available on the Internet, and it is difficult to find information in isiZulu on the Internet.' (P76, Q8, 12 August 2021)

The participants indicated that they would gladly contribute to creating resources:

> 'Yes, I would love to create resources that are used and to write poetry and clan names.' (P64, Q7, 10 August 2021)

> 'I would like to be given an opportunity to participate in the creation of the resources that are used because that is where I will see that I have gained sufficient knowledge that enables me to be part of the creation process that will help others with my knowledge about the language.' (P74, Q7, 12 August 2021)

> 'Yes, as I am a first-year student this year, all the work I have done and do well must be kept and used as resources for the following students.' (P71, Q7, 11 August 2021)

> 'I will be able to include my own views as a student, and it will assist others because I know about student needs as a student myself.' (P55, Q7, 10 August 2021)

The participants specifically note that resources can be created after they have obtained sufficient knowledge and that the reuse of such sources could be beneficial to future students. Importantly, the participants also view this as a way of giving them, as students, an opportunity to share their views and hence promote student agency in terms of learning resources. However, one of the participants also noted that when it comes to the localisation of resources (Olivier 2020b), in which sources are translated and made relevant for a specific learning context, students need to be fluent in both the source and target language:

> '[*P*]eople fluent and knowledgeable in two languages [*isiZulu and English*] could contribute positively to the creation of learning resources.' (P43, Q7, 10 August 2021)

It is within this context that resources could be created and then used within BLEs for the purposes of relevant, contextualised and SDL.

Collaborative learning in a blended learning environment

From the literature, the benefit of collaborative learning for SDL (cf. Garrison 2016) in BLEs is clear, and so the data also supported this concept. In this regard, Cope and Kalantzis (2017:11) emphasised 'social sources of knowledge' in the context of e-learning ecologies. In this research, the participants indicated that they are aware and make use of the opportunity to learn with others:

> 'I study on my own and ask for help from other students, we also have a learning strategy that works for all of us, and it helps me to submit my work on time.' (P27, Q1, 09 August 2021)

> 'This is the best opportunity for me as a student who is studying towards education to learn to study alone or as a group. This will improve my ability to do research, and I will be able to identify my weakness and my strengths.' (P34, Q1, 10 August 2021)

> 'It becomes difficult to learn on my own because there are things that I don't fully understand.' (P58, Q1, 10 August 2021)

The need to take charge in connecting with peers and the lecturer is clear: 'By being proactive and keeping in contact with other learners and our lecturer' (P74, Q3, 12 August 2021). However, the benefit of peers versus the lecturer in some instances is also evident: 'It is sometimes difficult, but through the interactions with the lecturer and student WhatsApp groups, it is much easier' (P41, Q1, 10 August 2021).

The latter quotation also highlights the importance of online communication platforms such as WhatsApp in supporting collaboration between students who are physically distanced from each other but who can still be of value to each other. This shows how BLEs can be extended from formal LMSs to other applications in daily use by students in any case.

However, despite opportunities being available for interaction with peers and having contact with lecturers, a participant did feel isolated and noted the following:

> 'My studies are not easy because I am finding knowledge on my own, there is no place where I can ask questions, to check if I am on the right path.' (P76, Q2, 12 August 2021)

Garrison's dimensions of self-directed learning

Motivation within a blended learning environment

Motivation is an essential element not only for SDL in BLEs but also for language learning in general. In this regard, the participants also noted the importance of motivational aspects for learning within their different modules:

> 'I always make sure that I keep a positive attitude towards my learning.' (P23, Q2, 08 August 2021)

> 'I believe it is very important to have motivation [*for*] this module as FP teacher because I will use [*it*] throughout my career.' (P13, Q4, 05 August 2021)

> 'The motivation that I have makes it easier for me to learn on my own including the knowledge that I receive from my peers and the lecturers.' (P37, Q2, 10 August 2021)

An element that was observed is the fact that students are motivated to learn in order to function well within their careers one day:

> 'My goal is to be a great teacher, so that motivated me to learn isiZulu in depth because for you to be a great teacher, you are required to be well learned.' (P24, Q4, 08 August 2021)

> 'To study with understanding everything that has been covered in order for me to be able to provide my learners with better and correct knowledge.' (P53, Q1, 10 August 2021)

> 'I want to learn more on this module so that I can be the best Zulu teacher and encourage my learners to love and learn more about their background.' (P52, Q4, 10 August 2021)

> 'As I am going to become an FP teacher, that is what pushed me to study this module; I found it very important to learn a language that I will be used in teaching my learners. Especially because we know that other learners learn better in their home language.' (P78, Q4, 13 August 2021)

Motivation to learn is also interpreted as being able to enjoy doing a certain module: 'You must enjoy the module that you are studying in order to pass it' (P44, Q1, 10 August 2021). It was also noted that the participants feel that motivation is prompted or supported by the lecturer:

> 'I have a supportive lecturer who gives us time to ask and understand the content and is also there whenever we need help.' (P32, Q4, 10 August 2021)

> 'The manner in which the lecturer teaches this subject is inspirational because of their patience and dedication to the students, which motivates me and makes me enjoy the subject.' (P45, Q4, 10 August 2021)

> 'By having meetings where student challenges pertaining to the module are discussed, this can motivate us as students to learn on our own.' (P37, Q5, 10 August 2021)

The last quotation highlights the relevance of interaction with the lecturer that can act as a way of addressing student concerns. This quotation also establishes the link between motivation and SDL in terms of lecturer support in preparation and support of more independent learning.

However, one participant also indicated being motivated by fear of failing:

> 'The fear of repeating the content of a language that I do not fully understand motivates me to avoid failing the module and just learn.' (P43, Q4, 10 August 2021)

An emotional connection with the language itself as a mother tongue and sharing that sentiment seems to be a motivation:

> 'I'd like the future generation to experience the beauty of their mother tongue.' (P35, Q4, 10 August 2021)

> 'It is my home language. I do not need motivation to learn it, I love my language.' (P36, Q4, 10 August 2021)

> 'As a Zulu person, I am proud of my heritage. I want to pass the same pride to my learners, giving them a solid foundation so that they will love and aspire to learn more about their language. As my mother tongue, it has influenced how I live and think; it has an influence on the humanity that I have today.' (P51, Q4, 10 August 2021)

The latter aspect is also highlighted later in terms of language-specific elements identified in the text.

Self-management in a blended learning environment

Definite elements of self-management were observed in the data. Self-management relates to task control, realising goals and managing learning resources (Abd-El-Fattah 2010). The following quotations illustrate these aspects within the BLE. Firstly, there is evidence amongst some participants that learning is managed by them in a structured manner:

> 'Set an attainable schedule and make priorities.' (P13, Q2, 05 August 2021)

> 'I can get what I am looking for on my own and work together with my other colleagues.' (P15, Q1, 05 August 2021)

> 'One studies well because you can choose the method that will work for you.' (P28, Q1, 10 August 2021)

> 'I usually make sure that I draw up a study plan that I will follow on a daily basis, and it does not end there. It is important to distinguish between important and unimportant things; therefore spend much time learning and sharing with other people so as to improve my knowledge.' (P14, Q2, 05 August 2021)

> 'I organize my studying to fit into my work time. I allocate each module time and resources that are going to be used.' (P56, Q2, 10 August 2021)

The responses show clear planning in terms of scheduling and management. A recurring idea was the role of time and time management as well as being able to allocate time and work effectively. From the quotations, the ubiquitous nature of the learning is evident, and this is in line with the nature of e-learning ecologies (Cope & Kalantzis 2017) as iterations of BLEs. The following selection of many quotations on this matter illustrates the overall feeling in terms of making time for learning:

> '[I] try to make a timetable, there I will give each module enough time to go through and be able to do expected assignments.' (P21, Q2, 07 August 2021)

> 'It is very important for me to prioritise and give myself time to study, do enough research and consult other resources so that I can pass my module.' (P52, Q1, 10 August 2021)

> 'I ensure that each day I have at least an hour to do my work.' (P58, Q2, 10 August 2021)

> 'I keep track by drawing a table and allocating the time that I have in a day.' (P39, Q3, 10 August 2021)

This independence in setting time slots for learning is to be expected from student-teachers who are studying at a distance and who often work full time or part-time. Consequently, unlike with a traditional contact mode of delivery, these students need to take responsibility for most of their time management as they have fewer meetings with lecturers and a limited structured, full-time institutional timetable. The specific approach within this distance education context is highlighted in the following participant quotation:

> 'I am very careful as a student of ODL as I have to ensure that a day doesn't end without checking eFundi [*learning management system*] and my email messages.' (P43, Q3, 10 August 2021)

Selecting and applying specific and relevant learning strategies seems to also be in support of self-management, and in this regard, the following was noted: 'By applying all the strategies that will assist in reaching the outcomes of the module' (P35, Q3, 10 August 2021).

Some participants also find some challenges in this regard, specifically in terms of their perceived success and understanding of content and instructions, as was noted by this participant:

> '[*L*]earning is not something easy because at times I cannot do well or do what is expected from me because of a lack of good knowledge or understanding.' (P21, Q1, 07 August 2021)

It is clear that academic self-concept, which relates to students' perceived evaluative view of their abilities (Marsh & Hau 2003), is an aspect that needs to be considered in terms of SDL in language learning contexts.

However, it is concerning that for some participants, the management of their learning is prompted externally and that they regard their responsibility only in terms of adhering to set structures. This is evidenced through the following quotation:

> 'I learn by understanding what is required in the question and to follow the set procedures.' (P29, Q2, 10 August 2021)

> 'I wait for an email message then commence with the work; hence I will be happy if I could receive a semester plan and due dates for assignments in order to complete everything on time.' (P62, Q2, 10 August 2021)

Self-monitoring in a blended learning environment

Self-monitoring involves reflection (cf. Garrison 2016) by students, and as such, such an approach also ties in with an approach in which student agency is made prominent in the context of e-learning ecologies (Cope & Kalantzis 2017) as BLEs. In terms of self-monitoring, some aspects of reflective practice amongst the participants were evident:

> 'I give myself time to reflect on what is working and what is not working. After that, I tried to figure out what I needed to do to make progress.' (P23, Q3, 08 August 2021)

> 'I set my own time for study as well as write down what I am learning so that it sticks in my mind and I do not forget it.' (P22, Q2, 08 August 2021)

> 'I do a lot of reflecting on how my actions contributed to my semester overall performance. Unfortunately, a few things still set me back.' (P45, Q3, 10 August 2021)

> 'I always check after completing my work as to what worked best for me and what didn't work according to my expectation. And also after writing tests.' (P49, Q3, 10 August 2021)

> 'I set time aside or certain hours to complete and understand a topic, then proceed to more work on the next topic. It may happen due to the workload that I learn different topics at the same time, especially if they are related or I'm short of time.' (P53, Q3, 10 August 2021)

Similarly, to an aspect raised in terms of self-management, a number of participants highlighted time management as an essential part of their learning process and specifically towards becoming self-directed in a BLE.

Furthermore, the data also shows some self-evaluative practices that align with students acting as initiators in the context of e-learning ecologies (Cope & Kalantzis 2017) as BLEs:

> 'I evaluate every now and then if my strategies [*are*] working for me and helping me gain better marks.' (P27, Q3, 9 August 2021)

> 'I constantly compare them with the Teacher's instructions, and I check if they are still relevant and whether they will help me finish the work on time and appropriately.' (P20, Q3, 7 August 2021)

Another form of monitoring is evoked through feedback from the lecturer. In this regard, the following quotation is relevant:

> 'I monitor them [*learning*] through the feedbacks [*sic*] given by my lecturers. That's when I can identify if the strategy used works for me or not.' (P34, Q3, 10 August 2021)

Student recommendations

A number of recommendations for possible improvement of the BLE experience were noted by the participants. These recommendations are summarised in terms of the relevant quotations in Table 8.1.

Specifically relevant for the BLE is the fact that participants repeatedly highlighted issues around access to devices and the Internet.

Resource development

An important aspect explored in this research was the role of student open resource creation as a vehicle for supporting SDL in BLEs. This aspect is central to an approach embracing e-learning ecologies as, in this context, students should be involved in 'active knowledge making' (Cope & Kalantzis 2017:21), and open pedagogy may have potential in this regard (Olivier 2020a). This is highly relevant as the authors of this chapter believe that OER is central to resource use and management in BLEs.

TABLE 8.1: Summary of student recommendations.

Student recommendations	Quotations
Active learning	'Perhaps have discussions in class where student[s] are actively involved not just to receive information but rather research on their own.' (P13, Q5, 05 August 2021)
Increased collaboration	'Students can also be assigned to work in groups on projects.' (P23, Q5, 08 August 2021)
Opportunities for self-evaluation	'[I]n class, one is able to assess one's knowledge through what one has learnt on one's own.' (P2, Q5, 03 August 2021)
Clear indications of the scope of assessments	'It is very difficult to do that because there is nothing that shows how much work is required.' (P63, Q3, 10 August 2021)
Continuous communication between lecturer and students	'The sending of messages is what helps the most because we are constantly reminded about the work that we need to do, and communicating with the lecturer also helps a lot.' (P29, Q5, 10 August 2021)
Recorded content for asynchronous learning	'I would like to have recordings that will be made accessible.' (P30, Q5, 10 August 2021)
Differentiation	'I think they can hold discussions in forums that examine what has been covered and also provide help with different points that differ from student to student.' (P55, Q5, 10 August 2021)

A hampering aspect of open resource creation is specific language-related as was expressed by the following participant noting skills in an appropriate register:

> '[*B*]ecause I don't understand the isiZulu academic language enough to create resources. Hence, I translate most of my information to English before submitting.' (P24, Q7, 08 August 2021)

The availability of resources in languages other than English is also noted:

> 'Most sources are available in the English language now. I was finding it challenging to translate from English to isiZulu.' (P20, Q4, 07 August 2021)

> 'My wish is that sources be made directly available in isiZulu. It should be books originally composed in isiZulu, not those interpreted.' (P20, Q6, 07 August 2021)

Elements specifically related to language learning and teacher preparation

Within the context of the foregoing content relating to SDL and student perceptions, it was evident that certain aspects related specifically to language classrooms and this would ultimately also have an impact on how these language teachers in training would approach their role as educators one day. In this regard, the following quotations were identified as being relevant:

> 'Because I am a Zulu person, I like to learn or teach isiZulu.' (P3, Q4, 03 August 2021)

> 'My love for mother tongue, nothing gratifies more than learning in a familiar language that you know well it is exciting and pleasant to be taught in your own

language even though there may be obstacles along the way it is never really tough because the language is easy and soft as a result this module brings back hope that there is still something to make learning a pleasant experience.' (P14, Q4, 05 August 2021)

'I started doing isiZulu in primary school and over time my love for isiZulu gradually grew which is why I also want to help in teaching isiZulu to children so that they will grow up knowing isiZulu and have love for their culture.' (P19, Q4, 06 August 2021)

'This module intensively develops indigenous languages and also assists us to preserve our cultures.' (P66, Q1, 10 August 2021)

'I love my language a lot and I love to share the knowledge that I have about the isiZulu language and culture as the Zulu nation with coming generations.' (P60, Q4, 10 August 2021)

When it comes to language learning and ultimately also learning to become a language teacher, cultural and linguistic identity is key. Furthermore, this deeper association with the linguistic heritage acts as an additional motivational factor that could potentially act in support of SDL. However, it remains to be seen how this aspect could, for example, be exploited in additional language settings. The importance of this individual social link with a specific language as a vehicle and focus of study has implications for SDL as, according to Garrison (1997:19), 'meaning and knowledge are both personally and socially constructed. This, in turn, prompts a 'balanced integration of cognitive and collaborative learning processes, therefore, defines learning outcomes as both personally meaningful and socially worthwhile' (Garrison 1997:19), especially in terms of linguistic identity.

Similarly, this emotional connection with a language can extend to learning the language as a way of ensuring language vitality:

'It is because I want to teach my isiZulu language to pupils. I want them to better understand this language. I do not want it to die out, but I wish for it to live on and that we should also promote it.' (P7, Q4, 03 August 2021)

The nuances of language variety were also noted by the participants, and the desire to learn *deep isiZulu*, or '*isiZulu esijulile*' was also expressed:

'Learning such deep isiZulu energised me a lot, and I learnt new approaches that I can use in the class as a future teacher.' (P16, Q4, 05 August 2021)

This concept of *deep isiZulu* is 'a colloquial term used to describe varieties of the language uncontaminated by anglicisms or urban vernaculars' and is also the variety that is preferred in classrooms (Coetzee 2017:6). Importantly, Titus (2013:294) highlighted the cultural significance of this aspect as 'Deep Zulu culture embodies everything that predates the displacement that emerged from the forced labour migrancy of the twentieth century, and it has normative implications for almost every Zulu South African'.

A further language-specific element that could be derived from the data is taking charge in learning vocabulary, which in turn supports other language skills. In this context, one participant noted as follows:

> 'All the time I teach myself new words that I can use in reading and writing by reading novels and poems, dictionaries etc.' (P54, Q2, 10 August 2021)

The relevance of knowledge of vocabulary for language learning is apparent in the literature. In this regard, both breadth and depth of vocabulary knowledge are essential for language learning and repetition of encounters of words in different semantic contexts – as is alluded to in the quotation above – would lead to 'a common core representation of the semantic constituent' (Tran, Tremblay & Binder 2020:336). Furthermore, such knowledge of vocabulary can contribute to comprehension (Harmon & Wood 2018), which is an essential aspect of language use.

In addition, authentic language in use, such as through voice recordings, seems relevant as for student-teachers, not only would the content be of importance but also pronunciation. This is illustrated in the following quotation:

> 'My view about the available resources is that they are insufficient; there must be voice recordings where a person would be heard speaking their indigenous language.' (P64, Q6, 10 August 2021)

As language learning relies heavily on the use of texts for learning, quality and contextualised content are needed in different languages. This sentiment aligns well with the literature on text-based language pedagogy, where authentic texts are central to the language learning process (Lopez & Mickan 2017). The *Curriculum and Assessment Policy Statement* (CAPS) also highlights the need for a variety of texts for different purposes and at appropriate levels of complexity (DoBE 2011). The following quotations highlight the participants' views regarding texts:

> 'Yes, someday I would like to write short stories that can be used by learners.' (P29, Q7, 10 August 2021)

> 'In due course, I would like to contribute to the creation of the resources that are used in this language.' (P63, Q7, 10 August 2021)

> 'I'd really like to contribute through writing poems, short stories and songs or any other resources related to language.' (P77, Q7, 12 August 2021)

It would seem sensible for these student-teachers to aspire to write different literature texts, as it is clear in the scholarship on language learning and even in terms of SDL that literary texts can play an important role in the language learning context (Grimmer 2017).

Potential hurdles for self-directed language learning for African languages

A number of aspects were raised that might have a negative and hindering effect on changes to classroom practice towards fostering SDL in the language classroom in higher education. The following quotations illustrate some issues noted by the participants:

> '[*F*]ocus on how a student learns it often causes confusion when situations or study methods change therefore the learning approach already familiar to the individual should be maintained.' (P14, Q5, 05 August 2021)

This reluctance for any changes in the way in which the student has experienced learning in the past shows how there might be resistance to different strategies being employed by the lecturer.

This specific cohort also highlighted access to technology and the Internet as a hurdle in learning in general but specifically also in terms of having access to resources:

> 'Learning for me takes place when my mother or sister is home because we share devices.' (P43, Q2, 10 August 2021)

> 'I think that if we could be provided with recordings on a memory stick, it will help us who are not technologically savvy because we can't download.' (P59, Q6, 10 August 2021)

Appropriate language skills in the register used for learning purposes at university also seemed to be a specific challenge identified by one of the participants:

> 'I would like to have access to a translator for academic language because I find that the language that is used is quite complex for me to understand. I had come across words that I had never seen before though I did Home Language isiZulu at high school. I sometimes use Google translate, but it is not that useful.' (P51, Q8, 10 August 2021)

Discussion

Despite the fact that some participants regard themselves as being self-directed, it is clear that further supportive measures are required specifically in a BLE. In this regard, the framework for promoting SDL for English language students (Strydom 2020) could also be translated and adapted to the content of African language modules with a specific focus on infusing elements of e-learning ecologies such as BLEs.

There is clear evidence of self-directedness and student agency amongst the participants as they realise the importance of active learning, and independent work but also the advantages of collaboration (cf. Garrison 2016) in the context of BL. The participants showed a sense of responsibility, and the distance mode of delivery prompted a need for a self-directed process in the BLE. Importantly, in terms of BL, students would require a sense of self-direction towards being able to successfully exploit the technologically-enhanced environment in order to support their learning effectively.

The issue of resources as both an element of SDL and a means to learning in BLEs was prominent. The participants seemed to act proactively in finding additional resources whilst recognising the importance of reliable sources. However, the lack of resources specifically for African languages was quite prominent, and this prompted the need for the development of OER towards building e-learning ecologies in BLEs. Furthermore, in terms of e-learning ecologies, the participants see themselves as social sources of knowledge where both peers and the lecturer has got roles to play.

As Garrison's dimensions of SDL were specifically explored, some conclusions can also be drawn in terms of the three dimensions. Motivation to learn was very important to these participants, and it was specifically driven by working towards making a success of their careers one day, enjoyment of the class and support from the lecturer. However, fear of failing also served as a type of motivation. Exceptionally, this research showed the conative value of linguistic identity as a supportive factor for SDLL in a BL context. In terms of self-management, the participants noted how they would schedule and plan their learning and the issue of time and time management seemed to be very important. With regard to self-monitoring, the participants noted that reflection was embedded in their learning and that self-evaluative practices were also common.

A number of recommendations were also made regarding how students would ideally like their learning to take place. Finally, the participants also reflected on their role in developing resources. Overall, the participants were positive about contributing to the creation of resources in order to broaden the resource pool for African languages. However, specific skills such as adequate bilingualism were also highlighted. In terms of language-specific SDL issues, the role of language as a carrier of culture and as a wider social phenomenon was identified. The prominence of self-directedness in terms of the learning of vocabulary was also highlighted as well as the importance of authentic texts and language use.

Within the BLE, the hurdles identified were specifically related to access to the Internet and relevant technologies. In terms of SDLL, there were some concerns regarding reluctance to change and language skills challenges.

Limitations

Some limitations were discernible from this research. Firstly, there were some limitations in terms of the research population in terms of them being from a single university, being enrolled for a distance mode of learning and being mainly from modules preparing students for teaching in the FP. The majority of the sample, it could be deduced, was mother tongue speakers of isiZulu. Consequently, the findings of this chapter cannot be generalised to all speakers of African languages or even all isiZulu and Sesotho sa Leboa speakers. Yet, this chapter has reached its aim of probing perception around SDL amongst student language teachers within this context.

Finally, even though pertinent questions were asked in relation to SDL after the concept was explained, it is clear from the data that the concept was, in some cases, misunderstood as being either autonomous or even distance learning. Consequently, further follow-up interactions with the cohort would probably provide more appropriate findings. However, from the analysis, a degree of data saturation was reached.

Conclusion

This research explored how Garrison's (1997) dimensions of SDL, that is, motivation, self-management and self-monitoring, are reflected in current practices of African language learning for student-teachers in BLEs and how SDLL can be supported in the future within a BLE. It is clear that amongst student-teachers of African languages, they believe that there are already many elements of SDLL present in their BL context. However, a number of measures have been identified to support further SDLL. Significantly, the role of the conative value of linguistic identity should be exploited for SDLL in BL contexts. It is also evident that BLEs pose specific challenges to student-teachers of African languages because of the nature of the linguistic landscape typical to most online contexts and BLEs. As with students in other disciplines, this cohort also experienced challenges regarding appropriate skills and access to technologies within the BLE context. Hence, such more general aspects will also impact SDLL in BLEs. Finally, this chapter prompts the need for increased research of SDLL within the context of blended and even online environments in order to inform future teacher training practices.

Appendix

This research involves SDLL for student-teachers of African languages in multimodal open learning ecologies. So, we would like to gauge your views regarding SDL and open education.

Self-directed learning is a dynamic process through which students take charge of their learning alone or through the help of others in identifying what they need to learn, setting their own goals and selecting resources – which can be either material or appropriate to others, then selecting and applying certain learning strategies and then finally evaluating the set goals (Knowles 1975:18).

Please answer the following questions to the best of your ability. Take note that there are no right or wrong answers.

Open-ended questionnaire:

1. Whilst considering your own SDL, based on the definition provided, what is your view about that in terms of learning in your module?
2. Describe how you manage your learning in an autonomous manner.
3. Describe how you monitor your learning strategies and learning.
4. Comment on your motivation to learn in this module.
5. How do you think the classes can be adapted in order to support your SDL?
6. What are your views on the nature of resources being available for learning this language?
7. Would you like to contribute to creating resources for this language? Explain your answer.
8. What do you require in terms of specific learning online in order to support SDL?

Chapter 9

Self-control tasks with self-explanation prompts as a component of self-directed online learning

Egon Werlen[a,b]
[a]UNESCO Chair on Personalised and Adaptive Distance Education,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland
[b]Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Victoria Mirata
UNESCO Chair on Personalised and Adaptive Distance Education,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland

Divan Jagals
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Potchefstroom, South Africa

Nicole Bergamin
Department of Computer Sciences,
Swiss Distance University of Applied Sciences (FFHS),
Brig, Switzerland

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Abstract

A way to help students cope with the demands of SDL in a BLE is to provide them with appropriate tasks in the online part. The tasks should allow students to complete and monitor them independently. This works well with closed questions. However, depending on the learning material and the learning objective, open-ended questions are better suited to achieve learning success. This is the case in courses with topics that leave room for interpretation and where answers are often not simply 'right' or 'wrong'. Here, too, it is important that students receive immediate feedback. However, open questions require the lecturer to correct the assignments of all students and give individual feedback. This is not always feasible, especially with large numbers of students.

Therefore, we have developed self-control tasks for the online part of a BLE to give students immediate feedback and to help them consolidate the learning material and prepare for the F2F classes. These tasks also enable the lecturers to prepare the next F2F class at the students' current level of knowledge.

The aim of this chapter is to present the self-control tasks and to provide a first answer to the research question: 'How good is the technology acceptance exemplified by perceived usefulness and the usability of the self-control tasks within the BLE?' We first discuss the theoretical foundations of self-control tasks: SDL, metacognitive scaffolding with self-evaluation and self-explanatory prompts. This follows a description of the self-control tasks in order to explain this type of task from the perspective of a lecturer or course developer.

A crucial aspect is to make sure that learners accept the tasks and perceive them as meaningful for their learning. Therefore, we evaluated the self-control tasks' acceptance and usability. We asked students of a project management course to fill in questionnaires on technology acceptance and usability ($n = 17$), and we conducted interviews with 14 students. The questionnaire results showed a large range in acceptance and usability. The qualitative analysis of the interviews reflected this in a wide variety of advantages and disadvantages mentioned by the students. They found the tasks very useful for learning and exam preparation, but some of the students had difficulties with the self-assessments of the answers. We suspect that this is because of a lack of skills in metacognition and SDL. Suggestions for improving the self-control tasks also emerged from the interviews.

Introduction

The field of online learning continues to grow and enables teaching and learning to take place wholly or partly outside the classroom. The BLE at our university, the Swiss Distance University of Applied Sciences (FFHS), generally consists of 80% online and self-study and 20% F2F learning. Therefore, in a

BLE like at our university, online learning plays an important role. This is in line with Picciano's (2006) statement that BL involves both online and F2F learning experiences. Appropriately, Rovai and Jordan (2004) cite the definition of Colis and Moonen (2001), who consider BL to be:

> [*A*] hybrid of traditional face-to-face and online learning so that instruction occurs both in the classroom and online, and where the online component becomes a natural extension of traditional classroom learning (p. 3).

This kind of learning requires, amongst other things, self-direction from the learners. In this context, monitoring one's own learning and receiving immediate feedback are essential prerequisites for successful learning. One type of learning that highlights this is SDL – a learning process in which learners initiate and plan, implement and evaluate their learning experiences. It involves self-assessment and metacognition (Brockett & Hiemstra 2018; Knowles 1975). In terms of assessments, various studies indicate that the use of closed questions works well both technically and didactically (e.g. Enders, Gaschler & Kubik 2021). Nonetheless, depending on the content and learning objective, open-ended questions are sometimes more appropriate to achieve learning success. However, differentiated feedbacks with open-ended questions require a high effort on the part of the lecturers. If the aim is to give rapid and detailed feedback, even with many students, this becomes a practically unrealisable challenge. We present a task type, the self-control task, that allows assessing open-ended questions directly by the students themselves. The self-control tasks are integrated into the university's BLE. They consist of a metacognitive framework with reflection prompts that challenge and foster learners' SDL skills. They are offered to students in the online preparation phase for the face-to-face classes and serve to consolidate the reading and learning material. Based on students' answers to the questions and the students' self-evaluation, the lecturer has the necessary information to adapt and prepare the face-to-face lessons. With the help of the self-control tasks, they can see whether individual topics need to be deepened and whether the students have understood the learning material. The formative self-assessment in these tasks includes self-evaluation of answers and self-explanation of the differences from a sample answer. Formative online assessments play an important role in SDL. Gikandi, Morrow and Davis (2011) conducted a review on online formative assessment practices in higher education contexts and found that online formative assessment brings assessments and learning together. Formative assessments, that is, assessments embedded in learning environments, involve constant monitoring of learning. This can lead to meaningful learning experiences and can help identify learning gaps and appropriate learning strategies. According to Gikandi et al. (2011:2245), 'online formative assessment can play a crucial role in enhancing learning by creating improved learning environments that motivate students to actively engage and regulate their studies'. Similar studies, for instance, by Ghosh et al. (2020) and Metz et al. (2017), showed that self-assessments enhance SDL.

In each self-control task, the students self-evaluate their answer, comparing it with a sample answer. A self-explanation prompt invites the students to reflect on the differences between their answers and the sample answer. The aim of the self-control tasks is to give students immediate feedback and to provide control over their knowledge and understanding of the learning content. As Doğan et al. (2020:3) note: ‘Actively participating in the assessment process motivates students [...]. Moreover, as students learn more about assessment processes, their self-assessment skills will also improve’. At our university, lecturers use self-control tasks to involve real-world problems not only for the development of professional competencies but also for the self-control of text comprehension and learning progress. In this chapter, we report on the second case. In a BLE, the self-control tasks have to take place in the context of individual self-study. This means that there is no feedback from lecturers, tutors or peers. As the tasks are completed online, large amounts of learning data are generated. With the help of learning analytics, these data can be used to design adaptive tasks, carry out semantic analyses and automate the process of self-control tasks completely. We have already implemented the first version of adaptive tasks based on the self-control tasks in a health psychology course (Werlen & Bergamin 2018). The self-control tasks form a basis for later building fully automated learning units in a BLE, where the results of the self-control tasks can be used by the lecturers for the preparation of the F2F teaching and for the formative control of the study achievements.

In this chapter, we will first provide a definition and an introduction to SDL. We then clarify our use of the terms and concepts relevant to the self-control tasks: scaffolding, self-evaluation, and self-explanation prompts. The third part of this chapter contains a description of the implementation of the self-control tasks within the online part of a BLE. Then in the evaluation section, we place particular emphasis on the concepts on which we base the evaluation of the tasks: technology acceptance and usability. The aim of this chapter is, therefore, to present the self-control tasks and to provide a first answer to the research question: ‘How good is the technology acceptance exemplified by perceived usefulness, and the usability of the self-control tasks within the blended learning environment?’ After presenting preliminary results of the quantitative and qualitative evaluation, we discuss some critical points of the self-control tasks and describe existing and planned future developments.

Theoretical background

Self-directed learning

Self-directed learning has received a great deal of attention in the recent research literature and is becoming a growing and centralised field in education. Self-directed learning can be regarded as a process of learning during which students can initiate the planning, executing, and evaluation of their own learning experiences. Malcolm Knowles (1975), the pioneer in the field, described it as follows:

> In this broadest meaning, self-direct learning describes a process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating goals, identify human and material resources for learning, choosing and implement appropriate learning strategies, and evaluating learning outcomes. (p. 18)

Self-directed learning is best viewed as a continuous characteristic of learning that every student possesses to some degree (e.g. Morris & Rohs 2021). Knowles suggested as one of the main assumptions of adult learning is that learners become more independent and self-directed with maturity. Being self-directed can, therefore, be considered a natural part of life.

At an early age, learners are entirely dependent on the learning experience's structure as well as the context set by their tutor, with the degree of their own learning responsibility being especially low. At this stage, the tutor must explain *how* and *why* a task should be carried out, following Grow's (1991) model. As students age, they require less and less guidance. However, the student must be engaged in the creation of a personal plan, and a tutor can participate in the evaluation process. Tough (1967, 1971), in line with Houle (1961, 1988) offered a broad interpretation of SDL as a type of self-planned learning. For adult learners, the 'climate should cause adults to feel accepted, respected, and supported; further, there should exist a spirit of mutuality between teachers and students as joint inquirers' (Knowles 1980:47). Being a self-directed learner also suggests that adult students can engage in diagnosing their learning needs, plan and implement the learning experience, and evaluate the learning experience. This indicates a strong sense of engagement and goal-directed behaviour (Virtanen 2019:11). Self-directed students take control of their learning and the factors that influence their learning experience; they make decisions regarding different sources of information and process their experience through self-reflection (Markant, Settles & Gureckis 2016:100).

The regulatory domain of SDL involves self-planned learning. Other terms associated with this skill include self-educating and self-managing – in other words, the capacity to plan and implement an activity towards a predetermined set goal. One of the attributes of these learners is that they can help other learners to be successful in learning, particularly in a BLE. Adult learners, however, do not like learning processes that are inconsistent with their self-concept as autonomous individuals and that do not meet their needs and interests. For instance, Thomson (1996) carried out a self-assessment project to get learners involved in their SDL processes. Nunan (1996:21) showed that self-assessment's effectiveness is indicated by learners who are encouraged to monitor themselves and those who self-assess. An integral part of this monitoring process is the awareness of how they are performing in their own learning. Self-directed learning promotes domain or context-specific knowledge as well as the capacity to implement and apply their (conceptual) understanding in different contexts and conditions. Students who are characterised as being self-directed often plan and regulate their own learning actions and experiences, which indicates a strong sense of engagement and goal-directed behaviour (Virtann 2019). Using their critical self-directing learning model, Hammond and Collins (2016) identify improved control of the learning process as the immediate aim of learning. Their objective is to enable students to utilise what they have learned to better the lives and workplaces of people around them. Additional study will help us understand how adult learners may be supported as participants. The notion of SDL also piqued adult educators' interest in adult learning, as shown by the rising number of serious and incisive books on the subject (e.g. Abdullah 2001; Baumgartner 2003; ed. Giuselffi 2019). Understanding theories of adult learning has become a 'dynamic area of research and theory building' (Merriam 2008:2).

The trend where educational models have emerged in BLEs (Eggers et al. 2021) also promotes the use of SDL behaviour as such platforms require the student to apply strategies such as goal-setting and help-seeking. Students who rehearse, elaborate, organise, plan, monitor and evaluate can further develop these skills in BLEs. As BLEs are known to create opportunities to facilitate cognitive, metacognitive, motivation and management strategies (Eggers et al. 2021), it is anticipated that the facilitation of these strategies will promote SDL.

Within the process of self-direction, three learning-type models exist: (1) linear, (2) interactive, and (3) instructional. The models illustrate the variety of conceptually theoretical, empirically proven, and experimentally obtained perspectives of the process of SDL. A more traditional way of teaching and learning is reflected by the *linear model* and is, therefore, considered the early understanding of SDL (Knowles 1971; Tough 1971). According to this traditional understanding, students gradually move through a series of steps as part of the process to reach their own identified learning goal. The interactive model can be considered the closest characteristic learning model for SDL (Rager 2009). The *interactive mode*l, as reviewed by Song and Hill (2007), proposes a close connection between SDL and emotions. Particularly, it is considered a cyclic model which revisits the initial SDL process (from identifying learning needs, etc.) and progresses towards the final stage of evaluating own efforts. As such, the interaction-type model suggests the learning process and the strategies utilised revolves around the intention(s) of learning. This process requires constant reflection between the task, personal – metacognitive knowledge, and monitoring of the decisions made and actions taken. As personal attributes (including motivation and emotions) are also part of this interactive process of reflection, the online learning platform of a BLE serves as the contextual tribute.

In addition, the *instructional model* focuses on the skills required to enable the process of becoming self-directed, which include planning, monitoring and evaluation (Suknaisith 2014). The conceptualising of this instructional type model involves a number of self-directed skills, including determining exactly what should be evaluated, identifying the concepts or theories provided (e.g. rubrics or matrices, guidelines, feedback or sample answers), and identifying the overall aim of the project, identify or determine criteria by which to evaluate and select appropriate evaluation and monitoring instruments (e.g. by providing model answers to facilitate reflection). These three models are also mentioned in Chapter 1 of this book (Van der Westhuizen & Bailey).

Self-directed learning stresses the importance of creating a favourable learning environment to develop SDL skills. According to Knowles (1979), for a student to be self-directed, they would need the proper learning environment or platform to assure the learner is comfortable and respected. Importantly, learning is considered to take place not only inside a classroom but also outside the institutional-based learning program.

Providing favourable learning environments is still a relevant topic due to the emergence of new environments such as BL. As BLEs combine online resources with traditional classroom teaching approaches, the way in which we learn and teach has changed in both the process and the method of learning. Because of the technological developments and affordances of BLEs, the field of education is rapidly changing. However, the way in which students develop SDL skills does not account for the dynamic technological advances and the professions of tomorrow. Students thus need to be equipped with more integrative ways of thinking. With the emergence of innovative technologies such as mobile and online learning platforms, AI and adapted learning technologies with new learning platforms are needed – that enable the development of collaboration skills as a form of professional sensibility (Eraut 2004).

Researchers such as Kruger (2020) presented new models, for instance, ones that integrate SDL skills in adaptive learning systems. Lee et al. (2021) showed promising experiments that focus on improving higher-order thinking skills through the facilitation of metacognitive awareness during online learning, showing a strong link between SDL and metacognition. This link is crucial as not every learner has the analytical skills for self-analysis, which can be facilitated by the development of metacognitive strategies. The progression of becoming aware of and knowing one's strengths and weaknesses during the learning process through such reflection involves metacognitive awareness. One way to promote this awareness is through metacognitive scaffolds.

Metacognitive scaffolding

In the online part of BLEs, direct interactions are often not feasible as lecturers cannot always accompany students promptly and give direct answers to questions. In such cases, scaffolds are useful to facilitate awareness of learning. Lipscomb, Swanson and West (2010) explained scaffolding in the educational context that was developed by Wood, Bruner and Ross (1976) as a metaphor for the support offered to learners by teachers, lecturers or peers. It is a process in which the lecturer helps the learner to master a task that the learner cannot do themselves. The student is expected to solve the task as much as possible by themselves, although mistakes are expected. The lecturer only helps where the task is beyond the student's ability. With the lecturer's feedback, the student should succeed in solving the tasks and become more and more independent over time. The increasing independence of the learner allows the lecturer to reduce their assistance. This process is called 'fading' (e.g. Doo, Bonk & Heo 2020).

Scaffolding has its origins in Vygotsky's (1978) sociocultural theory that postulates learning as occurring in the so-called 'zone of proximal development'. Originally, scaffolding was used through personal interaction as outlined above. More and more, scaffolding is used in online learning, for instance in BLEs. Guidelines for instructional design strategies for online scaffolds can be found in a paper by Maria Schutt (2003). There are several types of scaffolding. In their review, Ersani, Suwastini and Artini (2021) identified four such types: procedural, conceptual, metacognitive and strategic. The scaffold underlying our self-control task is a metacognitive one.

According to Suwastini et al. (2021:14), 'metacognitive scaffolding guides students to develop their thinking skills which include how information is perceived, kept and retrieved'. This requires an appropriately adapted instructional design so that students' metacognition can develop. To put it differently, metacognition involves the awareness of one's own cognitive functioning, meaning the awareness of the ways one learns most effectively and the ability to control, and therefore self-direct, these factors. For example, a student who realises that studying with background music reduces their ability to concentrate and then turns the music off is demonstrating metacognition. Students with metacognitive skills are better able to adjust strategies to match learning tasks and are consequently more successful students (Eggen & Kauchak 1994). A distinctly important way in which reflection supports learning is by means of encouraging metacognitive thinking. During learning, such metacognitive reflection activates the monitoring process as well as the conscious control and regulation of the cognitive processes involved. This form of awareness involves thinking about thinking, creating self-awareness as self-knowledge of the person, task and strategy and the self-regulation or control of this knowledge (Flavell 1979). Self-questioning is often employed as a means to make sure that students understand the task. Chapters 3 and 6 in this book also discuss metacognition and its relation to SDL (Bailey & Breed; Lotz, Kruger & Olivier).

Scaffolding with self-evaluation and self-explanation prompting

As noted in the introduction to this chapter, formative online assessment brings assessment and learning together and motivates students to engage in learning and SDL. Tillema (2010) describes three different forms of self-assessment: self-evaluation, self-monitoring and self-reflection. The way students self-assess their answers with the help of a sample answer can be defined as self-evaluation, but it is also close to self-monitoring. Self-monitoring is more informal and seeks a better understanding of the students' task performance.

Rolheiser and Ross (2001) present a theoretical model for self-evaluation. Following these authors, self-evaluation can be very helpful because it enhances self-efficacy and intrinsic motivation and has a positive effect on performance, especially for difficult tasks. They define 'self-evaluation as students judging the quality of their work, based on evidence and explicit criteria, for the purpose of doing better work in the future' (Rolheiser & Ross 2001:43). A similar definition is from Boud's (1991, as cited in Bourke 2014) with:

> [*S*]elf-evaluation as the involvement of students in identifying standards and/or criteria to apply to their work and making judgements about the extent to which they met these criteria and standards. (p. 912)

In our self-control tasks, the students compare their own answers to a sample answer. They were not trained, as suggested by Rolheiser and Ross (2001). Therefore, they use their own (implicit) standards and criteria. In their model, self-evaluation consists of the components self-assessment and self-reaction. Self-assessment includes the question of whether the student's goals are being met. In our self-control tasks, this is the question of whether the student's answer matches the sample answer.

Self-assessment leads to self-reaction, which is the emotional response to the former. This is not an explicit part of our self-control tasks. In the evaluation questionnaire and in the interview, however, we received spontaneous feedback on this from the students (e.g. when asked for comments on the self-control tasks and their use). Positive self-evaluation, in combination with goal-setting and conscious effort, can increase self-confidence. This leads to students setting higher goals forming themselves, and putting in more effort. Following this model, high goals and great effort lead to achievement, which in turn leads to self-evaluation. Thus, self-evaluation leads to an upward spiral in learning (Rolheiser & Ross 2001).

A component of the self-control tasks is self-reflection. After the self-evaluation, the students are given a prompt for self-reflection. As Bannert (2009) discussed, prompts in education involve support to increase recall and execution. There is a wide range of prompts forming general questions to explicit execution instructions. They do not provide new content; instead, they are 'based on the central assumption that students already possess the concept or processes, but do not recall or execute them spontaneously' (Bannert 2009:139). There are many different types of prompts mentioned in the literature. Here we give a brief overview of different types of prompts and then assign the prompts used in the self-control tasks to these terms. McCarthy et al. (2018) explain direct and indirect prompts. With direct prompts, the instructions are explicit and aim to 'evaluate knowledge and understanding' and may give 'instructions on how to improve metacognitive behaviours' (McCarthy et al. 2018:423). They are time and resource-demanding (Friedrich & Mandl 1992, 1997). Indirect prompts foster the use of metacognitive strategies but do not teach monitoring (McCarthy et al. 2018). They start and foster specific learning and regulation activities that may be unconscious. Indirect prompts are learning supports that are contained in the learning environment (Friedrich & Mandl 1992, 1997). The goal of cognitive prompts is to activate prior knowledge or to direct the learners' attention. They are used to support cognitive processes such as memory retrieval and information processing by the learner. They may also support metacognitive processes (Zheng 2020).

Metacognitive prompts 'support students' monitoring and control of their learning processes by inducing metacognitive and regulative activities [...] such as orientation, goal specification, planning, monitoring and control, and evaluation strategies' (Bannert et al. 2015). Bannert also mentions motivational prompts that aim to support the motivation of learners.

Self-explanation prompts are a form of metacognitive prompts. They require learners to give an explanation of the learning content to themselves and also to reflect upon the learning strategies that they employed (Bannert 2009). The self-explanation prompts in our self-control tasks serve to prompt the students to explain themselves the differences between their answers and the sample answer. Therefore, the self-control tasks are part of the metacognitive prompts as they foster the metacognitive strategy to reflect on one's own knowledge and possible errors. The self-explanation prompts are also indirect prompts as they foster metacognitive strategies and are embedded in the learning environment.

Within the context of the self-control tasks, self-evaluation and self-explanation as forms of self-assessment are typical learning activities of SDL. In our BLE, these tasks are part of the online learning process and can be used by the lecturers to prepare the F2F lessons and to discuss their results and contents there.

In the next section, we describe the rationale, the purpose and the structure of the self-control tasks.

Implementation of the self-control tasks

With the self-control tasks, we developed a metacognitive scaffold with self-explanation prompts to offer students tasks with immediate feedback and the chance to learn by reflecting on the correctness or wrongness of the answer. For lecturers, it would take up a lot of time to correct and eventually comment on students' answers. With the self-control tasks, we offer a simple option which demands SDL skills from the learners and concurrently promotes them. We integrated the self-control tasks into the online part of our BLE in preparation to the F2F classes. In the course about project management containing the self-control tasks presented here, simple open-ended questions are asked. The lecturers can also provide further information such as case vignettes, videos, etc. The learners themselves monitor the answers by comparing them to a sample answer, evaluating and reflecting on any differences. In order to use this type of questioning from the perspective of lecturers or course developers, a detailed description has been provided. The tasks can be combined into task sequences. The content of the assignments relates to a smaller or larger part of the course content.

The purpose of the self-control tasks is, besides deepening the learning content, to enhance students' metacognitive skills for SDL. This includes evaluation of the difficulty of content questions as well as monitoring of correctness of own answers. By assessing the level of difficulty after answering a question, students might be encouraged to reflect on how many resources (e.g. time) they should invest in the associated topic. The monitoring of the correctness of students' answers entails a self-evaluation by comparing them with a respective sample answer and a reflection on the differences between them. Thereby, students receive the sample answer as immediate feedback, which enables them to continue learning. In addition, the scaffold helps students to compare answers by asking them to think about and justify the differences. This last step can be described as a self-explanation prompt (Bannert 2009).

The scaffold of the self-control tasks consists of the following structure: (1) content question, (2) assessment of the difficulty of this question, (3) self-evaluation of student's answer by comparing with a sample answer and (4) evaluation of differences between student's answer and the sample answer. The content questions are based on literature students have read in advance. After answering the content question, students rate the difficulty of the question on a seven-point scale with the expression 'extremely easy' on one side and 'extremely difficult' on the other side. Seven-point scales are recommended as a scale with an optimal number of scale points (Cox 1980; Matell & Jacoby 1972; Tang, Shaw & Vevea 1999; Preston & Colman 2000). It is often used for the assessment of cognitive load (e.g. Pastore 2010). Besides the didactic purpose, this assessment of the difficulty of the question gives an estimation of the intrinsic cognitive load (Paas, Van Merriënboer & Adam 1994). In the next step, students compare their answers with a sample answer displayed and evaluate their own answers. The criteria of the self-evaluation are not given to the students. A seven-point scale is again used for this purpose, with the expression ’no similarity’ on the one side and ‘complete similarity’ on the other side. As a last step of the scaffold, students evaluate and describe the differences between their answer and the sample answer.

Evaluation of the self-control tasks

Our research team with the aim of further developing the self-control tasks and adding new features, evaluated the development and implementation of the self-control tasks in several courses. Firstly, it was very important for us to know whether the students accepted the self-control tasks described below and how they rated the usability. Technology acceptance and usability show where the weaknesses are, which can subsequently be addressed. Technology acceptance and usability are crucial factors in determining whether new applications such as scaffolds can be implemented successfully in a BLE, especially if the aspiration is for students to learn in a self-directed way. Therefore, we will respond to the research question: ‘How good is the technology acceptance exemplified by perceived usefulness and the usability of the self-control tasks within the blended learning environment?’

Self-directed learning requires that students select their learning strategy themselves, whether they work through a learning task or only read the corresponding text. Acceptance and usability of the learning tools and materials are of utmost importance to their success. Therefore, at this point, we describe the concepts of technology acceptance and usability that are central to the evaluation before describing the methods of the evaluation and their results.

Acceptance and usability

First, we address acceptance. ‘Technology acceptance can be defined as a user’s willingness to employ technology for the tasks it is designed to support’ (Teo 2011:1). There are several models and frameworks of acceptance, for instance, the ‘Technology Acceptance Model (TAM)’, by Davis (1989) and its extended variations (e.g. Venkatesh & Bela 2008; Venkatesh & Davis 2000; Venkatesh et al. 2003), the Matching Person and Technology Model – MPT (Scherer 2004) and the Hedonic-Motivation System Adoption Model – HMSAM (Lowry et al. 2012). We refer to the TAM of Al-Azawei, Parslow and Lundqvist (2017) that was tested in a BL system. The modified TAM includes five components, namely the intention to make use of, the perceived usefulness (PU) of technology, the perceived ease of use (PEOU), blended e-learning system self-efficacy and perceived satisfaction.

We adhere to the model of Al-Azawei et al. (2017) because it corresponds largely to the original TAM, includes perceived satisfaction and uses a short questionnaire that we judged suitable for our BLE. Before describing this model, we introduce the original TAM of Davis (1989; Davis, Bagozzi & Warshaw 1989). The central predictors for the use of a system are the PU and the PEOU. The PU is (Davis 1989):

> [*T*]he degree to which a person believes that using a particular system would enhance his or her job performance [...] A system high in perceived usefulness [...] is one for which a user believes in the existence of a positive use-performance relationship. (p. 320)

The PEOU refers to 'the degree to which a person believes that using a particular system would be free of effort' (Davis 1989:320).

Following Davis (1989), one of the theoretical foundations of PU and PEOU is Albert Bandura's (1977:321) Social Learning Theory, with self-efficacy similar to PEOU and outcome beliefs similar to PU, both standing for 'basic determinants of user behavior'. Other theoretical foundations mentioned are, for instance, the cost-benefit paradigm and the channel disposition model. Perceived usefulness and PEOU are important constructs that influence the decision to use information technology. After building scales for the two concepts and evaluating and validating them in two studies, Davis (1989) concluded that PEOU and PU predict self-reported and self-predicted use of new technologies, PU being a mediator of PEOU.

Davis et al. (1989) further developed and described the TAM, basing it theoretically on the 'Theory of Reasoned Action (TRA)' as proposed by Ajzen and Fishbein (1980), who integrated most parts of the TRA into the TAM. The TRA is much more general than the TAM. The TAM is designed for computer use behaviour, 'specifically tailored for modelling user acceptance of information systems' (Fishbein 1980:985). The developers took the TRA as the basis for their model and adapted most of the concepts for TAM. The *attitude towards behaviour* was specified as *attitude towards using* technology, containing the positive and negative feelings of a person about the use of a system, behaviour intention was defined as *behavioural intention to use* technology, being the strength of an intention to use a system, and the actual behaviour was renamed *actual system use*. These variables were brought together with *perceived usefulness* and *perceived ease of use* that influence all variables directly or indirectly. Furthermore, there are external variables as a part of the model that is often important if a system is used or not. External variables are, for example, objective design characteristics, usability, but also training, documentation, user support consultants, educational programs (to promote a system) and learning based on feedback. They influence both *perceived usefulness* and *perceived ease of use*. The latter also influences the former, and both exert influence on usage and *behavioural intentions to use*. Finally, the *actual system use* is affected by the *behavioural intentions to use*.

Al-Azawei et al. (2017) used the TAM by Davis (1989) as a basis for their model of technology acceptance. The authors inserted perceived satisfaction and 'blended e-learning system self-efficacy' into the model and focused their paper mainly on learning styles. According to the authors, the *blended e-learning system's self-efficacy* is a determinant of both *perceived usefulness* and *perceived ease of use*. This is still congruent with Davis (1989), who sees self-efficacy as similar to perceived ease of use. The authors excluded *attitude toward using*, because Venkatesh and Davis (2000) found it as a weak moderator between (1) *perceived usefulness*, (2) *perceived ease of use* and (3) the *intention to use technology*. In our research, we ignore the learning style part of the model. It has been shown several times that learning styles in the sense of a personality trait do not hold up to scientific standards (e.g. Papadatou-Pastou et al. 2021; Reynolds 1997; Scott 2010).

Next, usability is addressed. Usability is defined by ISO 9241-11 as 'The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (Jokela et al. 2003:11). The attributes of usability (effectiveness, efficiency) focus on measuring the usability of the system when using information technology to perform a *specific task*. Whereas technology acceptance, in the first line, the PU, looks at the general performance by the end-users subjective perception (Chiou, Perng & Lin 2009). For a BLE and other forms of technology-based learning, an important issue is the usability of technology. Usability is situated between technology and the learner or, more generally, the user. The design of a learning environment or a learning task and its implementation must be such that learning processes are not hindered but ideally enhanced. A major purpose of technology-based learning should be to support learning (Bergamin & Hirt 2017). According to Arora et al. (2021), in BLEs, usability is the most important dimension that should be considered and investigated. However, unlike in other technological areas, the adaptation of usability for BL is still unclear.

We refer to the System Usability Scale (SUS) by Brooke (1996, 2013), which measures the usability of the technological system very generally with 10 items. It was developed from practical experience. The short-scale measures usability and learnability and can be used in studies with few participants (Sauro 2018; Tullis & Stetson 2004). For a short description, see the methods section.

In the context of the self-control tasks, we can reformulate the definition: The usability of our self-control tasks is the extent to which the self-control task can be used by students to receive immediate feedback (on each question), assess their state of knowledge and learn about the corresponding topic effectively, efficiently and satisfactory in a BLE.

Methods

Design and study participants

We evaluated the technology acceptance exemplified by PU and the usability of the self-control tasks integrated into an undergraduate course on project management at the Swiss Distance University of Applied Sciences (FFHS). The course is offered in a BLE with a ratio of 80% self- and online study and 20% F2F learning. It lasts one semester and is part of the curriculum of several of the university's applied sciences degree programs (e.g. BA in Business Engineering). In five out of six thematic blocks of the project management course, the self-control tasks are an integral part of the preparation for the F2F classes.

In our evaluation, we considered the self-control tasks of two thematic blocks. After solving the last self-control task, students were asked to complete an informed consent form and a short questionnaire about technology acceptance and usability (quantitative research). The questionnaire is described earlier. Twenty-three (23) out of 93 undergraduate students in business engineering attending the course in the autumn semester of 2020/21 completed this questionnaire. Six of them did not answer the informed consent form. The remaining sample of 17 students was too small for classical statistics. Thus, we carried out a cluster analysis using a *k*-means clustering algorithm with an iterative swap heuristic (Kanungo et al. 2004). The goal of this algorithm is to find the number of clusters with an averaged minimised Euclidian distance (distortion) of all data points averaged over the number of data points. To calculate the optimal number of clusters, we used the Silhouette Index (Rousseeuw 1987), which measures how similar a data sample is to its own cluster (cohesion) compared to other clusters (separation). To calculate the SUS value for overall usability, we further excluded the answers of one student who gave exactly the same answer to all questions, which indicates that they did not fill in the questionnaire properly.

At the end of the course, students were invited to take part in an interview on self-control tasks. The interviews were conducted by three of the authors (ew, vm, nb) within two months. The answers on PU were evaluated by the same authors (qualitative research). The procedure for data collection and the analysis of the interviews are described in the subchapter 'Qualitative approach: Data collection and data analysis'. Fourteen undergraduate students in business engineering (1 female, 13 males) participated in the interview. All participants explicitly agreed to participate in the interview by completing the online consent form in the LMS. All interview material in the study was treated strictly confidentially and anonymously, which means that all personal data that could be traced back to the participants was deleted or anonymised. All interviews were conducted and recorded with the help of the conference and collaboration tool MS Teams®. The video recordings were converted into audio files and afterwards automatically transcribed by the NVivo® Transcription (2021) tool. The quality of transcripts was evaluated by the researchers and edited where necessary. The NVivo® (2018) software was used for managing and analysing the interviews' transcripts.

The FFHS Ethics Committee approved the 'SpeeTex Design Study' project that these preliminary results are based on, on 16 October 2020.

☐ Quantitative approach: Instruments

We presented the TAM in general and the model of Al-Azawei et al. (2017). For the analyses in this chapter, we used two scales: PU and PEOU. Al-Azawei et al. (2017) adapted both scales from Vankatesh and Davis (2000) for their use in a BLE. We adapted them to measure the technology acceptance of the self-control tasks. The three items of PU asked about how strongly the use of self-control tasks improves learning performance, scientific performance and learning effectiveness. The four PEOU items assessed if the handling of the self-control tasks was easy and free of barriers. We used a seven-point Likert scale ranging from 'not agreeing at all' (1) to 'agreeing completely' (7). In Al-Azawei et al. (2017), the PU scale had a Cronbach's alpha of 0.79 and the PEOU of 0.77.

The SUS by Brooke (1996, 2013), often used to evaluate web applications, was developed out of practical experience as a short instrument with 10 items and as a one-dimensional scale with values between 0 and 100. Lewis and Sauro (2009) reported the reliability (Cronbach's alpha) of the English version at 0.92. The reliability of the German version of the SUS that we translated and adapted is 0.90. We calculated this with unpublished data from 605 students that attended BL courses at our university. Gao, Kortum and Oswald (2020) reported the reliability and the validity of new German translations using them on products used in daily life (e.g. MS Excel, Amazon, Google Search). With 199 participants, they found the reliability of Cronbach's alpha of 0.81–0.88 and validity with an adjective list of $r = 0.73$–$r = 0.83$. The exception was found in the usability of Google search because 22% of the participants had the maximum score of 100; the reliability was 0.74; validity was $r = 0.61$. A big advantage of the SUS is its applicability with small groups of test participants. Tullis and Stetson (2004) found in their study that 12–14 participants were sufficient for analysis with the SUS.

There are some inconsistencies concerning the factor structure of the SUS. Some authors found one factor (Bangor, Kortum & Miller 2008; Brooke 1996), others two factors (Borsci, Federici & Lauriola 2009; Lewis & Sauro 2009) with *usability* and *learnability*. Lewis and Sauro (2017) reanalysed the factor structure with confirmatory factor analysis and found the best model fit for two factors consisting of a factor with the positively worded items and a factor with the reverse-coded items. They concluded that this factor structure is 'a function of item tone' (Lewis & Sauro 2017:189) and not of practical interest.

Qualitative approach: Data collection and data analysis

Because of the unexplored effects of the self-control tasks on student performance in our BLE and our research interest in in-depth knowledge about the technology acceptance and usability of this type of task from the student perspective, the qualitative approach was chosen to assess acceptance and usability of the self-control tasks. As our data collection method, we used a problem-centred interview based on the procedure proposed by Witzel (2000). This type of interview allowed us to gain insight into how students accepted the self-control tasks and how they perceived tasks' usability from their individual perspectives by telling personal stories about their experiences with those tasks. In addition, we could focus on the theory-guided concepts (e.g. PU) relevant to our research whilst remaining open to the interviewee's unexpected views and appropriate modifications of preconceived theoretical concepts. Four available instruments were used for conducting problem-centred interviews, namely a short questionnaire, interviewing guidelines, online recordings of the discussion and a postscript (Witzel 2000). Interviewing guidelines and conversational strategies were the core elements of the interview. The guidelines included various kinds of questions, namely a leading introductory question, specific detailed questions, clarifying questions and some concluding questions, for example, related to student motivation to participate in the interview. Such semi-structured guidelines helped the researchers to keep important concepts derived from the theory in mind whilst remaining open to new issues that might emerge during the interviews. Finally, it provided a helpful framework for the comparative analysis of all interviews conducted.

The guidelines began with an introductory question that allowed general explorations of issues relevant to interviewees. It invited the interviewees to talk about their general experiences with self-control tasks in an open manner: 'How was it for you personally to learn with these self-control tasks? Please tell us about your experience with as many details as possible'. Specific questions were developed based on the questionnaire of the TAM by Al-Azawei et al. (2017) and the SUS by Brooke (1996). If an interviewee did not address a certain topic in an interview, specific questions were used to ensure the comparability of the interviews. To assess PU of self-control tasks, for example, a specific question related to advantages and disadvantages of self-control tasks was developed: 'When you think about your learning process, that is, learning online, what advantages and disadvantages have these self-control tasks brought to learning?'

We used a data analysis procedure with both deductive and inductive coding strategies that resulted in multiple coding cycles (Miles, Huberman & Saldaña 2014) as well as general guidelines for analysing problem-centred interviews proposed by Witzel (1985). Three knowledgeable researchers (Egon Werlen [EW], Victoria Mirata [VM] and Nicole Bergamin [NB]) coded the data according to the following data analysis procedure:

1. pre-test coding of three interviews by each researcher (EW, VM, NB) to identify important ideas, and topics (*inductive coding*)
2. revising initial codes and eliminating inconsistencies together (EW, VM, NB)
3. coding of all data material by VM *(inductive and deductive coding)*
4. defining coded concepts by VM
5. revising the initial code list and original data chunks, eliminating inconsistencies together (EW, VM, NB)
6. categorising initial codes by VM
7. working through the emerged categories (EW, VM, NB)
8. revising original data chunks regarding the category system together (EW, VM, NB)
9. reflecting and discussing the meaning of the results (collaborative meeting, (EW, VM, NB)
10. describing and displaying the results.

The quality of the data analysis was ensured through careful documentation of all data analysis steps, and a definition of theoretical concepts (internal validity) as well as intensive discussions of all three researchers until an agreement on codes and categories was reached amongst the three researchers (researcher triangulation; Creswell & Poth 2018).

Preliminary results: Students' experiences with the self-control tasks

Technology acceptance and usability

According to the 16 students who confirmed the informed consent and completed the questionnaires, the usability of the self-control tasks is on a level that can be described as fair, with 67 points (SD = 14) (Sauro 2018). According to Tullis and Stetson (2004), 12–14 participants are sufficient to evaluate a system with the SUS. Six of the sixteen students attested well to the very good usability of the self-control tasks. The others indicated poor to fair usability. This already illustrates the wide range of values from 34–90 points, that is, from very poor to excellent usability.

For an in-depth evaluation of the technology acceptance, the sample is too small. A look at the individual values on the different scales, especially on PU and PEOU, shows large variances. Amongst the group with high usability, there are generally also higher values for PU and PEOU. In the group with lower usability, there are both lower and higher values for technological acceptance.

Because of the small sample and the large spread of the values, we decided to carry out a cluster analysis with PU, PEOU and usability items as described in the methods section. The analysis revealed seven clusters: cluster 7 (low acceptance, low usability) with three participants; cluster 3 (medium, low) with six participants; cluster 2[10] (medium, low/high) with three participants; cluster 6 (medium, high) with two participants; cluster 5 (medium, high); cluster 4 (high, high); and cluster 1 (high, high) with one subject each. These clusters also reflect the heterogeneity of acceptance and usability, with most participants having medium acceptance and usability scores. Twelve students accept the self-control tasks at a medium level and only two at a high level. Nine participants attest to the task's lower usability, six with a high and two with a mixture of high and low usability. These results are also reflected in the qualitative evaluation of the PU (advantages, disadvantages) of the 14 semi-standardised interviews, as reported in the next section.

Qualitative analysis: Perceived usefulness of self-control tasks

To understand how much students accepted the self-control tasks whilst learning, we focused on assessing the constructs from the TAM by Al-Azawei et al. (2017) related to PU, PEOU, perceived satisfaction and intention to use self-control tasks in other courses. In this chapter, we present the intermediate results related solely to the concept of PU of self-control tasks by the students. To assess PU of self-control tasks, the students were asked to report on advantages and disadvantages that the tasks had for their learning: 'When you think about your learning process, that is, learning online, what advantages and disadvantages do these self-control tasks have?'

Table 9.1 shows the identified advantages and disadvantages of the self-control tasks reported by the students. Repetition and intensive engagement with learning content, support for the exam preparation, flexibility, enhancing motivation, and positive emotions during learning were identified as relevant advantages of self-control tasks. The disadvantages mentioned by the students referred to the time required for performing the tasks and the difficulties of conducting various self-assessments, like estimating task difficulty, self-evaluation of the answers and self-explanation of the differences between own and sample answers.

In the following, we use exemplary quotations of the students to demonstrate and explain the identified advantages and disadvantages derived from the qualitative data.

10. This cluster contains the data of the student who answered all questions at the same response level.

TABLE 9.1: Summary of the qualitative analysis: Perceived usefulness of self-control tasks.

Advantages of self-control tasks	Disadvantages of self-control tasks
Advantages of self-control tasks refer to the benefits that self-control tasks bring to learners in the learning process.	Disadvantages of self-control tasks refer to possible damages or losses that self-control tasks might bring to the learner as well as unfavourable concomitants that might impede the learning process.
General • Flexibility because of: ◦ voluntariness in completing self-control tasks ◦ time flexibility in completing self-control tasks • Enhancing student motivation to learn • Eliciting positive emotions (e.g. enjoying learning) **Learning** • Repetition of learning content • Exam preparation in terms of: ◦ task type ◦ content of the examination • Good supplement to learning content • Intensive engagement with learning content **Self-assessment** • Receiving a sample answer for immediate self-assessment	**General** • Time-consuming because of ◦ design of self-control tasks (e.g. self-assessment of the correctness of own answer with a sample answer) ◦ a large number of tasks and questions • Lack of reward (e.g. grading) in completing self-control tasks • Eliciting negative emotions (e.g. anger) **Instructional design** • Estimation of task difficulty by a learner: ◦ perceived as unnecessary ◦ perceived as difficult to assess ◦ perceived with unclear purpose • Comparison of own answer with a sample answer: ◦ added value of assessment of conformity with sample answer perceived as unclear ◦ perceived difficulty in assessing the correctness of own answer ◦ no clear feedback on the correctness of own answer ◦ explanation of differences between own answer and sample answer: added value perceived as unclear • Long sample answers • Many clicks within a self-control task

☐ *Advantages of self-control task*

The main advantages of self-control tasks from the students' point of view relate to the learning process, self-assessment and general advantages such as motivation, flexibility and positive emotions during learning. Most of the students (n = 9) noted that self-control tasks were useful for their exam preparation and repetition of learning content. This is of particular value as the examinations were conducted before the students participated in the interview. One student reported, for example: 'The advantage of the tasks is actually to activate the material once again, that is, to grapple with the topic once again. I think that's very good and was also very positive for me' (3NK, 02 February 2021).

Some students (n = 6) explained why the self-control tasks were useful for exam preparation. On the one hand, the self-control tasks provided a focus and direction towards what kind of topics and aspects could be assessed during the exam (the content of the examination), and, on the other hand, they showed clearly how questions and tasks could be asked formally in an exam situation (task type). The representative quotes were:

> ‘Yes, it was certainly beneficial that I paid even more attention to certain aspects because I suspected that they might appear in the examination if they already appeared in the learning questions.’ (2EW, 26 January 2021)

> ‘I used it to [...]. I can orient myself a little bit about what’s coming up in the exam. In other words, what tasks I can expect. Maybe one of them could even come up in the exam. That’s how I perceived it once, that I simply have an orientation as to what will be asked.’ (1VM, 25 January 2021)

> ‘But I thought [...] no, it’s actually good for the exam if you get a bit of a feeling for the tasks that are actually set in the exam.’ (1VM, 25 January 2021)

In addition, five of the 14 students noted that receiving a sample answer was very useful for their immediate self-assessment, for example, that ‘one sees the actual state of knowledge’ (5VM, 03 February 2021). Another student stressed the role of a sample answer as follows:

> ‘Absolutely. Yes, that is helpful. [...] I found it positive here, for example, you also have other tasks, where we only saw, okay, the solution was right or wrong, and here you could also compare, what you wrote in with a sample answer. I liked that you had this comparison.’ (3EW, 27 January 2021)

☐ *Disadvantages of self-control tasks*

Besides the general disadvantages of self-control tasks, such as them being deemed rather time-consuming to learn with (n = 6) or lacking any rewards like grading (n = 1), most of the reported disadvantages were because of its (instructional) design. In particular, they were related to the estimation of task difficulty by a learner, the comparison of own answers with a sample answer, and the self-explanation prompt that required a self-reflection on the differences between their own answer and the sample answer.

Estimation of task difficulty was sometimes perceived as unnecessary (n = 1), difficult to assess (n = 3) and with unclear purpose (n = 2):

> ‘Which bothered us a bit – or me personally, I’ll put it this way [...] I’m only talking about me personally – I was always indicating the difficulties of the tasks. I think this could perhaps be done at the very end and not almost after each issue. Yes. How difficult was the question? How difficult was the task? It is difficult to assess the difficulty of the task.’ (2VM, 25 January 2021)

> ‘What I find superfluous is whether it was an easy or difficult task. Sure, maybe you can do something with it. I don’t.’ (6VM, 08 February 2021)

Similarly, some students found it difficult to assess not only the difficulty of the task itself but also the correctness of their own answer by comparing it with a sample answer (n = 7):

> 'It was too difficult for me to differentiate between the sample answer and the text I entered. Is that right? Will that count now? Or is that wrong now? I found that a bit difficult.' (1NK, 26 January 2021)

> 'I think it's always better when you get [...] a result [...], how correct the solution was. But I don't know if that's possible when you give free answers as a text. I always find it difficult to decide for myself. Is my solution accepted or not? If I misunderstand a topic now or think that it is good enough. But the lecturer says no, it has to be there in any case. Then it won't do me so much good.' (1VM, 25 January 2021)

Some students perceived such a comparison as 'subjective' and thus 'a little bit unsettling', because it was difficult to assess whether the answer was 'correct or not' (2NK, 01 February 2021; 2EW, 26 January 2021). One student had, for example, the feeling that he was 'completely wrong' all the time because he 'never found the exact answers in the book' and considered that 'the sample answers were more from [lecturer's] experience' (4VM, 02 February 2021). Pointing out the difficulty in comparing their answers with a sample answer, some students mentioned multiple-choice questions and expressed their expectations to receive direct, clear feedback on the correctness of their answers. The representative quotes are presented as follows:

> 'I found [*multiple-choice questions*] almost better than the direct questions because then I could also check whether the answer was really correct.' (4VM, 02 February 2021)

> 'I'm more in favour of multiple-choice questions because at least I get direct feedback, right or wrong. And that's really what I lack with these tasks, that I have direct feedback, right or wrong [...] And this subjective assessment makes it extremely difficult, I'll say, to get a good feeling, to say yes, I did the tasks well or not. [...]. But because it is very subjective, someone else can interpret it completely differently than I do.' (2EW, 26 January 2021)

Finally, two students (n = 2) did not understand the added value of assessing the conformity of their answer with a sample answer stating that it was 'totally unnecessary' (6VM, 08 February 2021) and 'of no use' (2NK01 February 2021) to them. The purpose of the self-reflection question at the end of the self-control task, in which a student should write down the difference between their own answer and the sample answer, was also unclear for one student: 'Why should I write underneath again? When I have the sample solution, it's clear to me what was missing' (1VM, 25 January 2021).

☐ *Suggestions to improve acceptance of self-control tasks*

To remedy some of the disadvantages of self-control tasks mentioned above, the students suggested how self-control tasks could be improved, in particular how to address the problem of properly comparing students' own answers with a sample answer.

Some comments were linked to the redesign of a sample answer and instructions. For example, some students (*n* = 3) suggested that including feedback hints in the assessment part (e.g. links to the literature, links with explanatory videos) would be helpful for their self-assessment, in particular when an answer is wrong or incomplete:

> 'I still think it's good to give hints when you give a solution. Perhaps it would also be helpful to refer in the sample answer to the relevant passages that were asked or where the solution can finally be found. That would certainly be helpful. [...] I would simply like a final check, an immediate check.' (6VM, 08 February 2021)

One student would find it useful if the 'the detail level of the answer' were determined in the assignment because after comparing his answer with a sample answer, they found out that 'the answer was required in more detail' (3EW, 27 January 2021). In the same vein, some comments referred to the length of the sample answers and their formal design. 'Presenting the sample answer in a keyword format, in a short and crisp manner' or even just highlighting the key message using a thick black marker would be helpful for some students for self-assessment. The representative quote was:

> 'I read the question, and it was good for me. I may also be a man of few words, but when a question is asked, give the answer as short and crisp as it needs to be and not much more. But, the sample answer was the opposite. And then, it becomes difficult as a student to assess, okay, would that be enough now in the case of an exam? Because I had one sentence, the model answer had six sentences. That gives you an uneasy feeling. Is that sufficient in terms of content or not?' (2NK, 01 February 2021)

Finally, some students wished that self-assessments proceeded automatically, for example, that the correctness of 'answers is perhaps assessed by the program itself' (1NK, 26 January 2021), or similar to 'multiple-choice questions, matching tasks or bullet list tasks' (3NK, 02 February 2021). Moreover, some students proposed using multiple-choice questions instead of self-control tasks because they gave clear feedback on the correctness of their answers (*n* = 3) in contrast to self-control tasks and were less time-consuming (*n* = 3).

Discussion

Summary

In this chapter, we introduced the self-control tasks, a scaffold with self-assessment that includes self-estimation of the difficulty of the asked question, self-evaluation of the student's answers with the help of a sample answer and a self-explanation prompt to comment on the differences between the answers. The self-control tasks are integrated into a BLE. They simultaneously require and encourage SDL through the various components of the self-control tasks, be it through the self-estimation of the question difficulty, the self-evaluation of the answer or the metacognitive prompting.

Self-directed learning is a learning process in which learners initiate, plan, implement and evaluate their learning experiences. It involves self-assessment and metacognition (Brockett & Hiemstra 2018; Knowles 1975). Self-assessment includes self-evaluation, assessing one's own learning. With scaffolds, learners receive help to develop and train SDL skills and to self-reflect on their learning process. They shall lead the learners to become more independent.

An important aspect of modern instructional design, especially in BLEs, is technology acceptance and usability by the users, in this case, the students. As part of the further development of the self-control tasks, we conducted a study about the acceptance and usability of the tasks.

The students showed a large heterogeneity in estimating the acceptance and the usability of the self-control tasks. The values ranged from very low to very high. A cluster analysis confirmed this pattern. Seven different clusters resulted with most students in clusters with moderate acceptance and low usability.

This finding of the quantitative analysis corresponds well to the results of the qualitative analysis. We analysed the advantages and disadvantages of the self-control tasks. The advantages of the self-control tasks for students are the intensive engagement and repetition of learning content and the support for preparing for the exam. Further, students mentioned advantages like flexibility, enhancing motivation and positive emotions. The disadvantages that were mentioned by the students concerned the time required to perform the tasks and main difficulties of conducting the different self-assessments: estimating task difficulty, self-evaluation of the answers and self-explanation of the differences between own and the sample answers. The statements about the high effort of the self-control tasks indicate a high cognitive load. Principally, this is consistent with the reported difficulties of the students to self-assess their answers.

Critical points

There are some critical points in the self-control tasks that need to be discussed. In the course about the basics of project management, we systematically evaluated the acceptance and usability of self-control tasks for the very first time. For acceptance and usability, the results showed a heterogeneous image with values over a large range. In a conference paper (Werlen & Bergamin 2014), we reported satisfaction with the self-control tasks in a further education course in health psychology. Most of the students were very satisfied with the tasks with a mean of eight on a 10-point scale. Some students recommended the tasks spontaneously for exam preparation. In the project management course, the technology acceptance is moderate, which might be a consequence of the time-consuming aspect of the self-control tasks and a high extrinsic cognitive load. The perceived problems with the tasks, design, duration, and difficulties with self-assessments lead to unnecessary extrinsic cognitive load. The usability issues and increased cognitive load have a negative impact on student performance. Longo (2018) resumes in his abstract 'that usability and mental workload are two non-overlapping constructs, and they can be jointly employed to greatly improve the prediction of human performance'. On the contrary, a reason could be that the students in question are undergraduates and have problems assessing their own academic performance as they report difficulties in self-assessment and are dependent on feedback from the lecturers; that is, they have deficits in SDL. This is plausible as similar self-control tasks at our university have a high acceptance in further education. Jung and Lee (2013) found a comparable result in a different context (acceptance of YouTube videos), where lecturers showed a higher performance expectancy than undergraduate students. Mei (2019) found higher values for PU in senior students compared to junior students. The deficits in SDL can probably be attributed to a lack of skills in metacognition. As a reminder, metacognition fosters SDL. This lack of metacognition explains why these students criticise the self-assessments in the self-control tasks and prefer MC questions where correct, and incorrect answers are clearly reported back to them. They lack self-awareness and self-knowledge to recognise the sense in self-assessments and to use them gainfully.

There are large variances in technology acceptance and in usability in the quantitative data, and the qualitative analysis showed that students reported both advantages, such as good exam preparation, and disadvantages, such as difficulty with self-assessments. Here too, a broad picture of the self-control tasks emerges. This breadth of feedback shows that some students accept the self-control tasks well and see a benefit for themselves, others do not, and some are in-between. This could be because some of the students show few skills in metacognition and little SDL. Three observations from the interviews point to this: the students not seeing the point of the various self-assessments, their having difficulty with self-assessments in general, and their desire for clear feedback from the lecturers.

Difficulty with self-assessments can lead to lower-quality self-assessments. This was analysed by Werlen and Bergamin (2018) in a study about under- and overestimation of the correctness of one's own answers. To do this, they compared the students' assessments with the lecturer's assessments. They found that approximately 15% of the answer correctness was underestimated and 19% overestimated, with large underestimations occurring in 4% and large overestimations in 3% of the answers. These misjudgements are influenced by the assessment of task difficulty and answer quality. Overestimation of correctness is more likely for easy tasks and poor answer quality. Misconceptions have an impact on future learning behaviour and pose a problem for adaptive tasks based on self-evaluation of answers to open-ended questions because this gives students inappropriate recommendations.

In the previous analyses, we mainly referred to PU (advantages and disadvantages) and additionally to PEOU and usability. However, we can assume that other variables are also or even more important for the use of self-control tasks. These certainly include affective factors such as emotions and self-efficacy, as reported by Lew, Lau and Leow (2019).

Future developments

We developed the self-control tasks at our university. In the meantime, these have been integrated into several courses. In some cases, the lecturers adapt the current structure to their needs. We ourselves are constantly developing self-control tasks. One important goal is to create our own question type for Moodle quizzes or even a new task type. Independently of this, we are testing the self-control tasks in a version with oral answer input and in an adaptive version. In the future, we want to develop an additional version of the tasks in which the self-assessment is replaced by an automated answer, that is, with a semantic analysis comparing the students' answer with the sample answer with a machine learning algorithm. In a further step, the students will receive feedback on errors in their answers. In another project, we are working with a company that develops automated feedback on open-ended questions. Further development to be strived for is an automated assessment (if possible, with feedback of errors), which would be particularly helpful when considering the difficulties with self-assessments mentioned in the qualitative analysis. We will have to investigate what influences this will have on self-regulated or SDL. The role of the lecturers should not be forgotten either. In order to promote the use of self-control tasks amongst lecturers, we plan to improve the presentation of the results of the tasks, that is, the number of tasks carried out and the correctness of the answers, in a dashboard. This would greatly simplify the preparation of F2F teaching using self-control tasks.

As mentioned above, the statements about the high effort of the self-control tasks and the reported difficulties with self-assessments might indicate a high cognitive load or missing competencies in metacognition and SDL or, more precisely, in self-assessment. This needs to be clarified in future investigations. The further development of the instructional design of the self-control tasks depends on the reasons for the reported higher effort. The moderate usability and the statements about the high number of clicks that must be made to carry out the tasks show that the usability needs to be addressed; that is, that the technical process must be simplified. We are already aware of this point and working on a solution. On the other hand, the statements about the difficulties with the self-assessments suggest that it is also because of competencies that are not yet available amongst some of the students. This means that we might have to embed the self-control tasks differently in the courses. One possibility that fits well in our BLE might be to introduce, explain and test the self-control tasks in the first F2F lesson or in an additional online lesson.

Another noteworthy point is the inclusion of scaffolds. Scaffolds can be faded out (a process known as fading). The aim of fading is to enable students to use the skills autonomously. However, it is not yet clear in the literature whether fading brings better effects (Doo et al. 2020) and if fixed or gradual fading is better (Gidalevich & Kramarski 2019). According to the meta-analysis by Doo et al. (2020:73), there is a need to 'explore questions that will lead to more practical and strategic outcomes for teachers and instructional designers'. This includes questions of timing, when fading should begin and when scaffolding should end. Practically, it could help if students are guided more closely at the beginning during their self-assessment in the self-control tasks. Ultimately, it is a matter of teaching the novices how to use the self-control tasks and the further they are in this learning process, slowly fade out the support. The guiding could be done through exercises in F2F classes or online exercises or through additional feedback on self-evaluation, as suggested by the students themselves in the interviews. This can be done within an extra course during a semester but also over a longer period during their studies. Metz et al. (2017) found in their study that self-assessment is a learned process that needs experience and opportunities to train it. Training the self-assessments should also increase technology acceptance. A possible approach to improve the self-assessment of answers in the self-control tasks, the Four-Stage Model for Teaching Student Self-Evaluation of Rolheiser and Ross (2001), can be used or adapted to the structures of our university. The model consists of four phases: (1) involve students in defining the evaluation criteria; (2) teach students how to use self-evaluation; (3) give students feedback on self-evaluation; and (4) help students develop goals and action plans. The four phases fit well into the approach of SDL, as the students independently decide the desired criteria and goals.

However, neither compulsory nor voluntary extra training is easy to implement within a BLE with employed students who have to manage their time very well. Students perceive additional training as extra effort. An alternative is to use more self-control tasks during study time. At the beginning of the studies, tasks should be chosen where self-assessment of answers is easy. As the curriculum progresses, more difficult tasks can then be set.

We are already using self-control tasks to develop future learning tools. The preliminary results reported above are from an implementation of the self-control tasks in their classical version, that is, students write the answers. We are now investigating a new version of the self-control tasks with voice recording; that is, students give their answers orally. A speech-to-text algorithm transcribes the spoken answer and displays it to the students for correction and additions. This version of the self-control tasks will be evaluated in terms of technical acceptability and usability, as well. Further, we will revise the instructional design of the self-control tasks with and without voice input. To foster deeper learning, we plan to include preparation questions (e.g. single, choice questions) for the open-ended questions. This is an additional scaffold to guide students to the central point of an issue or question. In the introduction, we mentioned another further development of the self-control tasks to adaptive tasks.

Limitations of the study

The study was conceived as a design study. The aim is to further develop the self-control tasks in our BLE to promote SDL and adapt them to the needs of students and lecturers. We implemented the self-control tasks and their evaluation in an ongoing course. Because our students are usually up to 80% or more in their working lives, they must organise their studies very well and have few resources to participate in studies. Accordingly, the number of participants is low. In the semester studied here, 17 out of 93 students completed the consent form and the questionnaire. But even the self-control tasks were opened or looked at by only 50–70% and completed by about 30–50% of the students. As planned, 14 participants took part in the interviews on the self-control tasks. In this chapter, we have reported from the qualitative evaluation only on PU and the students' suggestions for improvement. Furthermore, we have not yet conducted any analyses of the content (seriousness, correctness). We developed the self-control tasks together with lecturers. However, we have not yet systematically collected feedback from the lecturers. It is unclear whether and to what extent lecturers support the self-control tasks and what requirements they have for these tasks.

Conclusion

The self-control tasks are a helpful scaffolding for students in a BLE and promote SDL. However, the acceptance of the tasks is not high amongst all students. We assume that students with few skills in metacognition and SDL especially have difficulties with self-assessment and therefore view the tasks critically or wish for tasks that give clear feedback (right or wrong). Therefore, for the use of the self-control tasks, it must be considered whether and how students with little SDL can be trained in self-assessment.

The student-reported advantages of self-control tasks, including self-assessment, indicate that they allow students to answer open-ended questions in a self-directed manner. However, students' statements on technology acceptance let suggest that pre-existing metacognitive and self-directed skills influence the use but also the evaluation of these tasks.

In the interviews, students themselves made suggestions for improving the self-control tasks. Thus, in future further development, feedback hints to literature and supplementary information such as explanatory videos could be given. Furthermore, indications of the expected size of the answer are desired. One student suggested automated feedback instead of self-assessment.

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Chapter 10

Blended gamification: Using Habitica to develop the self-directed capabilities of BEd students

Byron J. Bunt
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Vanderbijlpark, South Africa

Nicolaas van Deventer
Research Unit Self-Directed Learning,
Faculty of Education, North-West University,
Vanderbijlpark, South Africa

Abstract

This chapter aims to present the results of a Scholarship of Teaching and Learning (SoTL) project from a selected South African university that uses a combination of both BL and gamification to develop the SDL abilities of BEd students (in the Faculty of Education). Moving to a blended environment could create the problem of a lack of student engagement, and this study sought to ameliorate this by using gamification. This particular approach makes use of an application called *Habitica*, which is freely available on the

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Google Play store for Android and the Apple App Store for iOS. The app itself utilises a gamified approach to time management and daily planning, enabling users to schedule tasks and set daily reminders. For this project, the application is tailored to suit the professional needs of the students within an educational context and not just for personal, everyday life. The researchers wish to tap into students' self-direction using such an approach – whilst adopting a fun and humorous narrative storytelling strategy that relates to the application's use during contact sessions. Specific habits will thus be embedded into the app, with particular focus given to the 16 habits of mind (HOM). The methodology entailed a quantitative study involving the use of the SDLI, using a pre-test and a post-test experimental design. The sample included students in the researchers' own classes. The analysis involved using Cronbach's alpha coefficients, effect sizes, as well as standard deviations to compare the pre-test and post-test results. The results revealed a medium effect size when comparing the pre-test and post-test, tentatively implying that the intervention supported the development of SDL. Further recommendations entail the use of qualitative data to gauge the perceptions of participants.

Introduction

The following chapter describes the methods used to incorporate a mixture of gamification within a BLE to both optimise the potential of and develop the self-directed capabilities of a sample of BEd students at a selected South African university.

As a reaction to our changing education culture, higher education is shifting towards a more learner-centred approach, which necessitates the capacity to think critically, adjust and learn constantly throughout life (Saks & Leijen 2014:190–198). Self-directed learning is a technique for attaining lifelong learning, and self-directed learners continue to study after formal schooling has finished (Altuger-Genc, Genc & Tatoglu 2017), which is necessary for most occupations worldwide. Students that are self-directed learners accept ownership and control of their own learning processes and are innately driven to learn (Din & Haron 2018:49–58). Self-directed learning has been related to critical thinking and high-quality learning. Students who understand their own learning requirements, have control over their learning techniques and objectives and have access to the appropriate assistance and resources are more likely to succeed (Abd-El-Fattah 2010:586–596) and may also have increased self-confidence in their own learning skills (Zimmerman, Bonner & Kovach 1996:147).

Gamification in teaching is becoming increasingly prominent in education. The application of game features in non-gaming situations is known as gamification (Deterding et al. 2011). Gamification is largely utilised in higher education as a technique to inspire and engage students in actively participating in their own education (Siemon & Eckardt 2017:153–164). It has also been demonstrated to encourage creative thinking and satisfaction (Azmi, Iahad & Ahmad 2016; Sheldon 2020). Nonetheless, whilst gamification has been extensively researched in the educational context, there is still a need to study how game features and mechanics may be appropriately applied in higher education to promote the best learning (Hill & Brunvan 2018:70–79).

Furthermore, the application of gamification in higher education is fraught with complications. Gamification, for example, can result in extra work for both teachers and students (Siemon & Eckardt 2017:153–164) if not properly balanced. Gamification is often used to inspire students to engage in learning (Dicheva et al. 2015:75–88) and is seldom used to promote a certain learning approach. Whilst motivation is crucial in learning, it is also necessary to evaluate the nature of the learning activities in which students are driven to engage. This chapter concentrates on SDL as a learning approach and attempts to investigate the possibilities of utilising gamification as a method to assist its development. Therefore, this chapter intends to answer the question: What effects could Habitica as a BL gamification strategy have on the development of HOM that could lead to better SDL?

The main aim of the project is to establish and discover how a BL gamification intervention program supports the development of HOM that could lead to SDL amongst 4th-year BEd students.

The main aim was operationalised in the following objectives:

- To recognise the elements of SDL and HOM.
- To determine why SDL and HOM are important for 4th-year BEd students.
- To establish how SDL and HOM could be effectively developed.
- To establish what role Habitica plays in nurturing SDL and HOM.
- To explore the student participants' perceptions and experiences regarding Habitica, whereupon it will be determined if certain SDL characteristics are visible after the intervention.

The following section outlines the key concepts embedded within the study.

Literature review

Self-directed learning

As SDL is the core variable in this study, it is crucial to understand what it entails. In terms of theory and practice, the connection between adult learning and SDL merits more investigation. Mezirow (1985:17–30) pointed out that 'no idea is more important to what adult education is all about than SDL'.

In its broadest meaning, SDL describes a process in which (Knowles 1975):

> [/]ndividuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

As we grow older, we become less dependent on those around us to fend for us and supply us with resources. Independence is a state we develop towards through time, and we become more self-reliant and autonomous as a result.

There are a number of distinguishing traits that may be seen in self-directed learners. Self-directed learners have a number of important characteristics, including intrinsic desire, the ability to set personal objectives, self-discipline, an ability to judge one's own progress and metacognitive abilities (King 2011). Self-directed learners have a high level of self-generated motivation to attain their goals and priorities, and they can keep track of and make adjustments to their own learning. There is a high level of dedication, tenacity, and self-motivation amongst self-directed learners (Cross 1992:54).

Self-motivation is a common characteristic amongst students. People with extroverted personality traits, such as those with a positive outlook on life or those who are very self-motivated in their pursuit of knowledge, tend to be more inclined to pursue their own personal learning objectives (Raemdonck et al. 2012:8). As a result of their personality type, certain students will be drawn to SDL, but all students may benefit from this form of learning. Motivating students to pursue self-directed, autonomous learning is a key component of intrinsic motivation (King 2011). Establishing environments that encourage intrinsic motivation and a learning style centred on self-direction may be one of the most important and fundamental educational objectives. Learners who take charge of their own education are expected to figure out what they want and to know and when to do it, prepare their own learning materials, track their progress through various resources, collaborate with others in order to support their own learning, as well as document their progress. SDL may benefit from the guidance and advice of mentors. Effective SDL requires some level of professional supervision (Hatcher 1997:34–39). Self-directed thinking does not occur naturally in a given context. The environment, society, culture and educational institutions all have a role in whether or not students are able to develop their own learning strategies (Hatcher 1997:34–39)

Adult learning is based on the assumptions of Lindeman (1987), that adults have a deep need to be self-directed (Manning 2007:104):

- Adults' orientation to learning is life-centred.
- Experience is the fundamental source for adults' learning.
- Adults have a deep need to be self-directed.
- Independent variations increase with ageing.

- The first three sentences clearly demonstrate a highly pragmatist learning method. Because of its apparent connection to SDL, the fourth assertion in this study is the most significant one. The final sentence demonstrates the significance of SDL, in which the form and amount of learning may be varied at any given moment.

As a result of these principles, it is obvious that education should be based on personal experiences, with a particular focus on real-life problems and aspirations. Instead of just transmitting knowledge, the teacher's role should be one of facilitator or participant rather than one of a transmitter (Manning 2007:104). Teaching methods would have to take into consideration variances in style, time, location and speed if the final point is correct (Manning 2007:104).

During the late 1940s and early 1950s, group dynamics work was used as a basis for adult learning theories, which are now widely accepted. Adult learners, according to this early idea, have developed a variety of cognitive, perceptual, emotional and attitude strategies to prevent them from learning or improving unless conditions are favourable (Manning 2007:104). Therefore, understanding and improvement could be seen as either safe or unsafe approaches. Adult education, according to Knowles (1975:14), works best when students are engaged and driven, and the content they're studying has real-world implications. This modern approach to adult education philosophy was quite practical. For adults to learn effectively, Knowles discovered that they want a crafted atmosphere, clear instructions, opportunities to practice their new abilities and encouragement from those who care about their progress (Manning 2007:104). Chapter 2 of this book also focuses on emotions and their relation to SDL (Kruger et al.).

Knowles (1975:16) argued that the learners themselves are essential resources for teaching; they allow and incorporate the rich experience into the instructional content and make it more relevant. As a result, the curriculum for adult learners must go beyond just disseminating information and instead focus on providing tools and resources to aid in SDL. Self-directed thinking may once again be mentioned as a possibility. In addition to imparting knowledge, adult education should provide a work-friendly social atmosphere (Manning 2007:104).

When Knowles' (1975:19) theory of andragogy emerged, Tough (1979:23–36) published the effects of seven years of work on adult learning, transition and development. Tough's research focused on both the why and the how of learning. In his study, he found that individuals were focusing their learning efforts on a sequence of connected tasks, which he estimated to take at the bare minimum, seven hours. Over half the person's total drive is to learn and keep a pretty clear knowledge and competence or to make a permanent change in oneself in each episode. Adult learners, according to Tough, go through a multi-stage learning process. In order to boost their learning, he suggested that helping children build better skills to deal with periods of decreased support may be a good strategy (Manning 2007:104).

Mezirow's perspective on the shift was shaped by his involvement in women's re-entry programmes at community colleges. Women had faced a unique form of reasoning: studying the psychological and cultural views that affected how they perceived themselves and their relationships. Later, Mezirow (1985:17–30) based his results on Jurgen Haberman's critical theory, which defined three domains in which individuals sought knowledge: work, relationships and emancipatory intervention. Mezirow (1985:17–30) converted these domains into adult learning settings, each with its own unique paradigm and set of demands. Mezirow (1985:17–30) defined perspective shift as Haberman's emancipatory behaviour or the uniquely adult world of thinking. The essential goal for adult educators, according to this concept, is to assist individuals in becoming conscious of the psycho-cultural prejudices that have shaped how they view themselves and others. Brookfield (1984:59–71) proposed six concepts of effective learning practice in designing college courses focused on adult learning philosophy: (1) voluntary participation in learning, (2) mutual respect, (3) collaborative spirit, (4) action and reflection, (5) critical reflection and (6) self-direction. The second concept is most closely related to SDL. To address the accomplishment of this SDL aim, it is necessary to understand the sorts of learning that might promote this goal in the 21st century. This objective might be aided by the use of BL, which will be described more below.

Blended learning

According to Graham (2006:3–21), with the use of Internet resources and social media, BL combines the advantages of traditional classroom instruction with the convenience of online learning. Both the teacher and the student must be present for this to work, with certain parts of the student's control over time, place or pace. Face-to-face instruction is combined with computer-based material and delivered whilst students are still in 'brick-and-mortar' classes with a teacher present. Professional development and higher education both employ BL (Graham 2006:3–21; Hrastinski 2019:564–569).

Blended learning, according to Singh (2003:51–54), is highly context-dependent, making it challenging to gain a consistent grasp of it. The inability to come to an agreement on a precise definition of BL has been cited by a number of writers as a contributing factor to the difficulty in evaluating its effectiveness (Singh 2003:51–54). Blended learning has been described as a mixture of traditional classroom teaching methods with online learning methods, reliant on technology-based instruction, where all participants in the process of learning were involved, according to a 2015 meta-analysis of evidence from a thorough examination of evidence-based research findings (McCutcheon et al. 2015:255–270). Another conclusion of this study was the superior success of students in BL (as opposed to online or in-person learning) as compared to both online and in-person learning methods. 'Blended learning' and 'tailored learning' are often used interchangeably (McCutcheon et al. 2015:255–270).

Advantages

Compared to F2F or online-only courses, Vo, Zhu and Diep (2017:17–28) believed that hybrid BL is more effective. Student accomplishment may be greater with BL techniques than with traditional F2F training. By combining digital education with one-on-one personal interaction, students may study independently with innovative ideas that allow instructors to explore and help specific students who may require special attention. As a result, instead of functioning at the lowest common denominator, teachers may now 'simplify their instruction and assist more students in reaching their full potential'. For example, Vo et al. (2017:17–28) as BL proponents argued at the start of this century already that the incorporation of 'asynchronous Internet communication technologies' in higher education classes helps to 'facilitate parallel, autonomous and interactive learning' (Osguthorpe & Graham 2003:227–233). This integration is a significant contributor to the happiness and success of the students in such courses. Students' attitudes towards learning have been positively impacted by the usage of ICT. Using 'computer-based qualitative and quantitative assessment modules' in class projects, lecturers and part-time students have been able to work more closely together, and students have been able to demonstrate their understanding of course content better. Osguthorpe and Graham (2003:227–233) claimed that BL had been shown to improve student attitudes about learning by researchers Rasheed, Kamsin and Abdullah (2020) and Dziuban et al. (2018:1–16). Education costs may be reduced by using BL. Blended learning may be less costly than traditional classroom education, according to some experts (Tikadar & Bhattacharya 2019:76–78). Costs may be reduced by moving lessons online and substituting expensive textbooks with electronic devices that students already bring to class, a practice known as BL (Garrison & Kanuka 2004:95–105; Tikadar and Bhattacharya 2019:76–78). Additionally, e-textbooks, which may be accessed online, can save classroom costs. Blended learning supports the ability to gather data and the customisation of curriculum and assessment as two of the primary benefits of this method. As a part of BL, there is also a need for software that collects and records students' academic progress on a regular basis. To offer immediate feedback, tests are typically evaluated at random (Garrison & Kanuka 2004:95–105; Oweis 2018:1–8).

Students' log-ins and work hours are also monitored to ensure that they are being sincere. This may be done by reallocating resources in schools that use BL systems. Curriculum technologies are used by students with special talents or interests that are not included in regular curricula (Abusalim et al. 2020:1203–1220; Thorne 2003:84–85). Blended learning eliminates the paradigm in which the teacher stands at the front of the class, and all students are expected to move at the same speed, allowing for more personalised instruction. It is possible for students to study at their own individual pace, ensuring that they completely grasp novel ideas before moving on to the next one. In order to be successful, students in a classroom where BL is being used are more likely to exhibit better adaptability, self-regulation and independence. As a result of providing students with an initial curriculum orientation when using a BL method, they will be better prepared to integrate the various components and develop more autonomy (Oweis 2018:1–8; So & Brush 2008:318–336). To construct a virtual classroom, several online institutions use web-based conferencing technology to connect students and instructors. Innovations introduced by online university courses are used by many other organisations. The basic notion of educational technology may identify some of the advantages of BL, particularly in schools up to and including the 12th Grade (Abusalim et al. 2020:1203–1220; Heinze & Procter 2004:1–13). It is also one of the most effective ways to tailor learning to the needs of a large group. Norms are favoured by proponents of BL because they allow them to keep an eye on effectiveness and usability. Access 4 Learning Schools Interoperability Framework specification or the IMS Global Consortium Learning Framework specification are two examples of interoperability specifications that may be used in conjunction with education standards like policy requirements and the Common Core State Standards (Graham 2006:3–21; Tikadar & Bhattacharya 2019:76–78). It is possible to foster a sense of community amongst students by using an LMS or federation of systems. This 'virtual café' allows instructors and students to interact without having to meet F2F (Vo et al. 2017:17–28). In most schools, this Internet application is used for online classrooms and other school-related activities. The online community has demonstrated great outcomes with the use of a BL approach. These findings were compared to those of Alcoholics Anonymous and Weight Watchers and found to have comparable consequences (Dziuban et al. 2018:1–16; Osguthorpe & Graham 2003:227–233).

To what extent may BL be beneficial? That is dependent on the amount of system integration used. 'facilitating student learning, conveying ideas effectively, exhibiting enthusiasm in learning, preparing successfully, showing respect for students, and judging achievement equitably' are just a few of the qualities that distinguish the best BL programs (Dziuban et al. 2018:1–16; Osguthorpe & Graham 2003:227–233). For more information on the benefits of SDL, consult Chapter 1 of this book (Van der Westhuizen & Bailey).

Disadvantages

A lack of proper planning and execution may lead to technological limitations in BL, as it is heavily reliant on technology resources or instruments used to convey it. In order to have a significant influence on the learning experience, these resources must be accurate, easy to use and current (Moskal, Dziuban & Hartman 2013:15–23). Information Technology literacy will act as a major impediment to students needing exposure to course materials, rendering the provision of high-quality technical support a priority. Certain elements of BL that may be daunting include community training because of communication challenges in an online setting (Moskal et al. 2013:15–23). Students may fall behind on coursework if teachers employ recording technology. Just over 40% of the students who participated in a study at four separate colleges watched several weeks of lecture videos in one sitting, according to the findings. In terms of the instructor and how often electronic material is made available to the student, it has greater ramifications (Moskal et al. 2013:15–23).

From the standpoint of an educator, it has lately been noted that offering appropriate evaluations through online media is more time-consuming (and hence more costly) than traditional (e.g. paper-based) assessments. Using e-learning services may take more time than conventional methods and may incur additional costs as e-learning sites, and service providers may charge educators user fees (Heinze & Procter 2004:1–13; Rasheed et al. 2020). Another significant problem is access to network infrastructure. Although the digital gap is narrowing as the Internet becomes more widely available, numerous students – even in their schools – do not possess comprehensive and ubiquitous Internet access. Every effort must be made to include BL methodologies into the institution's educational approach. This is why learning centres are constructed with secure WiFi connections to handle this problem (Horn & Staker 2011:1–17).

From the above discussion, it is evident that BL does have its fair share of disadvantages. However, this chapter wishes to address some of these disadvantages by proposing an alternative form of BL, that is, embedded within a gamification approach.

Gamification

Alsawaier (2018:56) stated that utilising gamification principles in a 'pedagogical context' may provide solutions to learners who feel uncomfortable or disaffected by conventional teaching and learning methods.

To 'gamify' a scenario is to apply game design features and ideas to non-game contexts (Alsawaier 2018:56). To put it another way, it may be thought of as a series of actions and procedures, including the application of game mechanics to the resolution of issues. Game design elements are generally used to improve user experience, corporate efficiency, productivity, training, crowdfunding, recruitment and staff evaluation, accessibility, program efficiency, physical activity, traffic infractions, voter apathy and more in the context of ‘gamification’. More than half of the study on gamification reveals that it has a positive impact on individuals. However, there is a wide range of conditions and persons (Alsawaier 2018:56).

Techniques

Gamification strategies are designed to manipulate the natural desires of individuals for socialisation, learning, dominance, competitiveness, accomplishment, prestige, self-expression, selflessness or resolution, or merely their reaction to the presentation of a game or play scenario (Negruşa et al. 2015:11160–11189). Early gamification techniques utilise incentives to attract gamers for the players who accomplish required activities or competitions. Achievement styles involve awards, recognition badges or ranks, filling a progress bar or offering virtual currency for the player/learner. Having the incentives for performing tasks accessible to other teams or offering leadership forums are ways to encourage competition (Negruşa et al. 2015:11160–11189).

Creating activities that resemble video games is one method of gamification. Some of the tactics utilised in this approach include meaningful choice, starting a lesson, increasing difficulty and adding narrative (Fotaris et al. 2016:94–110).

Game design elements

A gamification application’s foundation is built on the principles of game design. Typical game design aspects include points rewards, leaderboards, performance graphs, meaningful storylines, avatars and teammates (Fotaris et al. 2016:94–110). When it comes to promoting continuous learning and academic achievement, the best way to promote SDL is to give students a sense of agency and ownership over their education (Lindberg 2019:1765). Motivating oneself is a necessity for attaining SDL (King 2011), and gamification as a method of motivating and engaging oneself should, in principle, be ideal for supporting that facet of SDL. However, the implementation of gamification is still precarious, and it has to be demonstrated how gamification can complement the elements of SDL (Lindberg 2019:1766).

Points

Points are a key component of many games and gamified applications. Typically, they are given to participants who successfully complete prescribed activities in the gamified environment, and they serve as a numerical representation of how far they've progressed (Caponetto, Earp & Ott 2014). There are many other ways to categorise points, such as skill points, redeeming points and prestige points, as well as the many roles that each of these points serves. Providing feedback is a primary goal of the points. Points allow players' in-game activities to be evaluated and serve as a continual and immediate source of feedback and incentive (Caponetto et al. 2014).

Badges

In the field of gamification, badges are used as pictorial representations of achievements and may be earned and collected (Nicholson 2015:1–20). They serve as a powerful affirmation of the players' successes, as well as a sign of their character traits and the extent to which they've met their goals. On the basis of a given amount of points or specified actions in the game, badges may be awarded to players (Seaborn & Fels 2015:14–31). When a player understands the conditions for obtaining them, badges may serve as both objectives and status markers. Similarly to points, badges also serve as an indicator of how well players have performed. Because of this, players may be motivated to take specific paths and take on certain tasks in order to acquire the badges that go along with them (Buckley & Doyle 2016:1162–1175). Aside from the obvious psychological effects, badges may impact players and co-players as they represent the collective identity of those who have earned them.

Leaderboards

Leaderboards rank players based on how well they have done in comparison to other players and a predetermined standard of success. As a result, the leaderboards may be used to assess who performs best in a certain activity and are consequently comparative indicators of success that compare the player's performance to the achievement of others (Nicholson 2015:1–20). However, the leaderboards' power to motivate is not uniform. It is a tremendous motivator when there are just a few points remaining to the next level or location but a demotivator if the players find themselves at the bottom of their leaderboard (Seaborn & Fels 2015:14–31). The social pressure of the leaderboards might improve the degree of involvement of the player, which can have a good influence on participation and learning. It is also more frequent if the competitors are on an equal playing field when it comes to their effectiveness (Buckley & Doyle 2016:1162–1175).

Performance graphs

Simulated or strategy games often make use of performance graphs to show players how they stack up against their prior results (Nicholson 2015:1–20).

Success metrics, on the other hand, do not compare a player's performance against that of other players but rather assess the player's performance over a period (Seaborn & Fels 2015:14–31). Success measures are determined by an individual benchmark metric in contrast to the aggregate reference standard of the leaderboards. As a consequence of this visual representation of the player's progress, they focus on it. Using motivation theory, it is said that this encourages a sense of mastery, which is advantageous to learning (Buckley & Doyle 2016:1162–1175)

Meaningful narratives

In games, meaningful storylines have no purpose other than to entertain players (Nicholson 2015:1–20). A tale may be woven into the game's narrative to give its actions and characters meaning beyond the simple pursuit of points and rewards. With current role-playing video games (e.g. World of Warcraft), a game's story might be expressed by its title or by its complex plots (e.g. The Elder Scrolls Series). There are a variety of ways in which storytelling environments may be used in a non-game context (Seaborn & Fels 2015:14–31). As a result, they may enliven even the most dreary of settings, especially if the tale is a match for the player's interests. So, narratives are essential to the application of gamification, as they may alter the nature of real-world occurrences, such as being followed by zombies whilst running, by adding a narrative 'overlay' (Buckley & Doyle 2016:1162–1175).

Avatars

Avatars are digital depictions of players in a game or gamification world. Typically, a player is selected or even formed (Nicholson 2015:1–20). Avatars might be simple pictograms or elaborate animated, three-dimensional representations of themselves (Seaborn & Fels 2015:14–31). Clearly distinguishing between players and other human or digital avatars is a significant formal responsibility of the game. When playing cooperative games, avatars enable players to adopt or develop a new identity and become a member of a group (Buckley & Doyle 2016:1162–1175).

Teammates

Conflict, competitiveness or collaboration may occur amongst teams, whether they are actual players or artificial non-player characters (Nicholson 2015:1–20). Furthermore, by building teams, such as by having established teams of individuals working together towards an agreed-upon purpose, the latter may be fostered (Seaborn & Fels 2015:14–31). Figure 10.1 below highlights the various classes that can be played in teams using the Habitica application.

Source: https://habitica.com/static/press-kit, available for use as open-source material from the Press Kit.
FIGURE 10.1: Habitica classes.

The above figure shows the various classes that can be used in the Habitica app, which allows players to form teams of four.

Education

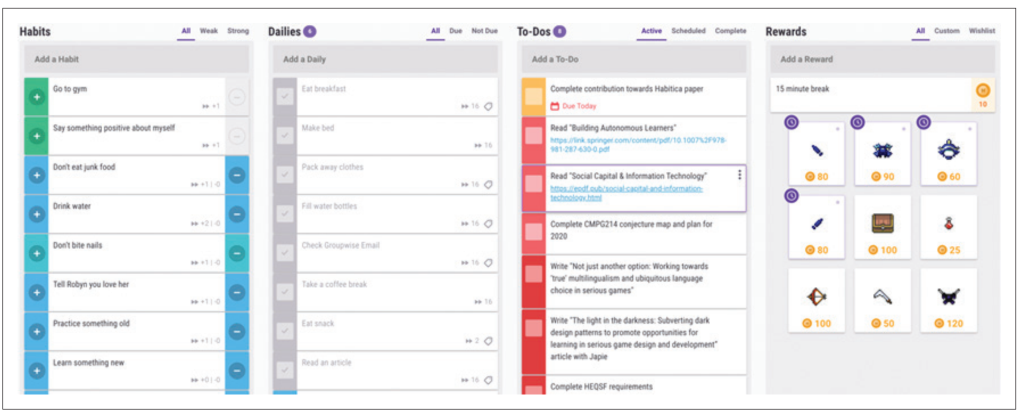
Gamification has shown a keen interest in the sectors of education and training. The Ribbon Hero 2 game was released by Microsoft as an add-on to their Office productivity suite in order to assist customers in learning how to use it effectively. Microsoft describes this project as among the most successful Office Labs projects ever published (Nicholson 2015:1–20). The MacArthur Foundation and the Bill and Melinda Gates Foundation have helped the New York City Department of Education build a school dubbed Quest to Learn that focuses on game-based learning, with the goal of making education more entertaining and relevant to students (Seaborn & Fels 2015:14–31). System Analysis Program's sustainability training includes games. Gamification was also employed by the US military and Unilever in their preparation. The Khan Academy serves as a good example of how gamification may be used in online learning. A new educational location-based game, Gbanga Zooh, was launched for Zurich Zoo in August 2009 that challenged gamers to rescue endangered animals and return them to a zoo. In order to attract and exploit endangered animal species, players created artificial ecosystems around the Canton of Zurich. Students with dyslexia may benefit from gamification in the classroom, according to certain studies (Buckley & Doyle 2016:1162–1175).

To encourage employees to apply what they have learned in the classroom in the real world, companies are increasingly turning to gamification as a tool for training. Around 78% of workers say they utilise games-based motivation at work, and almost 91% say that these programs help them become more committed, knowledgeable and efficient in their jobs.

Habitica

Figure 10.2 highlights the application known as Habitica. In the image, four main columns are present, namely the Habits, Dailies, To-Dos and Rewards columns.

Habitica, formerly known as HabitRPG, is computer software used to keep track of various tasks (Madera & Figueroa 2019:150–153). Habitica is a role-playing game rather than a task management system. It is a free and open-source project. Using gaming dynamics on top of a self-improvement program on the web, Habitica encourages users to keep track of their progress and remain motivated to reach their objectives. As in a role-playing game, the player builds their character's strength by acquiring goods like gold and armour. Goals achieved in the framework of Habits, Dailies and To-Dos are rewarded (Barik, Murphy-Hill & Zimmermann 2016:134–142).



Source: https://habitica.com/static/press-kit, available for use as open-source material from the Press Kit.

FIGURE 10.2: Habitica main menu.

Habits

A person's behaviours may be changed by setting long-term objectives in Habitica. Both positive and negative values may be assigned to these 'Habits' (Madera & Figueroa 2019:150–153). For instance:

> '1 h of productive work' is a specified Habit. If a player spends an hour doing anything useful, they'll get experience and money. (Barik et al. 2016:134–142)
>
> 'Eat junk food' is a preset habit. It's a bad habit to overindulge in fast food, as it degrades one's health. (Barik et al. 2016:134–142)
>
> 'Take the stairs' is a preset Habit. If a player chooses to utilise the stairwell, they will earn money and experience, although doing so is a bad habit. Health is at risk if they do not use the stairs (Barik et al. 2016:134–142). A specific approach will be used in this project, where the HOM will be integrated into Habitica. The HOM are a collection of 16 problem-solving, life-related abilities that enhance strategic thinking, insightfulness, tenacity, creativity, and craftsmanship in order to efficiently function in society (Costa & Kallick 2000:36). Listening with understanding and empathy, thinking and communicating with clarity and accuracy, and thinking interdependently are all SDL-related HOM (Costa & Kallick 2000:36).A person's ability to deal with real-life problems and achieve great outcomes depends on their mastery of these 16 HOM and their ability to apply what they've learned in the actual world (Costa & Kallick 2000:36):

- **Persisting:** Keeping one's focus on the work at hand and completing it. Can and do keep their attention on the task at hand (Costa & Kallick 2000:36).
- **Managing impulsivity**: It is important to slow down and analyse your choices whilst dealing with impulsive behaviour. Consider your words and actions before you speak or act. When faced with adversity, maintain your composure, empathy and compassion; proceed with caution (Costa & Kallick 2000:36).
- **Listening with empathy and understanding:** Pay attention and do not dismiss what another person has to say. Assume that the other person's point of view is my own; tell people if I can identify with what they're saying; do so when I can. Respect another person's emotions and point of view by keeping your opinions at a distance (Costa & Kallick 2000:36).
- **Thinking flexibly:** Consideration of others' thoughts and ideas; coming up with other solutions; evaluating the available choices (Costa & Kallick 2000:36).
- **Thinking about thinking:** Be conscious of one's own thoughts, emotions, intentions, and deeds; Realising that what I do and say has an influence on others; Willing to examine the consequences of one's actions on oneself and others (metacognition) (Costa & Kallick 2000:36).
- **Striving for accuracy:** Ensure accuracy and double-check for mistakes; measure at least twice; cultivate an interest in precision and workmanship (Costa & Kallick 2000:36).

- **Questioning and posing problems:** Ask myself, 'How do I know?'; create a questioning mindset; consider what knowledge is required, and identify tactics to get it; consider the barriers that must be overcome in order to reach a solution (Costa & Kallick 2000:36).
- **Applying past knowledge to new situations:** Learn from the past and apply it to current situations: What you've learnt may be put to good use. Consider your existing knowledge and experience (Costa & Kallick 2000:36).
- **Thinking and communicating with clarity and precision:** Strive to be clear when speaking and writing; Strive to be accurate when speaking and writing; Avoid generalisations, distortions, minimisations and deletions when speaking and writing; (Costa & Kallick 2000:36).
- **Collecting data through all senses:** Pause to take in the sights, sounds, smells and tastes around me; savour what I'm putting in my mouth and experience what I'm touching (Costa & Kallick 2000:36).
- **Creating, imagining, innovating:** The ability to think creatively, imagine alternative solutions, and come up with innovative solutions is essential in today's fast-paced world (Costa & Kallick 2000:36).
- **Responding with wonderment and awe:** Be inquisitive about the world's beauty, nature's strength and the immensity of the cosmos; admire what is awe-inspiring and can touch my heart; be open to the tiny and huge surprises in life that others and I perceive. Responding with Wonderment and Awe.
- **Taking responsible risks:** I am open to trying new things, even if they are risky; I do not allow my fear of failing or failing miserably stop me from trying new things that are both safe and sensible (Costa & Kallick 2000:36).
- **Finding humour:** One must be willing to laugh at the proper times; look for the whimsical, silly, sardonic and unexpected in life and laugh at oneself whenever possible (Costa & Kallick 2000:36).
- **Thinking interdependently:** Accept and value other people's ideas and perspectives is an important part of being a team player; even if I do not agree with the group's choices, I must follow through on them. Learning from people in reciprocal settings is a good trait to have (Costa & Kallick 2000:36).
- **Remaining open to continuous learning:** Adaptable to new experiences; adaptable to change. Self-assured and self-effacing enough to confess ignorance when it occurs; Please accept any and all new information (Costa & Kallick 2000:36). It may become green if a person follows a healthy practice as well. It is a good sign if they are succeeding in their habit. Those that engage in unhealthy habits on a daily basis, however, may begin to show signs of redness and enhance the damage they do to their health. The health of players increases when they reach a certain level of experience (Madera & Figueroa 2019:150–153).

Source: https://habitica.com/static/press-kit, available for use as open-source material from the Press Kit.

FIGURE 10.3: Habitica character with player statistics.

As can be seen in the figure above, the player's character is shown, next to some statistics such as player health next to the heart, experience points next to the star and mana (for spells) next to the gem.

Dailies

'Dailies' (daily tasks) are used by Habitica to keep track of the routines the user must follow in order to complete chores on time and in the same way each time. To complete a daily, click the checkbox next to the task's textual reference (Madera & Figueroa 2019:150–153). The user plans their Dailies beforehand and analyses what they have completed during the workday in summary. In the actual world, it is the user's responsibility to verify these thoroughly and honestly. To get experience and money, players must complete their Dailies. One's level of experience influences the four primary player stats: strength, intelligence, constitution and perception. Players who fail to complete their daily tasks at the end of the day risk losing health, which might ultimately result in a decrease in their total level (Madera & Figueroa 2019:150–153).

To-Dos

To-Dos are one-time responsibilities that the user may add or delete. To-Do items are deleted from the active list whenever they are completed, and users get experience for completing them. They may be found later under the 'Complete' To-Dos page (Barik et al. 2016:134–142). Like Habits and Dailies, To-Dos need not deplete your health bar if you leave them uncompleted. In contrast, To-Dos grow more useful as time goes on, providing more experience and gold if/when they are finished.

Multiplayer

Aside from the daily single-player content in Habitica, users can also (1) create or join a party to complete quests and defeat tough bosses, (2) take on community-generated 'Challenges', (3) partake in 'Tavern chat' with other players and (4) join private or public guilds based on pre-defined criteria (arts, entertainment, finance, etc.) (Barik et al. 2016:134–142). Communities of interest can connect and share their own habits, dailies and to-dos by engaging with one another on this platform. Groups of like-minded individuals can thus devise challenges, which can be accomplished alone or together, making it easier for users to generate their own tasks and, ideally, become more effective in doing so. We can liken this aspect of the gamified system to the extension of one's own desire to become self-directed to others (Barik et al. 2016:134–142).

Applying habits of mind

Each module has its own curriculum that consists of pre-defined content and skills that should be taught and learned. Assessments are supposed to provide certain results based on the outcomes that are set, based on the content and skills of each module. Quantifying the results sets a clear direction for students because they can set clear goals of achieving a certain mark. Education should not be a mere result-based education, as Dweck (2007:34–39) highlighted the importance of the process of reaching the end result that should be clear to the students. Implementing the HOM in the process can make it clear to the students what they need to do to reach their desired results whilst enabling them to improve their processes.

Giving students more responsibility in their own reflection and also in peer assessment can have the same value as lecturer feedback in the teaching and learning process (Rienties et al. 2018:117–136). By using Habitica, the reporting of their feedback becomes more student-centred (Costa & Kallick 2008b:258–268). These encapsulate competencies for SDL.

The students ultimately need to understand what each Habit of Mind entails. By reflecting on these habits on their own and with deliberation from their peers, the opportunity to engage with the theory of HOM more may improve the shared understanding of HOM that is essential for successful self-reflection and peer assessment (Bloxham & West 2004:721–733; Rust, Price & O'Donovan 2003:147–164; Costa & Kallick 2008b:258–268). Using self-reflection and peer assessment also adds the advantage of being able to give better-detailed feedback in larger classes (Rienties et al. 2018:117–136). See Chapter 9 of this book for more detail on the advantages of self-assessment and reflection on SDL development (Werlen et al.).

Self-reflection is the constant and careful deliberation about what supports beliefs or knowledge and what it concludes to (Dewey 1933:4–5), including the exploration of an individual's own experiences intellectually whilst including emotions to establish a new understanding and appreciation (Boud, Keogh & Walker 1985:16). Reflection differs from self-assessment because it is not only measured against established criteria. Reflection is to think about what a person knows or not and about the area of confusion in-between (McMillan & Hearn 2008:40–49). Goals are then set to be met, and criteria that have not been established can now be established to reach certain goals.

Self-assessment is a process where a student reflects and evaluates the quality of their own learning and product of learning, the extent to which reflection was done on specific goals, identifying personal strengths and weaknesses, including the ones in their work and revising and refining (Andrade & Du 2007:160). Self-assessment does not only mean that students measure themselves against given criteria, but they should identify criteria that they deem as important to their work and should be able to measure their own work against said criteria to reach specific goals (Boud et al. 1985:16). Self-assessment on the part of the educator is the process to pass control over learning to the students (Brew 1999:159–171).

Peer assessment is a process where students are evaluated by peers, in other words, students of equal status. Peer assessment allows a student to not only reflect on their peers by using feedback but also help with their own reflection (Van Zundert, Sluijsmans & Van Merriënboer 2010:270–279).

To guide student self-reflection and peer assessment, the students need to understand the theory of HOM to be able to judge the increases and decreases in their HOM bars in Habitica. The following tools can be implemented to help with the reflection and assessment processes.

An important part of self-reflection and peer assessment is a discussion to create a classroom understanding of HOM and how to reflect and assess with them successfully. The tools that are given above are some examples that may be used on their own or adapted by the students and the lecturer to fit their own teaching and learning process better. The students can decide on their own which criteria in the tools can be linked with each HOM and, in turn, use self-reflection and peer assessment to increase and decrease their HOM bars in Habitica.

Methodology

Sampling

Non-probability sampling techniques, such as purposive and convenient sampling, were employed in this study, which indicates that not everyone in the population has an equal chance of participating in the study

(Maree & Pietersen 2020:191–202). Pre-service instructors in History education programs at a South African institution were specifically targeted by the researchers. This group of pre-service teachers has been selected because, during their undergraduate studies, it may be possible to identify deficiencies and weaknesses relevant to the growth of SDL and put in place action plans to remedy these deficits and weaknesses before they graduate and begin their teaching careers. The convenience of the sample comes from the fact that the people who took part in the study live close to where the researchers do their work. One of the researchers had an impartial individual post a recruitment notice on the researchers' LMSs to guarantee that participants were not misunderstood about their engagement in the study. Participation was completely optional, and respondents may end the survey at any moment by refusing to open the browser. A consent form was integrated into the online survey to convey this message to survey takers. All steps of the process were conducted in complete secrecy. The reflections were done anonymously, with just a participant's unique number serving as a method of identifying them. This questionnaire was only filled out by 21 out of 40 pupils that signed up for the school-based initiative, despite there being 40 participants (the school-based project was compulsory as part of the course; however, it was not compulsory to complete the questionnaire).

Research approach

Data were collected using both quantitative and qualitative phenomenological research methods simultaneously by the researchers to see if participants' SDL may be aided by gamification and HOM in the context of mixed-method research (Creswell & Plano Clark 2018:52–59). As part of the quantitative technique, the SDLI, developed by Cheng et al. (2010:1152–1158), was distributed to participants to gauge their level of SDL. Qualitative data were obtained from the participants' written comments on the advantages of the HOM approach to assist their growth of SDL after the adoption of the mixed gamification method. As a result of a confidentiality agreement and no conflict of interest, the data gathering was overseen by an unaffiliated individual.

Quantitative and qualitative methods and instruments

Self-directed learning instrument questionnaires were completed by all participants, as stated in the preceding section. Learning motivation (LM), planning and implementing (PI), self-monitoring (SM) and interpersonal communication (IC) were the four categories of SDL in the questionnaire. Descriptive (frequency and percentages) and inferential statistics were both used in the statistical study (confidence intervals). A 5-point Likert scale was used to score responses to each question. Participating students were asked to write about their experiences with the new teaching method that was implemented in order to help them become more self-directed learners. They were also asked whether they felt they would be capable of adapting this strategy to their own studying and teaching in the future. Qualitative data were likewise protected by identifying participants only by their code names. The qualitative data, on the other hand, are currently being analysed and will not be included in this chapter.

Data analysis

Data were analysed using descriptive and inferential statistics, including frequencies, means, Cronbach's alpha coefficients, standard deviations, as well as effect sizes. These statistics were done for both the pre-test and post-test of the SDLI.

Results

Quantitative results will be reported in this chapter, as the qualitative data are still being collected.

Table 10.1 reports on the Cronbach's alpha coefficient, as well as the mean and standard deviation for the SDLI pre-test.

The reported Cronbach's alpha value (0.69) corresponds to the guideline value of 0.7, which indicates that the factor is reliable (Table 10.1). The resulting mean of the SDLI score is 93.76 (SD = 5.74). This shows that the pre-test that was conducted was reliable and that the resultant mean of 93.76 reflects that student participants felt that they were experts in their SDL levels. The minimum mean was 74, still reflecting quite a high level of SDL.

The following figure represents the various age groups of respondents for both SDLI pre-test and post-test:

Less than half of the respondents (n = 10; 47.6%) were of the ages 19–22, and the remainder were 23 years or older (n = 11; 52.4%). This was to be expected as the module that this project took place in was a third-year BEd

TABLE 10.1: Cronbach's alpha coefficient, mean and standard deviation of self-directed learning instrument pre-test.

Test	n	Cronbach's α	Minimum	Maximum	Mean	SD
Pre-SDLI	21	0.69	74	100	93.76	5.74

Key: SD, standard deviation; SDLI, Self-directed learning instrument.

module consisting of senior students who should have completed at least two years of study (Figure 10.4).

The following graph represents the various language groups of respondents for both SDLI pre-test and post-test:

From the graph (illustrated in Figure 10.5), it is noted that a third (33.3%) of the group speaks Sesotho (*n* = 7), whilst another third (33.3%) speaks isiZulu (*n* = 7). The remaining third is split between English (9.5%) speakers (*n* = 2), siSwati (9.5%) speakers (*n* = 2) and Afrikaans (14.3%) speakers (*n* = 3). This is also to be expected at the institution where the students are studying. The campus is located in Gauteng, South Africa, where the demographics align quite clearly with these results, as the majority of people living in that area are Sesotho speakers. The English and Afrikaans speakers also align with the demographics of the country as the minority.

The following graph represents the gender of the respondents for both the SDLI pre-test and post-test:

From the graph (illustrated in Figure 10.6), it is noted that the small majority of respondents were female (*n* = 11), whilst the slightly smaller group was male (*n* = 10). Again, this is also to be expected, as the normal distribution of education students at the university is in line with the numbers of male and female respondents.

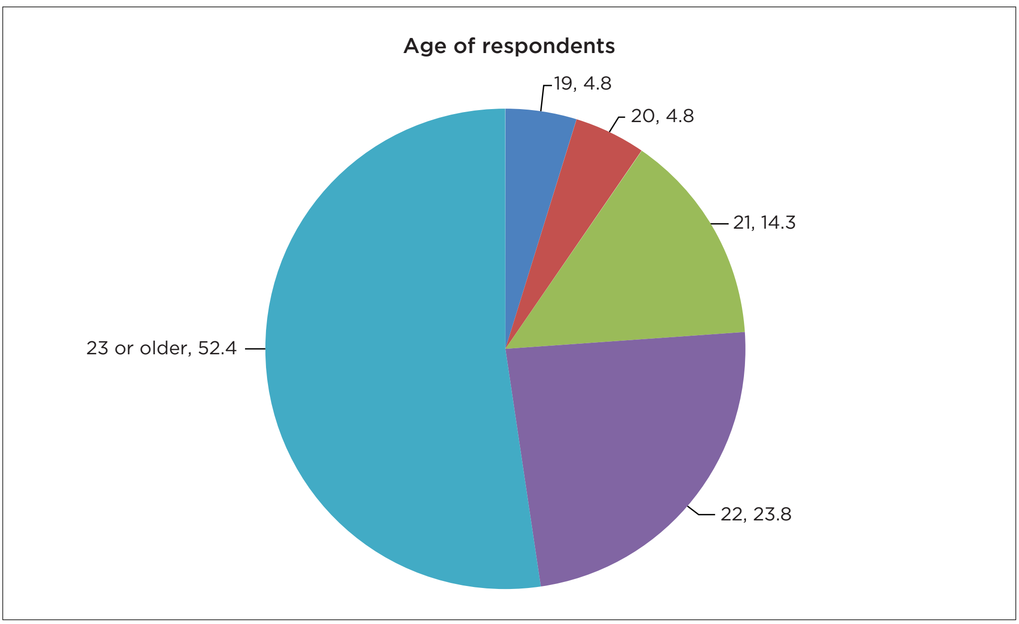


FIGURE 10.4: Age groups of respondents for both self-directed learning instrument pre-test and post-test.

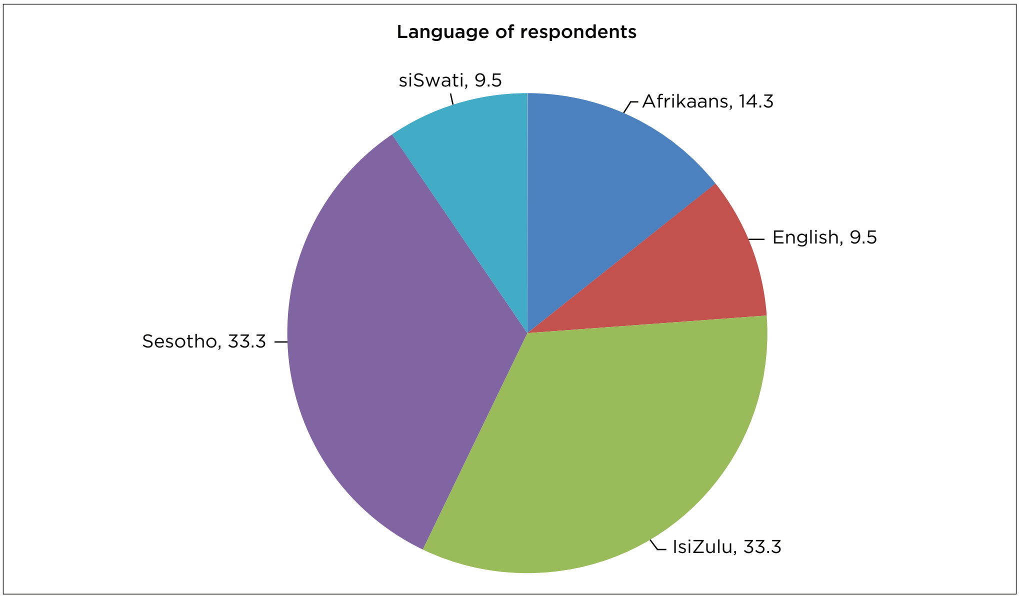


FIGURE 10.5: Language groups of respondents for both self-directed learning instrument pre-test and post-test.

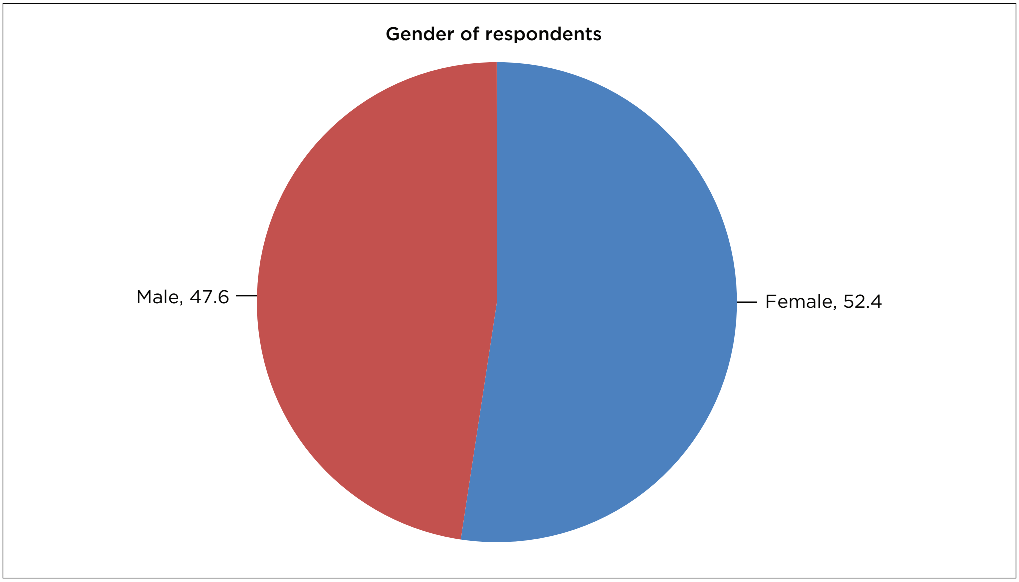


FIGURE 10.6: Gender of the respondents for both the self-directed learning instrument pre-test and post-test.

Table 10.2 represents the frequencies and descriptive statistics obtained for the SDLI pre-test.

The SDLI is divided into four main categories of SDL: LM (Questions 1–6), PI (Questions 7–12), SM (Questions 13–16) and IC (Questions 17–20).

The means reported for the LM statements all indicated that the respondents *strongly agreed* with the statements (Table 10.2). The lowest means were reported for Q1.1 (mean = 4.48; SD = 0.98), indicating that the respondents *agreed* to *strongly agreed* that they knew what they needed to learn.

The means reported from the PI statements all indicated that the respondents *strongly agreed* with the statements. Despite this, some questions did indicate some disagreement, especially Q1.8 (knowing what learning strategies are appropriate), with 8 being *neutral*, Q1.11 (arranging and controlling learning time), with 6 being *neutral*, and Q1.12 (how to find resources for learning), with 6 being *neutral*.

The means reported for the SM statements all indicated that the respondents *strongly agreed* with the statements. The lowest means was reported for Q1.15 (mean = 4.67; SD = 0.86) indicating that the respondents either disagreed (*n* = 1), were *neutral* (*n* = 2) or *strongly agreed* (*n* = 18) that they can monitor their learning progress.

The means reported for the IC statements all indicated that the respondents *strongly agreed* with the statements. The lowest means were reported for Q1.19 (mean = 4.43; SD = 0.93), indicating that the respondents were either *neutral* (*n* = 6) or *strongly agreed* (*n* = 15) that they are able to express messages effectively in oral presentations.

The average mean for the LM statements was 4.85, whilst the average mean for the PI statements was 4.53. The average mean for the SM statements was 4.73, whilst the average mean for the IC statements was 4.64. Therefore, from the pre-test results, before the blended gamification intervention was utilised, the highest scoring category was for LM, with SM coming in second place. PI had the lowest score.

Table 10.3 represents the frequencies and descriptive statistics obtained for the SDLI post-test:

The means reported for the LM statements all indicated that the respondents *strongly agreed* with the statements. There was no lowest mean reported, as all questions reported the highest mean possible (mean = 5.00; SD = 0.00), indicating that the respondents all *strongly agreed* that they feel motivated to learn (Table 10.3).

The means reported from the PI statements all indicated that the respondents *strongly agreed* with the statements. Despite this, some questions did indicate some disagreement, especially Q1.18 (knowing what learning strategies are appropriate), with 1 being *neutral*, Q1.11 (arranging and controlling learning time), with 2 being *neutral* and 1 *disagreeing*, and Q1.12 (how to find resources for learning), with 2 being *neutral*.

TABLE 10.2: Frequencies and descriptive statistics of self-directed learning instrument pre-test.

Theme	No.	Statement	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly agree	Mean	Standard deviation
Learning motivation	Q1.1	I know what I need to learn	0	1	4	0	16	4.48	0.98
Learning motivation	Q1.2	Regardless of the results or effectiveness of my learning, I still like learning	1	0	1	0	19	4.71	0.96
Learning motivation	Q1.3	I strongly hope to constantly improve and excel in my learning	0	0	0	0	21	5.00	0.00
Learning motivation	Q1.4	My successes and failures inspire me to continue learning	0	0	0	0	21	5.00	0.00
Learning motivation	Q1.5	I enjoy finding answers to questions	0	0	1	0	20	4.90	0.44
Learning motivation	Q1.6	I will not give up learning because I face some difficulties	0	0	0	0	21	5.00	0.00
Planning and implementing	Q1.7	I can proactively establish my learning goals	0	1	3	0	17	4.57	0.93
Planning and implementing	Q1.8	I know what learning strategies are appropriate for me to reach my learning goals	0	0	8	0	13	4.24	1.00
Planning and implementing	Q1.9	I set the priorities of my learning	0	0	1	0	20	4.90	0.44
Planning and implementing	Q1.10	Whether in the clinical practicum, classroom or on my own, I am able to follow my own plan of learning	0	1	1	0	19	4.76	0.77
Planning and implementing	Q1.11	I am good at arranging and controlling my learning time	0	1	6	0	14	4.29	1.06
Planning and implementing	Q1.12	I know how to find resources for my learning	0	0	6	0	15	4.43	0.93
Self-monitoring	Q1.13	I can connect new knowledge with my own personal experiences	0	0	2	0	19	4.81	0.60
Self-monitoring	Q1.14	I understand the strengths and weakness of my learning	0	0	3	0	18	4.71	0.72
Self-monitoring	Q1.15	I can monitor my learning progress	0	1	2	0	18	4.67	0.86
Self-monitoring	Q1.16	I can evaluate my learning outcomes independently	0	0	3	0	18	4.71	0.72
Interpersonal communication	Q1.17	My interaction with others helps me plan for further learning	0	1	2	0	18	4.67	0.86
Interpersonal communication	Q1.18	I would like to learn the language and culture of those whom I frequently interact with	0	0	4	0	17	4.62	0.80
Interpersonal communication	Q1.19	I am able to express messages effectively in oral presentations	0	0	6	0	15	4.43	0.93
Interpersonal communication	Q1.20	I am able to communicate messages effectively in writing	0	1	0	0	20	4.86	0.65

TABLE 10.3: Frequencies and descriptive statistics of self-directed learning instrument post-test.

Theme	No.	Statement	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly agree	Mean	Standard deviation
Learning motivation	Q1.1	I know what I need to learn	0	0	0	0	17	5.00	0.00
Learning motivation	Q1.2	Regardless of the results or effectiveness of my learning, I still like learning	0	0	0	0	17	5.00	0.00
Learning motivation	Q1.3	I strongly hope to constantly improve and excel in my learning	0	0	0	0	17	5.00	0.00
Learning motivation	Q1	My successes and failures inspire me to continue learning	0	0	0	0	17	5.00	0.00
Learning motivation	Q1.5	I enjoy finding answers to questions	0	0	0	0	17	5.00	0.00
Learning motivation	Q1.6	I will not give up learning because I face some difficulties	0	0	0	0	17	5.00	0.00
Planning and implementing	Q1.7	I can proactively establish my learning goals	0	0	1	0	16	4.65	0.47
Planning and implementing	Q1.8	I know what learning strategies are appropriate for me to reach my learning goals	0	0	1	0	16	4.85	0.47
Planning and implementing	Q1.9	I set the priorities of my learning	0	0	0	0	17	5.00	0.00
Planning and implementing	Q1.10	Whether in the clinical practicum, classroom or on my own, am able to follow my own plan of learning	0	0	0	0	17	5.00	0.00
Planning and implementing	Q1.11	I am good at arranging and controlling my learning time	0	1	2	0	14	4.59	0.94
Planning and implementing	Q1.12	I know how to find resources for my learning	0	0	2	0	15	4.76	0.06
Self-monitoring	Q1.13	I can connect new knowledge with my own personal experiences	0	0	2	0	15	4.76	0.06
Self-monitoring	Q1.14	I understand the strengths and weakness of my learning	0	0	0	0	17	5.00	0.00
Self-monitoring	Q1.15	I can monitor my learning progress	0	0	3	0	14	4.65	0.79
Self-monitoring	Q1.16	I can evaluate my learning outcomes independently	0	0	2	0	15	4.76	0.67
Interpersonal communication	Q1.17	My interaction with others helps me plan for further learning	0	0	3	0	14	4.65	0.78
Interpersonal communication	Q1.18	I would like to learn the language and culture of those whom I frequently interact with	0	0	3	0	14	4.65	0.79
Interpersonal communication	Q1.19	I am able to express messages effectively in oral presentations	0	1	2	0	14	4.59	0.94
Interpersonal communication	Q1.20	I am able to communicate messages effectively in writing	0	0	1	0	16	4.85	0.47

TABLE 10.4: Non-parametric statistical comparison for pre-test and post-test.

Measurement	Descriptives			Wilcoxon signed ranks test		Dependent *t*-tests	
	Mean	*n*	Std. deviation	*p*	Effect size	*p*	Effect size
Pre	95.0588	17	3.52616	0.10	0.40	0.080	0.57 – medium
Post	97.0588	17	3.59636				

The means reported for the SM statements all indicated that the respondents *strongly agreed* with the statements. The lowest means were reported for Q1.15 (mean = 4.65; SD = 0.79), indicating that the respondents were *neutral* (n = 3) or *strongly agreed* (n = 14) that they could monitor their learning progress.

The means reported for the IC statements all indicated that the respondents *strongly agreed* with the statements. The lowest means was reported for Q1.19 (mean = 4.59; SD = 0.94) indicating that the respondents *disagreed* (n = 1), were *neutral* (n = 2) or *strongly agreed* (n = 14) that they are able to express messages effectively in oral presentations.

The average mean for the LM statements was 5.00, whilst the average mean for the PI statements was 4.85. The average mean for the SM statements was 4.79, whilst the average mean for the IC statements was 4.69. Therefore, from the post-test results, after the blended gamification intervention was utilised, the highest scoring category was for LM, with PI coming in second place. IC had the lowest score.

Table 10.4 displays the results obtained for the non-parametric statistical analyses, comparing the pre-test and post-test results.

In Table 10.4, p-values are reported for completeness' sake but will not be interpreted as a convenience sample; instead, a random sample was used. Although the SDLI categories indicated that respondents remained experts when comparing the pre-test and post-test, there is a practically visible difference (effect size = 0.40) between the pre-test and post-test SDLI scores of the respondents when considering the Wilcoxon signed ranks test. This was confirmed by the dependent t-tests (effect size = 0.57), which is interpreted as a medium effect size. The average score increased from 95.06 (SD = 3.53) to 97.06 (SD = 3.60), tentatively implying that the intervention had some effect on the improvement of SDL.

Discussion

The results alluded to in the previous section can be interpreted in a positive manner. All of the pre-test scores highlighted that students really thought highly of their self-directedness, with means ranging from 4.29 up to 5, indicating that all participants perceived themselves as experts in SDL. This could be attributed to the overestimation of abilities at the onset of the study. After the semester concluded over a period of five months, the blended gamification approach was utilised within the coursework for that time.

The Habitica app, which had the 16 HOM added as habits, was used by students to track their progress whilst completing their assignments and homework tasks. Using the fantasy-themed role-playing approach, the students took on new characters with new names and could level up their avatars by completing tasks and cultivating good habits. The participants were expected to report on their progress each week by sending a screenshot of their Habitica character to the researcher. However, this qualitative data will not be analysed in this paper. This approach was intended as a method for the researcher to monitor the participants' use of the app. By encouraging SDL, students were trusted to be honest in their application of experience points when stating that their tasks were completed.

It was hoped that this novel blended gamification approach would inspire and motivate participants to want to engage in meaningful learning and to be self-directed in searching for related sources and research data when completing tasks. As this study was conducted when F2F classes were still possible before the COVID-19 pandemic, the BL used in the study focused on using the university LMS, in addition to normal lectures (i.e. 'normal' BL). The use of the gamification approach was added to the use of the LMS as well, which supported students in their learning. The assumption was that the intervention would positively influence the participants and that the post-test would show significant growth when compared to the pre-test results. The results indicate growth in all four categories in the SDLI test for (1) LM, growth from 4.85–5.00, (2) PI, growth from 4.53–4.85, (3) SM growth from 4.73–4.79 and (4) IC, growth from 4.64–4.69. The two factors that showed the most growth were PI and LM.

With regard to LM, the reason for the growth noted in the data could stem from the motivational aspects of gamification as a strategy. Literature states that gamification has the aim of making education more exciting and meaningful to young children (Seaborn & Fels 2015:14–31). This was clearly seen as the outcome of this study, as young adults were also more motivated using this approach. Relating this finding to the 16 HOM, LM links tremendously with the habits of persistence, managing impulsivity as well as taking responsible risks. If one is motivated, the likelihood of not giving up is much higher; hence the persistence of the participants improves as a result. Also, if one is motivated, one will more likely manage impulsive urges to procrastinate, for example, and stick to the task. If one is motivated, one is more likely to take responsible risks, such as challenging oneself. Therefore, the researcher tentatively argues that a blended gamification approach can lead to increased levels of motivation, as well as improve the

HOM mentioned previously, which aligns with the research of Alsawaier (2018:56–79).

Regarding PI, the reason for the growth noted in the data could stem from the task organising nature of the Habitica app itself, leading to the improvement of HOM such as striving for accuracy, creating, imagining and innovating and thinking flexibly (Madera & Figueroa 2019:150–153). The nature of the Habitica app allows a user to plan their tasks and manage their time more effectively. The results have shown this to be accurate, as the app may have assisted the students in managing, planning and implementing their tasks more efficiently. If one is more inclined to plan more effectively, the habit of striving for accurate work would be cultivated. If planning is done properly, more accurate work will result. If planning is improved, then being able to create, imagine or innovate will be more likely, as accurate planning will allow students to see better pathways to complete a task, which also links to flexible thinking.

Self-monitoring did also see some slight growth, but not as much as the previous two facets of SDL. However, the idea behind the blended gamification approach using Habitica was to enable participants to monitor their progress as they completed tasks and gained experience points which is a gamification characteristic (Caponetto et al. 2014:October). Habits of mind linked to this facet of SDL include thinking about your thinking, questioning and problem posing and gathering data through all senses. If one monitors themself, they are likely to be applying metacognitive strategies, otherwise known as thinking about one's thinking, in order to find mistakes or inaccuracies (Costa & Kallick 2000:36). When one self-monitors progress, they are also posing questions to themselves and looking for problems. Also, when doing this SM, one is trying to gather as much information as possible through all senses to understand the situation or task. This facet of SDL may have shown only marginal growth, perhaps as a result of the online teaching that took place, as the researcher could not gauge the participants monitoring their own progress.

The last facet of SDL, IC, showed the least growth. The blended gamification approach used in the study used the Habitica app, which does allow for 'party' formation, which groups people together, where they can chat and share information (Barik et al. 2016:134–142). The HOM that link with this facet of SDL include listening with understanding and empathy, thinking and communicating with clarity and precision, as well as thinking interdependently (Costa & Kallick 2000:36). When one is able to communicate interpersonally, it implies some form of group collaboration with other people, hence why thinking interdependently is the habit formed with this facet of SDL. One will also need to communicate to these group members with clarity and precision when discussing assignments. However, the communication ought to be reciprocal, meaning that one needs to also listen to other group members with understanding and empathy. The reason that this facet was least developed could also be because of the online learning environment, as the researcher could not gauge the quality of collaboration amongst students as one could during a F2F session.

Conclusion

This chapter highlighted the significance of promoting SDL, as well as the benefits of a BL approach. Gamification techniques were also elaborated upon, and a specific gamification application called Habitica was also elucidated upon. A specific teaching strategy, called HOM, was then incorporated into the Habitica application, which was the BL tool used. This paper delineated the methodology for a study conducted amongst BEd students at a South African university. Students were exposed to a blended gamification strategy for five months, where a pre-test and post-test using the SDLI instrument were conducted. Findings revealed that the intervention showed visibly significant differences when comparing pre-test and post-test results. Growth is noted for all four categories in the SDLI test for (1) LM, growth from 4.85–5.00, (2) PI, growth from 4.53–4.85, (3) SM growth from 4.73–4.79 and (4) IC, growth from 4.64–4.69. The two factors that showed the most growth were PI and LM. The researchers tentatively argue that the approach was a success and that, furthermore, prolonged exposure to this approach may have generated more growth in terms of SDL.

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Chapter 1

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Chapter 2

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Chapter 5

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Index

In this book, self-directed learning is comprehensively examined as an indispensable 21st-century skill on the path to successful, lifelong learning in the most diverse facets. Blended learning environments open the way to the future in order to promote and improve self-directed learning in the long term, taking into account metacognition, differences in socio-economic background and digital capability, among other factors. Since COVID-19, blended learning has gone from being optional to mandatory, so that the need for concepts, strategies and solutions for self-directed learning in blended learning environments has increased immensely. The book is highly recommended as an introduction to the theory and practice of self-directed learning, but also of particular interest to researchers and teachers experienced in this field. It provides a comprehensive insight into contemporary concepts, challenges and practical solutions with precious experiences. The basics of self-directed learning in blended learning environments are explained in detail and, building on this, new trends and developments are discussed and formulated in a plausible way. The results presented are very well transferable to the international context, as educators and institutions worldwide are certainly in need of assistance and such valuable empirical evidence on precisely these points. The contributions in this book definitely help to adequately underpin the importance of self-directed learning in science and education and to postulate it as a particularly important prerequisite for success in the 21st century. The diverse teaching strategies and practical examples in the book are an inspiration for lecturers and offer scientific orientation for designing one's own teaching settings, with a focus on self-directed learning. The promotion of self-directed learning through blended learning scenarios becomes a symbiotic, future-oriented premise in the educational context.

Prof. Dr-Ing. Monika Steinberg, Department of Information and Communication, Faculty 3 – Media, Information and Design, University of Applied Sciences and Arts Hannover, Hannover, Germany

With the pivot to remote learning during the Covid-19 pandemic, blended approaches to learning have received an increasing amount of attention. Virtually all courses in higher education already incorporated digital technologies to some degree, and the pandemic accelerated this adoption. These technologies have created new possibilities for students to interact with their peers, faculty, and content. The infusion of information and communications technology in higher education has drawn increased attention to the theory and practice of blended learning. The pandemic resulted in a forced test of the potential of blended learning. The possibilities and constraints associated with this approach to learning were in many ways unfairly put to the test as many educators lacked a research-based framework to guide the redesign of their courses and programs. Blended learning inherently demands a fundamental rethinking of the educational experience and presents a challenge to traditional presentational approaches. If we are to deal with the theoretical and practical complexities of rethinking the educational experience from a blended learning perspective, then the first challenge is to provide conceptual order that goes beyond rigid, non-reflective recipes. Such order and coherence are of particular importance for peers who may not fully appreciate the possibilities that new and emerging technologies present for helping students become self-directed learners. In order to overcome this challenge, Blended learning environments to foster self-directed learning provides educators with a variety of conceptual frameworks to help educators redesign their courses. The first two chapters provide specific conceptual frameworks while the other eight chapters provide recommendations and lessons learned from research studies about how blended modules (courses) can help students become self-directed learners.

Prof. Dr Norman Vaughan, Department of Education, Faculty of Health, Community, and Education, Mount Royal University, Calgary, Canada

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