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UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

DIGITAL TECHNOLOGY ENABLED EDUCATION: EXPLORING DIGITAL EDUCATION AFFORDANCES ON STUDENT PERFORMANCE

A Thesis Submitted

by

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A thesis submitted to the Faculty of Humanities, University of the Witwatersrand in fulfilment of the requirements for the degree Doctor of Philosophy (Education)

Supervisor:

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Faculty of Humanities

School of Education

May 2025

DECLARATION

I, Mmabatho Millicent Motheogane, hereby declare that this thesis, titled *Digital Technology Enabled Education: Exploring Digital Education Affordances on Student Performance* is my own work. This work has not been previously submitted to any other institution of learning and all the sources used and quoted have been acknowledged by means of a comprehensive list of references.

Name of Candidate: Mmabatho Millicent Motheogane

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Date: 16 May 2025

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I would like to express my deepest gratitude to God for strength, wisdom, and perseverance throughout this journey. Only He knows how many times I felt like giving up, yet here I am.

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Special thanks to my family, my father and siblings, thank you for your prayers and unwavering support. To my children, I hope this achievement marks the beginning of many PhDs in our family.

DEDICATION

I dedicate this thesis to God, my father, siblings, and children. It is also dedicated to my beloved late mother: I know you would have been proud of this achievement. To Makazi Nomathemba and Rakgadi Shirley, I know you would also have been so proud of me.

ABSTRACT

Digital education leverages technology to enhance teaching and learning through approaches like technology enhanced learning and online education. Technology enhanced learning employs strategies such as blended, flipped, and personalised learning by using digital resources to improve educational experiences. The Covid-19 pandemic triggered a swift transition to online teaching and learning in educational institutions across the world, and it significantly affected South Africa's higher education sector. This transformation revealed substantial disparities as resource-endowed universities rapidly adapted to online teaching and learning while historically disadvantaged institutions faced challenges due to insufficient resources. Resource constraints, including inadequate digital technology tools, internet connectivity, high data costs, and insufficient preparedness among students and educators, impeded productive learning experiences. While there is sufficient literature in the realm of digital education and online education, there is still a gap in the efficacy of inclusive digitally enabled education. This study examined the effects of this transition on student performance in South African universities by emphasising the critical necessity for equitable access to digital education and comprehensive support systems, which were identified as the current gap.

The study gives solutions for enhancing resilience and accessibility in forthcoming digital technology educational frameworks by analysing these problems. The discussion was centred on the critical elements that influence the efficacy of digital technology enabled education, which was analysed through the lens of community of inquiry framework. Central to this was the development of the conceptual framework that was deemed to sustain inclusive digital education in a socio-epistemological orientation approach. This study posits that learning occurs within an epistemically integrated and engaged community characterised by social presence, teaching presence, cognitive presence, student skills, academic skills, technology, infrastructure, and environment. These requirements are essential for establishing equitable digital education in all South African higher education institutions. This study used a mixed methods research strategy that incorporated questionnaires with both closed and open-ended questions and documents review. The data were gathered from three South African higher educational institutions that were categorised as metropolitan, rural, and semi-rural. The study further used mixed methods sampling by incorporating both probability and purposive sampling techniques. With the probability

sampling, the study adopted the stratified sampling process in which only the third- and fourth-year students were required to complete the questionnaire. A total of 165 responses from academics and students were collected via a questionnaire from these universities. The quantitative data were analysed descriptively using the Statistical Package for the Social Sciences (SPSS) software, and the qualitative data was analysed using thematic and factor analysis. The study triangulated these approaches to reach conclusions. This study employed triangulation to elucidate the intricacies of the phenomena, resulting in the addition of a conceptual framework to the literature on digital technology enabled education.

The findings highlight that the sudden shift to digital education in South Africa worsened existing inequalities, particularly for low-income students who struggled with limited access to computing resources, internet connectivity, and power outages. About 49% of academics mentioned that their courses required practical work, while 51% did not, which means almost half of academic courses taught involved practical or laboratory work, which portrays a need for technological affordances. The findings showed a high percentage of academics and students being negatively affected by this swift digitalisation of teaching and learning processes. Both students and academics faced challenges due to a lack of digital literacy and were negatively impacted by the rapid transition to online learning. The following are some of the recommendations of the study: Compulsory computer and digital literacy skills for academics and students regardless of their field of study, online professional training for academics, and ubiquitous access to educational, technical/technological, social, environmental, access, and infrastructure resources.

In responding to the research question, this study will help higher education institutions deliver more effective digital education to improve the student digital experience, create a ubiquitous learning environment to achieve equity, bridge the student attainment gap, promote social inclusion, and broaden equitable access to tertiary education for all students. This will be achieved through the conceptual framework that identifies key factors for achieving success in digital technology enabled education for South African universities. This framework is highly pertinent and is essential for transforming the South African educational system, reducing inequalities and fostering sustainable development.

Keywords: community of inquiry, digitalisation, digital education, digital literacy, digital technologies, higher education institutions, social affordances, technological affordances, technology enabled assessments, technology enabled education

TABLE OF CONTENTS

DECLARATION i

ACKNOWLEDGEMENTS ii

DEDICATION iii

ABSTRACT iv

TABLE OF CONTENTS vii

LIST OF TABLES xiv

LIST OF FIGURES xvi

LIST OF ACRONYMS xix

GLOSSARY OF KEY TERMS xx

CHAPTER 1: INTRODUCTION AND BACKGROUND 1

1.1 Introduction 1

1.2 Problem Statement 3

1.3 Aim of the Study 5

1.4 Objectives of the Study 5

1.5 Research Questions 5

1.5.1 Primary Research Question 5

1.5.2 Sub-research Questions 5

1.6 Delimitation 6

1.7 Significance of the Study 6

1.8 Contribution of the Study 7

1.8.1 Practical Contribution 8

1.8.2 Methodological Contribution 8

1.8.3 Contextual Contribution 8

1.9 Research Outline 8

CHAPTER 2: PHILOSOPHY UNDERPINNING THE STUDY 10

2.1 Chapter Overview 10

2.2 Emergency Remote Teaching 10
2.2.1 Pedagogical Access and Constraints 11
2.2.2 Epistemological Access and Constraints 12
2.3 Resilience and Innovation in Higher Education During Crisis 13
2.3.1 Unsettled Zone 14
2.3.2 The Learning Zone 15
2.3.3 The Growth Zone 15
2.3.4 Emergency Remote Teaching 16
2.4 A Comparative Analysis of Learning Environments: Emergency Remote Teaching, Online Learning, and Face-to-Face Instruction 20
2.5 State-of-the-art Reviews from Other Researchers on Emergency Remote Teaching, Online Learning, and Face-to-Face Learning 22
2.6 The Efficacy of Digital Technology Enabled Education 26
2.6.1 Digital Literacy 28
2.7 Digitalisation: Enhancing Teaching and Learning Experience 30
2.8 Modes of Instructional Delivery 32
2.8.1 Online Learning 33
2.8.2 Blended Learning 35
2.8.3 Hybrid Learning 36
2.8.4 Face-to-Face Learning 38
2.8.5 Flipped Learning 38
2.9 Affordances of Digital Education for Student Performance 40
2.10 Technology Enabled Assessment 44
2.10.1 Alignment Between Assessment, Teaching and Learning 44
2.10.2 Benefits and Challenges of Technology Enabled Assessment 45
2.10.3 Academic Integrity of Technology Enabled Assessments 46
2.10.4 Integration of Artificial Intelligence into Education 47
2.11 Sustainable Development Goals 48
2.12 Concluding Remarks 50
CHAPTER 3: THEORETICAL FOUNDATION 51
3.1 Chapter Overview 51

3.2 Community of Inquiry Framework 51
3.3 Reflections on the Community of Inquiry Framework 51
3.4 Examining Community of Inquiry Framework 52
3.4.1 "Learning Presence: Towards a Theory of Self-Efficacy, Self-Regulation, and the Development of a Communities of Inquiry in Online and Blended Learning Environments" (Shea & Bidjerano, 2010) 52
3.4.2 "How Communities of Inquiry Drive Teaching and Learning in the Digital Age" (Anderson, 2017) 53
3.4.3 "Exploring Communities of Inquiry in Massive Open Online Courses" (Kovanović et al., 2018) 55
3.4.4 "20 Years of the Community of Inquiry Framework" (Castellanos-Reyes et al., 2020) 56
3.4.5 "A Re-examination of the Community of Inquiry Framework: Social Network and Content Analysis" (Shea & Bidjerano, 2010) 56
3.4.6 "Designing a Community of Inquiry in Online Courses" (Fiock, 2020) 57
3.4.7 "Interactivity, the Heart and Soul of Effective Learning: The Interlink Between Internet Self-Efficacy and the Creation of an Inclusive Learning Experience" (Dlamini, 2023) 57
3.4.8 Gaps in the Existing Theorical Frameworks 58
3.4.9 Summary of Gaps identified in this study 62
3.5 Development of the Conceptual Framework 64
3.5.1 Learning Theories 64
3.5.2 Conceptual Framework 65
3.5.3 Correlation of the Constructs 66
3.5.4 Constructs of the Conceptual Model 69
3.6 Concluding Remarks 70

CHAPTER 4: RESEARCH METHODOLOGY 71

4.1 Chapter Overview 71
4.2 Research Paradigm 71
4.3 Research Strategy 72
4.4 Research Approach 72

4.4.1 The Convergent Design 74
4.5 Sampling 75
4.5.1 Sampling Frame 76
4.6 Research Instruments 77
4.6.1 Online Questionnaire Surveys 77
4.6.2 Document Analysis 78
4.7 Data Analysis 78
4.7.1 Thematic Analysis 79
4.7.2 Descriptive Analysis 82
4.7.3 Factor Analysis 83
4.8 Validity and Reliability 88
4.8.1 Thematic and Descriptive Analysis Validity 88
4.9 Reliability of Construct 90
4.9.1 Academics' Dataset 90
4.9.2 Students' Dataset 92
4.9.3 Cronbach's Alpha Based on Standardised Items 94
4.10 Construct Validity 95
4.10.1 Convergent Validity 95
4.11 Triangulation 99
4.12 Ethical Issues 100
4.13 Concluding Remarks 101

CHAPTER 5: DATA ANALYSIS AND DISCUSSION OF FINDINGS 102

5.1 Chapter Overview 102
5.2 Descriptive Frequency Analysis 103
5.2.1 Descriptive Frequency Demographics: Academics 103
5.2.2 Descriptive Frequency Demographics: Students 105
5.3 The Efficacy of Digital Technology Enabled Education 106
5.4 The Impact of Emergency Remote Teaching 111
5.4.1 The Impact of ERT: Academics' Perspectives 111
5.4.2 The Impact of ERT: Students' Perspectives 112
5.5 Digitalisation 114

5.5.1 Digitalisation: Academics' Perspectives 114
5.5.2 Digitilisation: Students' Perspectives 117
5.6 Modes of Instructional Delivery 121
5.6.1 Flipped Learning 121
5.6.2 Face-To-Face Learning 123
5.6.3 Blended Learning 126
5.6.4 Hybrid Learning 129
5.6.5 Online Learning 130
5.6.6 Teaching Methods: Academics' Perspective 132
5.6.7 Teaching Methods: Students' Perspectives 132
5.6.8 Crosstabulation Analysis: Academics Perspective: Teaching Methods 134
5.6.9 Crosstabulation Analysis: Students' Perspectives 135
5.7 Online Assessments of Students 136
5.8 Documents Analysis 138
5.8.1 Documents Analysis: Metropolitan University 138
5.8.2 Documents Analysis: Semi-Rural University 144
5.8.3 Annual Report Analysis: Rural University 151
5.8.4 Summary of Document Analysis for the Metropolitan, Rural, and Semi-Rural Universities 153
5.8.5 Impact of Digital Education on Student Performance 154
5.9 The Factors that Contribute to the Success of Digital Technology Enabled Education 157
5.9.1 Social Presence 157
5.9.2 Cognitive Presence 160
5.9.3 Learner Presence 163
5.9.4 Academics Skills 165
5.9.5 Student Skills 167
5.9.6 Technology 170
5.9.7 Infrastructure 173
5.9.8 Environment 177
5.9.9 Exploratory Factor Analysis 180

5.10 RQ5*:* What Framework Can Be Implemented to Ensure the Successful Integration of Digital Technology Enabled Education at HEIs? 192
5.11 Concluding Remarks 193
CHAPTER 6: INTERPRETATION OF FINDINGS AND RECOMMENDATIONS 194
6.1 Chapter Overview 194
6.2 Interpretation of the Findings 194
6.2.1 Interpretation of Findings for the First Theme 194
6.2.2 Interpretation of Findings for the Second Theme 198
6.2.3 Interpretation of Findings for the Third Theme 204
6.2.4 Interpretation of Findings for the Fourth Theme 206
6.2.5 Interpretation of Findings for the Fifth Theme 222
6.3 Recommendations of the Study 223
6.4 Concluding Remarks 229
CHAPTER 7: EVALUATION, CONTRIBUTIONS, AND CONCLUSION 230
7.1 Chapter Overview 230
7.2 The Research Problem 230
7.3 Research Aim 231
7.3.1 The Achievement of Research Objectives 231
7.3.2 Primary Research Question 232
7.4 The Contribution of the Study 232
7.4.1 Triangulation 232
7.4.2 Methodological Contribution 234
7.4.3 Practical Contribution 234
7.4.4 Contextual Contribution 234
7.5 Limitations of the Study 235
7.6 Future Research 235
7.7 Conclusion of the Study 237
CHAPTER 8: PUBLICATION 240
8.1 To be Published 240

8.2 Published 240

REFERENCES 241

ANNEXURE 1: ETHICS CLEARANCE FROM THE UNIVERSITY OF WITWATERSRAND 268

ANNEXURE 2: ETHICS CLEARANCE FROM THE UNIVERSITY OF VENDA 269

ANNEXURE 3: ETHICS CLEARANCE FROM THE UNIVERSITY OF KWAZULU-NATAL 270

ANNEXURE 4: QUESTIONNAIRE 271

ANNEXURE 5: INITIAL PRODUCED CORRELATIONS: ACADEMIC DATA 277

ANNEXURE 6: FINAL REPRODUCED CORRELATIONS: ACADEMIC DATA 278

ANNEXURE 7: INITIAL PRODUCED CORRELATIONS: STUDENTS' DATASET..... 279

ANNEXURE 8: FINAL REPRODUCED CORRELATIONS: STUDENTS' DATASET 280

ANNEXURE 9: LETTER FROM LANGUAGE EDITOR 281

LIST OF TABLES

Table 2.1 Learning environments 21

Table 2.2 Strengths, weaknesses, opportunities, and threats analysis: Online learning experience (Hallal et al., 2020) 29

Table 3.1: Gaps from the existing theorical frameworks 59

Table 3.2 Factors contributing to the success of digital technology enabled education 69

Table 4.1 Participants' demographics 76

Table 4.2 Data collection, analysis and interpretation process (Creswell, 2007) 78

Table 4.3 Data collection and analysis process 79

Table 4.4 Coding of items: Academics' dataset 90

Table 4.5 Construct reliability statistics for the Likert scale of the academics' dataset 92

Table 4.6 Coding of items: Students' dataset 92

Table 4.7 Construct reliability statistics for the Likert scale of the students' dataset 93

Table 4.8 Reliability: Cronbach's alpha on all Likert-scale items for the academics' dataset 94

Table 4.9 Reliability: Cronbach's alpha on all Likert-scale items for students' dataset 95

Table 4.10 Correlations of different constructs within the academics' dataset 95

Table 4.11 Correlations of different constructs within the students' dataset 97

Table 5.1 Research questions, objectives and theoretical lenses used 102

Table 5.2 Descriptive statistics of the demographics of the respondents: Academics 104

Table 5.3 Descriptive statistics of the demographics of the respondents: Students 105

Table 5.4 Overview of effective teaching methods and their impact on student learning outcomes: Academics 134

Table 5.5 Overview of effective teaching methods and their impact on student learning outcomes: Students 135

Table 5.6 KMO and Bartlett's test: Academics 180

Table 5.7 Initial communalities: Academics' dataset 181
Table 5.8 Revised KMO and Bartlett's test: Academics' dataset 182
Table 5.9 Total variance explained: Academics' dataset 183
Table 5.10 Revised communalities: Academics' dataset 183
Table 5.11 Final factor loading: Academics' dataset 184
Table 5.12 Final factor loading of items: Academics' dataset 186
Table 5.13 KMO and Bartlett's test 187
Table 5.14 Initial communalities: Students' dataset 187
Table 5.15 Revised KMO and Bartlett's test 189
Table 5.16 Revised total variance: Students' dataset 189
Table 5.17 Revised communalities: Students' dataset 190
Table 5.18 Final factor loadings: Students' dataset 191
Table 5.19 Final factor loading of items: Students' dataset 192
Table 6.1 Summary of the study objectives, themes, findings and recommendations 227

LIST OF FIGURES

Figure 1.1 UNESCO's leadership on mitigating the impact of Covid-19 (ProFuturo, 2020) 4

Figure 1.2 Outline of the study 9

Figure 2.1 Experiences of teachers during the pandemic (Fullan et al., 2020)..... 14

Figure 2.2 Instructional delivery methods (College of Dupage, 2015) 40

Figure 2.3 SDG 1 49

Figure 2.4 SDG 4 49

Figure 3.1 The original CoI model by Garrison et al. (1999) 52

Figure 3.2 Revised CoI model by Shea and Bidjerano (2010) 53

Figure 3.3 CoI specific for MOOCs (Arbaugh et al., 2008) 55

Figure 3.4 Interaction in a teaching and learning community (Dlamini, 2023) 58

Figure 3.5 Convergent validity: academics' dataset 67

Figure 3.6 Convergent validity: Students' dataset 68

Figure 4.1 Convergent mixed methodology (Creswell & Clark, 2007) 75

Figure 5.1 Frequencies: Academics who taught courses with practical or laboratory work during the Covid-19 pandemic..... 107

Figure 5.2 Frequencies: Student who had courses with practical or laboratory work during the Covid-19 pandemic 108

Figure 5.3 Academics' perceptions of the effect of digitalisation on their teaching experience 114

Figure 5.4 Students' perception of the effect of digitalisation on their learning experience..... 118

Figure 5.5 The effect of digitalisation on student performance during ERT and online learning 119

Figure 5.6 An overview of effective teaching methods preferred by academics..... 132

Figure 5.7 The learning methods that enhance students' learning experiences..... 133

Figure 5.8 Descriptive analysis: Student performance for the Faculty of Humanities at the metropolitan university in 2019, 2020, and 2021 141

Figure 5.9 Descriptive analysis: Student performance for the Faculty of Commerce at the metropolitan university in 2019, 2020, and 2021 142

Figure 5.10 Descriptive analysis: Student performance for the Faculty of Law at the metropolitan university in 2019, 2020, and 2021 142

Figure 5.11 Descriptive analysis: Student performance for the Faculty of Health Sciences at the metropolitan university in 2019, 2020, and 2021 143

Figure 5.12 Descriptive analysis: Student performance for the Faculty of Science at the metropolitan university in 2019, 2020, and 2021 144

Figure 5.13 Graduation rates for the College of Agriculture, Engineering and Science at the semi-rural university in 2019, 2020, and 2021 149

Figure 5.14 Graduation rates for the College of Health Sciences at the semi-rural university in 2019, 2020, and 2021 149

Figure 5.15 Graduation rates for the College of Humanities at the semi-rural university in 2019, 2020, and 2021 150

Figure 5.16 Graduation rates for the College of Law and Management Studies at the semi-rural university in 2019, 2020, and 2021 150

Figure 5.17 Student success rate at the rural university in 2019, 2020, and 2021 ((UNIVEN, 2021) 152

Figure 5.18 Graduation rates at the Rural University in 2019, 2020, and 2021 (UNIVEN, 2021) 153

Figure 5.19 Final scree plot: Academics' dataset 183

Figure 5.20 Scree plot: Students' dataset 189

Figure 6.1 Overview on how digitalisation affected the teaching experience 199

Figure 6.2 Overview on how digitalisation affected student performance 200

Figure 6.3 Overview on the preferred teaching methods: Academics' perspectives 201

Figure 6.4 Overview on the preferred teaching methods: Students' perspective 202

Figure 6.5 Conceptual framework: Digital technology enabled education 223

LIST OF ACRONYMS

AI	Artificial Intelligence
CoI	Community of Inquiry
CFA	Confirmatory Factor Analysis
Covid-19	Coronavirus Disease 2019
DHET	Department of Higher Education and Training
EFA	Exploratory Factor Analysis
ERT	Emergency Remote Teaching
HEI	Higher Education Institution
GPA	Grade Point Average
ICT	Information and Communication Technology
KMO	Kaiser-Meyer-Olkin
LMS	Learning Management Systems
MOOC	Massive Open Online Course
NSFAS	National Student Financial Aid Scheme
SAPO	South African Post Office
SDG	Sustainable Development Goal
SPSS	Statistical Package for the Social Sciences
UKZN	University of KwaZulu-Natal
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNIVEN	University of Venda
Wits	University of the Witwatersrand
YOS	Year Of Study

GLOSSARY OF KEY TERMS

Asynchronous teaching and learning	Teaching and learning that do not occur in the same location and time, such as working in a shared Google document, an online learning platform at different times, posting to a discussion board, or using email (Kreijns et al., 2014; Santiago Iglesias-Pradas et al., 2021; Yamagata-Lynch, 2014).
Cognitive presence	The design of learning activities and assessments as well as the facilitation of a course (Garrison et al., 1999).
Construct	A variable measured by a researcher.
Communality	The amount of variance a variable share with all the other variables being considered (Hardy & Bryman, 2009).
Computer literacy	The ability to use basic computer applications.
Construct validity	The extent to which a test effectively measures the exact notion or concept it was designed to evaluate (Strauss & Smith, 2009).
Convergent validity	The extent to which two measures of variables that are expected to be connected demonstrate a relationship (Strauss & Smith, 2009).
Correlation	The extent of the relationship between two variables (Strauss & Smith, 2009).
Covid-19	Contagious illness caused by the SARS-CoV-2 virus (Haleem et al., 2020; Mahmut & Suna, 2020).

Demographics	Attributes of a population, such as race, ethnicity, gender, age, education, profession, occupation, income level, and marital status.
Digitalisation	The use of technology to renew, simplify and improve processes, tasks and products (Tømte et al., 2019).
Digital divide	Denotes the disparity between individuals with sufficient access to information and communication technologies and those with little or inadequate access to it (Soomro et al., 2020).
Digital education	Digital technologies are tools, systems and devices that can generate, create, store or process data (Dlamini, 2023).
Digital literacy	The capacity to comprehend and use information from various sources in different formats, specifically when delivered through computers.
Digital skills	The ability to use technology; to find, use and critically evaluate information; to organise data and media sources; and to communicate, collaborate and participate in online environments.
Epistemology	Beliefs regarding the fundamental nature of knowledge (Merriam, 2009).
Learning management system	An online platform that facilitates the sharing of materials between teachers and students, allows for the submission and return of assignments, and enables online communication (Oliveira et al., 2016).
Online learning-teaching method	A method used to teach and learn using technological, digital, and electronic devices with internet services.

Paradigm	An essential set of views shared by scientists about how to understand problems, how to view the world, and how to conduct research (Rahi, 2017).
Research approaches	The strategies and methodologies employed to conduct research, encompassing the progression from overarching assumptions to specific techniques for gathering, analysing, and interpreting data (Creswell, 2014).
Research strategy	A systematic approach that provides direction and guidance for conducting research to enable the researcher to effectively accomplish their study objectives (Denscombe, 2010).
Sage on the stage	The primary figure in a classroom, typically the instructor, who delivers lectures to students using a one-way communication approach (Adebo, 2018; Gonzalez et al., 2020; Matadi & Uleanya, 2022).
Social presence	The ability to identify with the community, communicate purposefully in a safe environment, and cultivate interpersonal relationships by projecting one's own personality (Garrison et al., 1999). The presence of the facilitator/participants during learning.
Survey	A method of gathering data from a sample of individuals through their responses to the same questions about their sentiments, opinions, qualities, or features about a specific topic (Check & Schutt, 2012).
Synchronous teaching and learning	Teaching and learning occur at the same location and time, for example, a physical, brick-and-mortar classroom or the same digital space, such as a Zoom, Google Meet, or a phone call (Kreijns et al., 2014; Yamagata-Lynch, 2014).

Technical skills	Understanding of basic computer hardware and software with the ability to perform computer operations, such as using a keyboard and mouse.
Theory triangulation	The practice of employing numerous theories or hypotheses in the analysis of a given situation or phenomena (Mathison, 1988).

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction

Digital education refers to the use of digital technologies in teaching and learning. Technology enhanced learning or e-learning is a teaching and learning approach that uses various technology enhanced educational approaches (McLaughlin, 2018). These approaches encompass blended, flipped, personalised learning, and other strategies that depend on digital resources (McLaughlin, 2018). According to Dlamini (2023), digital education is the incorporation of digital tools and technologies into education to enhance teaching and learning through the internet. Implementing digital learning can improve learning experiences, streamline teachers' workload, personalise learning, facilitate the monitoring of student progress, and offer transparency in the learning process. Online learning, as defined by Ferri et al. (2020), is the delivery of educational instructions through digital devices with the purpose of facilitating learning. The author mentioned other benefits of online learning, such as the ability to study from anywhere and at any time, the potential for substantial cost savings, the elimination of commuting on crowded public transportation, and time savings.

By employing digital technologies, educators have the chance to create captivating learning experiences in their courses, which can be in the form of blended or online courses and programmes (Kirkwood & Price, 2014). Digital technologies encompass tools, systems, and devices capable of generating, creating, storing, or processing data. Educators can also derive advantages from the flexibility to teach at any time, in any manner, and without being limited by geographical boundaries. Digital technology offers advantages to students, instructors, and institutions by facilitating significant transformations in schools, enhancing instruction, and enabling schools to connect with the external environment, which guarantees effectiveness and efficiency (Kirschner & Wopereis, 2003).

The significant ambiguity regarding the development and adoption of emerging technologies results in a lack of comprehension of the transitions instigated by this industrial revolution. Nonetheless, owing to the intricacy of these technologies across diverse sectors, it is imperative for all stakeholders, including governments, enterprises, academia, and civil society, to enhance the alignment of their business processes and systems to comprehend the current trends (Schwab, 2016)

Having a comprehensive and universally accepted understanding of how technology is impacting people's lives and the lives of future generations, as well as how it is transforming

the economic, social, cultural, and human environment is crucial. The use of digital education has the capacity to expedite the acquisition of skills and inspire and captivate students in the process of learning (Davis & Tearle, 1999; Lemke & Coughlin, 1998).

The global outbreak of the Coronavirus Disease 2019 (Covid-19) occurred in March 2020. Covid-19, a contagious illness caused by the SARS-CoV-2 virus, was classified as a pandemic due to its worldwide spread (Haleem et al., 2020; Mahmut & Suna, 2020). This pandemic caused widespread destruction and chaos in many areas of society. It had detrimental consequences for the education industry. Given the worldwide impact of Covid-19, the higher education commissions of several nations advised educators to transition from traditional classroom instruction to an online learning and teaching method of instruction (Asgher & Hanif, 2021). The online learning and teaching method is used for giving education using technological, digital, and electronic devices with internet services.

Various ministries of education in different nations proposed the use of online learning across all educational levels. UNESCO (2020) also supported this decision and claimed that online learning could mitigate the spread of the virus by reducing face-to-face interactions. UNESCO (2020) released a list of freely available educational platforms and resources. These resources were intended for online learning and could be tailored to the specific requirements of educational institutions. Additionally, they indicated that these resources promoted social care and engagement during periods of school closures (Ferri et al., 2020).

On 23 March, the President of the Republic of South Africa declared a countrywide lockdown as a preventive measure to save the population from the spread of the infection. During that period, nearly all countries implemented temporary closures of their physical education systems and evacuated students from their residences, resulting in a disruption for higher education students. Due to the lockdown, universities either closed or implemented emergency remote teaching (ERT) and online delivery methods. ERT is initiated by unexpected occurrences such as the Covid-19 pandemic and offers both pedagogical and epistemological access and constraints for educators and learners (Knoetze & Du Toit, 2022). Pedagogical access is improved by the flexibility and diversity of instructional resources, yet hindered by insufficient engagement, digital inequalities, and the difficulties of remotely engaging students. Epistemological access can be improved by diverse and accessible educational resources, yet the transition to remote formats may diminish the depth of learning and render knowledge transmission more superficial. The shift to ERT presented both benefits and challenges for

students' access to knowledge and the efficacy of instructors in facilitating learning (Ferri et al., 2020).

Not all universities were equipped to transition to ERT and online delivery right away. Those who were able to make the shift encountered challenges, particularly with students facing connectivity issues, many of whom struggled with data access, that hindered their full participation in online learning. These universities experienced great difficulties because students live in areas where connectivity is intermittent and others could not afford data at all. During that period, the most evident and widely discussed issue by experts and policy makers was that socially disadvantaged groups faced difficulties meeting the basic conditions required by online learning (Ferri et al., 2020).

The decision for higher education institutions (HEIs) to quickly substitute face-to-face lectures with online learning had repercussions for both learning and examinations. Schleicher (2020) said that despite the extensive efforts made by HEIs to enable a smooth transition to digital education, some universities encountered difficulties during the transition. The pandemic exposed the enormous inequality among South African universities because endowed institutions, referred to as historically advantaged/established universities, get financial assistance from the government and donors for their teaching, learning and research activities while none-endowed universities, referred to as historically disadvantaged institutions, lack support from benefactors and depend only on student fees and government support. Endowed institutions were able to promptly initiate online courses, while non-endowed universities faced delays moving to online learning due to resource constraints.

1.2 Problem Statement

The motivation to pursue this study was the challenges South African universities, in particular academics and students, experienced when the higher education commissions of various countries suggested the transition from traditional educational systems to online learning and teaching in 2020 during the pandemic period (Dlamini & Ndzinisa, 2020; Hodges et al., 2020; UNESCO, 2020). During this period, there was no equitable access to learning, and UNESCO estimated that around 1.19 billion learners were affected by Covid-19, which implies that more than 1.2 billion students in both schools and universities were out of school (ProFuturo, 2020) Figure 1.1 shows that the pandemic had affected 68% of the world's learners, from the primary, secondary, and tertiary sectors, by the end of May 2020.



Figure 1.1 UNESCO's leadership on mitigating the impact of Covid-19 (ProFuturo, 2020)

The transition from the traditional education system to online learning and teaching was easy for developed countries but a challenge for developing countries because of limited technological resources (Zaidi & Sala, 2020). Technological knowledge for both students and academics was a challenge and none of them were prepared for this transition. The content had to be digitised and delivered to the learners, while learners had to adapt to digital learning.

Most endowed universities in South Africa swiftly converted to online education to replace the face-to-face education system. It was a great challenge for non-endowed universities, and as a result, their academic year was delayed and only completed in the first quarter of 2021 (Fataar, 2021). These universities struggled because they lacked the experience and digital pedagogies necessary to adopt new ways of instructional delivery. The course outlines were revised to accommodate the time lost and assessments that could be conducted online. Examinations were also affected, causing disruptions to students' learning and progression (Schleicher, 2020).

The transition revealed the digital divide, where some students encountered numerous challenges such as infrastructure, technology, network, data affordability, pedagogical and epistemological access and restrictions as well as home environments that were not conducive to online learning. In other areas, students who could afford data had problems with loadshedding, which made it impossible for them to continue to learn from home. Asgher and Hanif (2021) indicated that teachers and learners faced various challenges using online learning and teaching methods, such as internet connectivity, electricity, assessment, and grading.

It is for this reason that it was necessary to investigate how South African university academics and students were affected during this transition and to investigate how digital education efficacy can enhance student performance despite the national online education policy gaps.

1.3 Aim of the Study

The aim of this study is to assess the impact of the shift to ERT and online learning on the academic performance *(measured through comparison of their performance prior and during Covid 19 as well as the completion rates)* of undergraduate students in South African universities during the 2020 academic year.

1.4 Objectives of the Study

The objectives of this study are the following:

- To assess the efficacy of digital technology enabled education in HEIs.
- To explore how digitalisation enhances student experience in HEIs.
- To explore the impact of digital education on student performance.
- To analyse the factors that contribute to the success of digital technology enabled education.
- To develop a conceptual framework for successful integration of digital technology enabled education at HEIs.

1.5 Research Questions

1.5.1 Primary Research Question

The following primary research question guided the study:

- How can HEIs realise success in digital technology enabled education?

1.5.2 Sub-research Questions

The following sub-research questions further guided the study:

- **RQ1:** What is the efficacy of digital technology enabled education in HEIs?
- **RQ2:** How does digitalisation enhance student performance and experiences in HEIs?
- **RQ3:** What is the impact of digital education on student performance?
- **RQ4:** Which factors contribute to successful digital technology enabled education?
- **RQ5:** What framework can be implemented to ensure the successful integration of digital technology enabled education at HEIs?

1.6 Delimitation

The present study explored the affordances of digital technology for student performance in the context of South African HEIs. The researcher collected data from academics and students but excluded management, who are the decision and policy agents. Management is responsible for implementing technological and infrastructural decisions, and therefore, their views in this study would have been valuable. The researcher conducted convergent validity to test the relationships between the constructs and excluded the divergent validity that tested the opposite. According to Strauss and Smith (2009), divergent or discriminatory validity ensures the measure is not overly related to other measures that are theoretically unrelated, demonstrating that it is distinct from other constructs, while convergent validity helps confirm that different instruments or methods that assess the same concept yield similar results. Perhaps future studies can conduct both the convergent and divergent validity of these constructs. The researcher further conducted an exploratory factor analysis (EFA) to confirm the results of the convergent validity and excluded confirmatory factor analysis (CFA). This can be explored in future research and would be beneficial because EFA explores the possible underlying factor structure of a set of observed variables without imposing a preconceived structure on the outcome, whereas the CFA verifies the factor structure of a set of observed variables, which allows the researcher to test the hypothesis and that there exists a relationship between observed variables and their underlying latent constructs (Bandalos & Finney, 2018; Suhr, 2006). Although technology enabled assessment is discussed in the findings, it was not the focus of the study and rather a recommendation for future studies.

1.7 Significance of the Study

The South African government has consistently evaluated its policies and activities to align with the 2030 sustainable development goals, aiming to achieve a better life for all and ensure no one is left behind. This commitment is reflected in the government's priorities. According to Sachs et al. (2019), education fosters the development of human skills and knowledge, which subsequently stimulates economic advancement, eradicates severe poverty, provides fair employment opportunities, and addresses gender and other forms of inequality. Achieving equitable access to education for all students will go a long way to eradicating poverty. The Department of Higher Education and Training's (DHET) main emphasis in their Strategic Plan is Priority 2 ("economic transformation and job creationand") and Priority 3 ("education, skills, and health") (DHET, n.d.), which is in line with the National Development Plan Pillar

Capabilities of South Africans (NDP, 2012). The objective is to enhance the quality of education and training, as well as increase accessibility and efficiency in the post-school education and training system (DHET, 2020). The Strategic Plan further mentions that every individual is entitled to receive a fundamental education, including adult fundamental education. Additionally, individuals have the right to pursue higher education, which the government must gradually provide and ensure is accessible to all through appropriate actions (DHET, 2020).

In light of the Sustainable Development Goals (SDGs), the National Development Plan and the DHET Strategic Plan, this research will help HEIs break the inequality between endowed and non-endowed universities by affording all students digital education (DHET, n.d.; NDP, 2012; Stats SA Department: Statistics South Africa, 2023). The study will also demonstrate the pedagogy strategies that contribute to the teaching methods and enhance student performance. Finally, it will contribute to the total body of knowledge on the digital education space, and more specifically, to the knowledge on public universities.

Higher education can be the catalyst to reshape a struggling economy, lessen the unemployment rate, and ultimately reduce poverty. With South Africa's staggering poverty rate of 55.5%, higher education in South Africa is rife with inequalities that persists from the apartheid era and the Bantu Education Act (Nortje, 2017). These historical inequities have sparked student-led protests and movements to eliminate financial and cultural constraints in the education system (The Borgen Project, 2025). The World Bank (2018) found that if a household head achieved some higher education in South Africa, the risk of poverty is reduced by about 30% compared to household heads with no schooling.

This study will help HEIs provide excellent digital education to improve student digital experience and provide technology-rich learning environments to achieve equity and close the student attainment gap, as well as to support social inclusion and expand equitable access to tertiary education for all students.

1.8 Contribution of the Study

The research employed method triangulation by using multiple methods, theories, data sources and types of data analysis to develop a comprehensive understanding of the phenomenon with the aim of ensuring the validity of the study (Cohen et al., 2002; Mathison, 1988). The combination of these techniques was necessary because it has not been applied previously to investigate digital technology enabled education in South African higher education.

1.8.1 Practical Contribution

The practical contribution of this study is the development of the conceptual framework that identifies key factors for achieving success in digital technology enabled education for South African universities. This framework provides valuable insights into improving digital education practices that will benefit both academics and students. It highlights how HEIs can successfully implement digital education that is inclusive for all students by addressing the identified practical knowledge gap.

1.8.2 Methodological Contribution

This study employed a pragmatist paradigm and a case study strategy to provide a deeper understanding of the aspects on digital technology enabled education. The case study approach offered a detailed and subjective examination of digital technology as experienced by South African university students. This study effectively used these research methods to explore and explain the impact of digital technology on student performance. Establishing these methods was valuable for understanding this topic in the higher education context. The research method used allowed respondents to explore the 'how' and 'when' aspects of the phenomenon, which had not been previously examined in the context of digital technology enabled education in South Africa.

1.8.3 Contextual Contribution

The affordance of digital technology varies significantly depending on context. South Africa's unique governmental, educational, economic, and socio-economic conditions make its situation distinct from other parts of the world. This thesis recognises that strategies that are effective elsewhere may not apply to South Africa because of its specific challenges and characteristics. It underscores the need for digital technology in South African higher education to be tailored to its unique context. By addressing the contextual knowledge gap identified in the first chapter of this study, this study provides insights relevant to South Africa's specific needs

1.9 Research Outline

Figure 1.2 gives the outline of the study and a short summary of the content of each chapter.

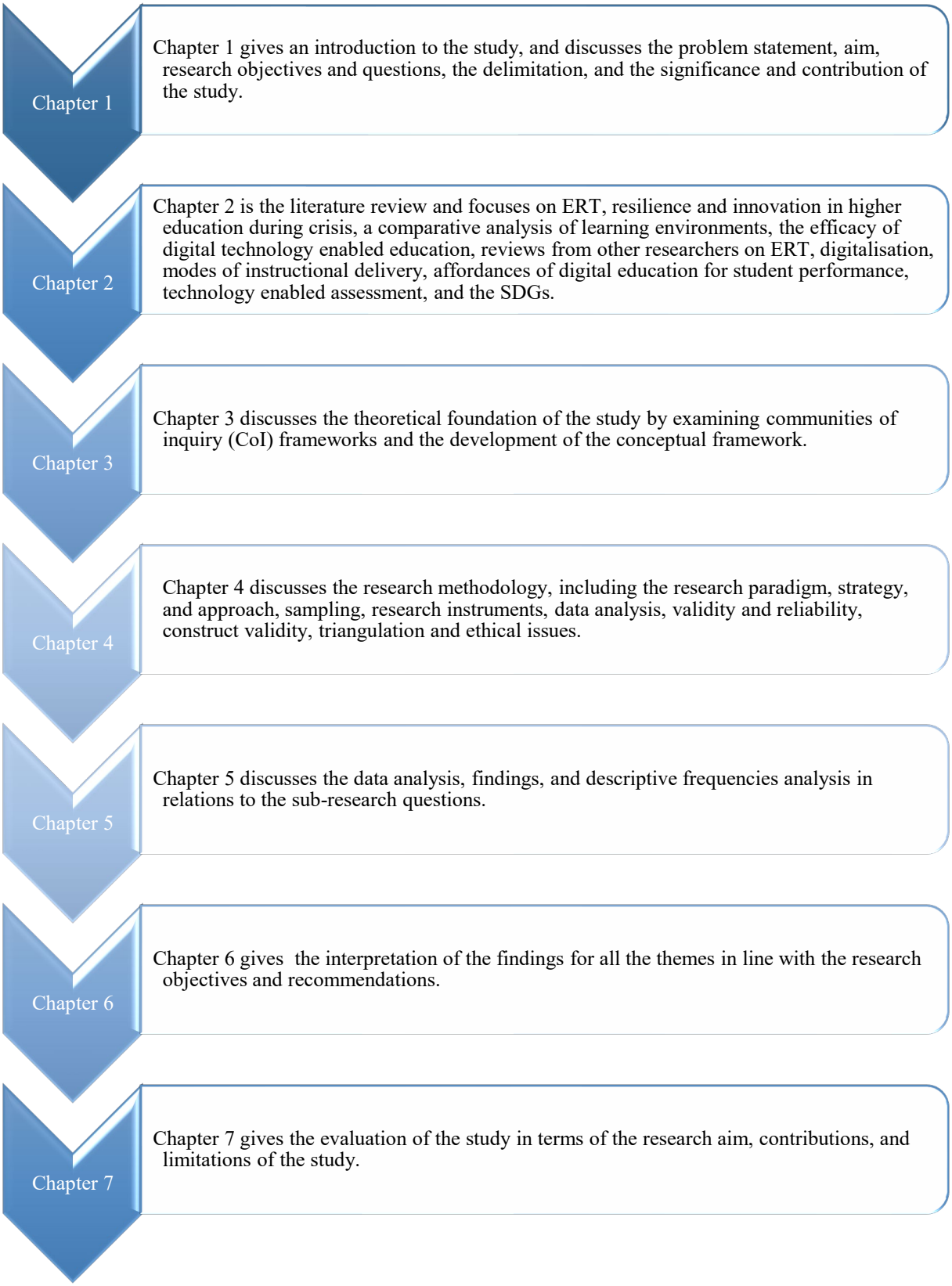


Figure 1.2 Outline of the study

CHAPTER 2: PHILOSOPHY UNDERPINNING THE STUDY

2.1 Chapter Overview

As indicated in Chapter 1, when Covid-19 was declared a pandemic, most countries went into complete lockdown (World Health Organization, 2020). Universities' academic terms were affected, and most universities transitioned to ERT without much planning (Mielgo-Conde et al., 2021). Digital learning platforms were introduced to enable learning beyond brick-and-mortar classrooms (Dlamini & Ndzinisa, 2020). In some cases, teaching methods such as blended, flipped, and personalised learning as well as other strategies were introduced. All these strategies relied on digital tools (McLaughlin, 2018). It was evident that digital learning can enhance learning experiences, save time, enable academics to better tailor learning to meet student needs, aid in tracking student progress, and provide transparency in the learning process; however, the process also exposed the inequalities in South African universities (Ahmed & Firdous, 2020).

The sudden shift to e-learning in South Africa further intensified the gap in learning technology access, particularly disadvantaging low-income students and the majority of learners (Ahmed & Firdous, 2020). This disparity hindered these students' ability to access computing resources and participate in ongoing lessons. Responding to the objective of this study, the researcher reviewed the literature to examine ERT and online learning, the efficacy of digital technology enabled education, digitalisation, modes of instructional delivery, affordances of digital education for student performance, technology enabled assessments, integration of artificial intelligence (AI) in education, and the SDGs.

2.2 Emergency Remote Teaching

ERT refers to using entirely remote teaching methods for instruction or education that would typically be conducted in person or as a combination of in-person and remote learning during a crisis that will revert to the old format once the crisis or emergency has ended (Hodges et al., 2020; Rapanta et al., 2020). Hodges et al. (2020) defined ERT as a strategy to quickly and reliably offer temporary access to training and instructional assistance during an emergency or crisis, rather than replicating a comprehensive educational environment. ERT is characterised by the rapid adaptation of face-to-face instructional materials into an online delivery mode in emergency situations (Hodges et al., 2020).

During the Covid-19 pandemic, system leaders, instructors, students, and families all over the world showed great energy, devotion, and flexibility in promptly responding to the need to switch to remote learning. Teachers all over the world extended their classes by including videos, game-based learning, and powerful collaboration tools into their virtual lessons. Students experienced a new method of learning with significant long-term impacts. According to institutional officials, going online was about more than just remote education; it was about developing solutions that would keep departments functioning efficiently, and it evolved with changing student and staff needs (Fullan et al., 2020). Various HEIs adopted diverse strategies to implement ERT. The transition to ERT presented both pedagogical and epistemological access and constraints for educators and learners. The following section looks that these access and constraints.

2.2.1 Pedagogical Access and Constraints

Pedagogy refers to the methods and strategies used to teach, including how content is delivered and how students engage with it (Gelles et al., 2020). The transition to ERT impacted pedagogical access in the following ways:

- **Enhanced flexibility:** ERT facilitate improved access to educational resources, enabling students to learn at their own speed and at convenient times. This is particularly applicable when recorded lectures or resources are accessible online (Yamagata-Lynch, 2014).
- **Expanded accessibility:** ERT can enhance educational opportunities for students in rural regions who may lack access to conventional face-to-face instruction. Online platforms can transcend geographical barriers (Fataar, 2021; Wang et al., 2024).
- **Transformation of instructional techniques:** During ERT, educators investigate innovative approaches such as interactive multimedia, virtual simulations, and digital evaluations that may be impractical in a conventional classroom environment (Ahmed & Firdous, 2020; Wang et al., 2024).

The transition to ERT impacted pedagogical constraints in the following ways:

- **Restricted interaction:** The absence of in-person participation limits opportunities for impromptu discussions, peer cooperation, and prompt feedback, which are essential components of active learning and involvement (Wang et al., 2024).

- **The digital divide:** Not all students have equitable access to essential technology or internet connectivity for ERT. This can exacerbate existing inequalities by placing certain kids at a disadvantage (Soomro et al., 2020).
- **Teacher readiness:** Numerous instructors may lack the training or competencies necessary for a successful transition to virtual instruction. This may result in inadequately implemented teaching or an unproductive use of available resources (Mesuwini & Mokoena, 2024).
- **Engagement challenges:** Sustaining student enthusiasm and participation in a distant environment presents difficulties, particularly for disciplines that significantly depend on practical experiences or collaborative conversations (Sangster et al., 2020).

2.2.2 Epistemological Access and Constraints

Epistemology relates to the essence of knowledge and the methods by which it is obtained or comprehended (Du Preez & le Grange, 2020). The transition to ERT influences the methods by which knowledge is accessible, comprehended, and generated. The transition to ERT impacted epistemological access in the following ways:

- **Access to varied resources:** ERT facilitates students' access to a broad spectrum of online resources, encompassing open educational resources, databases, and international viewpoints.
- **Asynchronous learning opportunities:** ERT facilitates asynchronous learning, enabling students to interact with materials at their own pace, review content as necessary, and allocate additional time to comprehend intricate topics (Yamagata-Lynch, 2014).
- **Expanded modalities of knowledge representation:** In ERT, knowledge can be expressed through several formats like videos, podcasts, interactive modules, and digital simulations, potentially improving understanding for diverse learner types (Knoetze & Du Toit, 2022; Matadi & Uleanya, 2022).

The transition to ERT impacted epistemological constraints in the following ways:

- **Transitioning from tacit to explicit knowledge:** In a conventional classroom setting, a significant portion of knowledge transmission occurs implicitly through conversations, nonverbal cues, and informal feedback. In ERT, knowledge transfer

frequently necessitates a more explicit and systematic approach, perhaps failing to encompass all facets of learning (Knoetze & Du Toit, 2022).

- **Superficial learning:** In the absence of profound, in-person interaction, education may devolve into a superficial engagement with information, hindering the development of critical thinking and analytical skills that arise from conversations and debates (Fataar, 2021; Roy, 2019).
- **Knowledge fragmentation:** In an online context, learning may become increasingly disjointed, as it is more challenging to construct a cohesive narrative across many digital formats. This may impede pupils' ability to develop a profound, cohesive comprehension of intricate subjects.

2.3 Resilience and Innovation in Higher Education During Crisis

While some universities swiftly and effectively transitioned to remote learning, others faced challenges and took longer to adapt. These differences in transition times and methods provided valuable learning opportunities for institutions to observe and learn from each other's experiences. By doing so, universities could avoid reinventing the wheel and instead adopt best practices and strategies that had already been proven successful in other settings. Fullan et al. (2020) created three strategies of learning phases, echoing the sentiment that in every situation there is a solution. The author stated that these learning phases can help moving from times of crisis to a future-focused system. These strategies of learning phases emphasise how the new approaches that enable wellbeing, equity and quality learning will flourish. To realise such improvement, it is imperative to embrace an innovative mindset. It is important to be open to rethinking and creating a powerful new future that meets everyone's needs. Figure 2.1: Adapted from education reimagined: The future of learning (Fullan et al., 2020) shows the three learning phases and their purpose. The three learning phases can be explained as follows:

Phase 1: Disruption: Identifies initial responses and the lessons learned during the pandemic. When dealing with this unexpected change, not everyone had the same experience. Some had better teamwork and technical infrastructure that allowed them to respond more efficiently, while others struggled to find the appropriate approach. Fullan et al. (2020) mentioned that their own success was driven by their people being ready to be adaptive and innovative in their context. The Covid-19 pandemic was an unfortunate situation, but it did allow educators and staff to build their capacity and be adaptable (Fullan et al., 2020; Hodges et al., 2020; Rapanta et al., 2020).

Phase 2: Transition: outlines how to navigate planning for reopening while the pandemic still created uncertainty (Fullan et al., 2020). In this phase, educators need to embrace the digital environment, support students, at times view students' work through the students' perspective, and advocate for the students when necessary. This student-centred lens is important and helps novice teachers transition to effectiveness while providing support for student success (Maldonado & De Witte, 2022).

Phase 3: Reimagining: lays out a vision for an educational approach that enables all students to thrive and prepares them with skills to navigate ambiguity and change. This phase draws from the best traditional approaches, innovative practices, and insights from remote learning to shape new, flexible, and agile hybrid deep-learning models (Fullan et al., 2020).

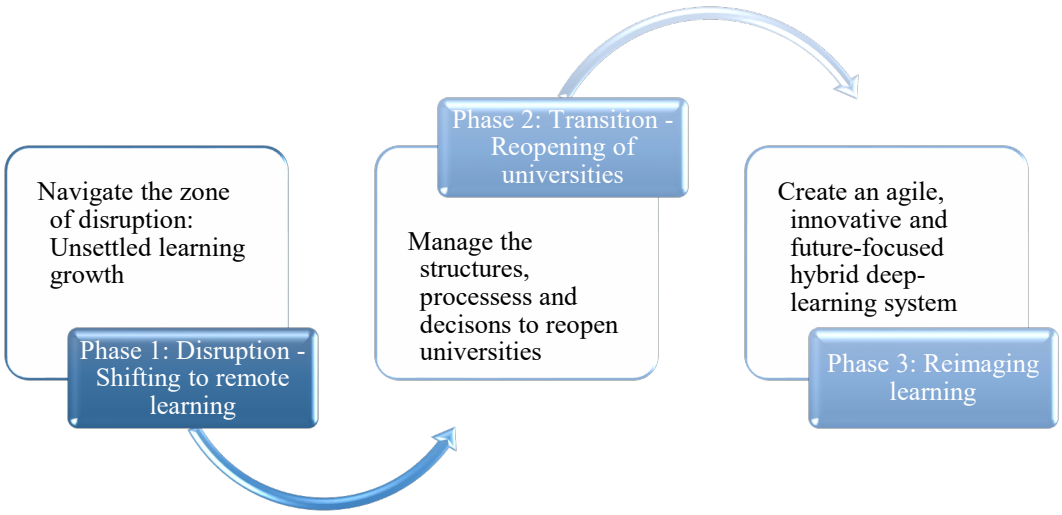


Figure 2.1 Experiences of teachers during the pandemic (Fullan et al., 2020)

Fullan et al. (2020) also listed three zones that both individuals and systems experience as they navigate the disruption phase. These are the unsettled zone, the learning zone, and the growth zone. These zones are discussed in the following subsections.

2.3.1 Unsettled Zone

In this zone, the shock and enormity of the change may be overwhelming. Emotions are running high, and everyone's attention is focused on resolving the immediate structural and procedural problems (Fullan et al., 2020). At the peak of the pandemic, 1.9 billion students were absent from school. As a result of this sudden and unexpected development, policymakers and practitioners were forced to scramble to devise quick and safe methods to provide learning at home. Distance learning became a quick fix. However, students were unable to attend class for several weeks due to a lack of connectivity and access. Plans had to be made to have gadgets

delivered to some university students who did not have them, and connectivity in underserved areas was created. A quick reaction was required.

South African universities had to come up with ways to provide students with resources to enable them to study online. On average, across the system, 94% of undergraduate students were provided with data; this number reduced as the students returned to campus. The National Student Financial Aid Scheme (NSFAS) offered their funded students' laptops and data. Educators had to adapt to new pedagogical techniques and modes of instructional delivery to enable ERT and online learning.

2.3.2 The Learning Zone

During this stage, the status quo is evaluated, and plans are made to improve the quality of life for everyone involved. Those affected begin to think about a variety of elements and the prospect of shifting the focus from merely surviving to successfully navigating the new, out-of-the-way setting (Fullan et al., 2020).

2.3.3 The Growth Zone

In this zone, academics and students recognise that they are no longer working on a temporary or stopgap solution. During the disruption, it became clear that technology is a critical component of the solution. It was recognised that it was time to move beyond a mix of traditional teaching and online instruction, both of which take place in brick-and-mortar settings, to something more (Dlamini & Ndzinisa, 2020; Fullan et al., 2020). Moving beyond the growth zone raised new issues that necessitated creativity to plan for schools reopening and agility to respond to the resurgence. Health and safety, wellbeing, quality learning, equity, technology, and capacity had to be prioritised.

Teachers and leaders who were able to progress through the growth zone reported the following significant discoveries (Fullan et al., 2020; Knoetze & Du Toit, 2022):

- Recognition of the importance of wellbeing as a prerequisite for learning;
- Technology shifted from being a vehicle for delivery/transmission to a mechanism for collaboration, social connectedness, and culture building;
- Self-regulation and learning were important factors in determining student motivation, engagement, and success;
- Students who discovered they had more choice and voice outperformed expectations by finding ways to help themselves and collaborate with others; and

- Collaboration among teachers and leaders emerged.

2.3.4 Emergency Remote Teaching

The following section reflects on the how institutions in various countries navigated these challenges

2.3.4.1 The University of the Witwatersrand Experience

When the Covid-19 pandemic hit, South Africa entered Lockdown Level 5 in March 2020. The University of the Witwatersrand (Wits, 2020a) swiftly transitioned to ERT and learning in an online format, starting from April 20, 2020. ERT and learning was sustained throughout the remainder of the 2020 academic year, except for certain clinical and laboratory activities for small student groups that required physical presence.

Wits produced and disseminated various resources aimed at developing educational materials that are accessible online, designing remote assessment tasks, and facilitating technology-mediated interactions with students. The university implemented a learning management system (LMS), an online platform that facilitate the sharing of materials between teachers and students, to allow for the submission and return of assignments, and enable online communication (Oliveira et al., 2016). Teaching and learning were primarily conducted through this LMS, named Ulwazi, which means knowledge. Comprehensive support services were extended to students, including provision of devices, data, and electronic/telephonic counselling, tutoring, and mentoring. Mid-year assessments and most final assessments were conducted remotely.

Despite encountering numerous challenges, collaborative efforts between staff and students enabled Wits to successfully conclude the 2020 academic year, predominantly via ERT (Wits, 2020b). The Online Learning and Teaching Unit offered assistance and support to the academics in the rapid shift to ERT and learning. This included daily and weekly lunchtime webinars, having a centralised support site in the university LMS that shares information, adapting or creating new resources as they themselves learned more, and being available on email, WhatsApp and Microsoft Teams to be able to support staff where needed.

2.3.4.2 The University of KwaZulu-Natal Experience

University of KwaZulu-Natal (UKZN; Singh et al., n.d.) faced a crucial decision to shift from traditional face-to-face teaching to online instruction in response to the sudden onset of the

pandemic. In response, each college and school at UKZN undertook its own mapping process to facilitate this transition. Many academics actively sought out resources to support the new teaching method, assessed student needs for online access and skills, and established protocols for online teaching and learning.

The onset of the pandemic caused widespread concern among academics globally, especially those less familiar with digital tools. To support these individuals at UKZN, digital training webinars were organised. The response was overwhelmingly positive, and sessions reached full capacity within an hour of being announced. To accommodate demand, the number of participants per session had to be gradually increased, starting from 40 and reaching 180 in institution-wide sessions, alongside additional smaller sessions held at college level.

Adapting to teaching practical topics in a virtual environment required managing screen sharing, video, and microphones because of the large number of users. Having technical support personnel at each session allowed facilitators to focus on delivering content and addressing academic-related queries.

This experience served as a learning opportunity for academics to understand and effectively use digital tools. The support provided aimed to empower academics by familiarising them with the institution's current technologies and coaching them on deployment and use for the transition to online learning during the Covid-19 pandemic. The support and cooperation from the students, and the staff; both academic and support was empowered technologically, demonstrating passion and taking the required initiatives in terms of the new normal. Universities must develop new digital platforms, online teaching strategies, and e-conference models for knowledge generation and dissemination.

2.3.4.3 The University of Venda Experience

In response to the unprecedented disruptions caused by Covid-19 pandemic, the University of Venda (UNIVEN, 2020a) took proactive measures through its Centre for Higher Education Teaching and Learning Academic Development Unit team to develop a protocol aimed at enhancing the quality of teaching and learning. This protocol provided guidance for both academic staff and students to ensure the continuation of support and development services from the Academic Development Unit during and possibly beyond the Covid-19 period. Practices such as e-mentoring and e-tutoring, recommended by the Academic Development Unit, were implemented, with individuals referred to as MenTuts providing support to mentees or tutees.

Additionally, instructional videos or audio sessions addressing challenging topics in various modules were created. Communication through group chats via platforms like WhatsApp and Facebook was heavily used, especially to assist vulnerable first-year students who may have felt confused or lost in their studies. All existing materials were adapted for online delivery.

Despite the suspension of face-to-face classes, efforts were made to ensure teaching and learning continued seamlessly. Module lecturers took on the responsibility of keeping students engaged while awaiting normalisation of the global, national, and institutional situations. Various online platforms such as Blackboard, WhatsApp, Facebook, Zoom, and Teams were used for teaching purposes, with e-learning practitioners available to assist with any related issues.

2.3.4.4 The Arabian Gulf University

All nations globally recognised the need for remote instruction as the principal method to address the circumstances faced during the Covid 19 pandemic. The Gulf Cooperation Council nations were no different. To mitigate any adverse effects of restricting students' physical attendance at universities and to maintain the academic year of 2019–2020 in alignment with established educational schedules and objectives, the Arabian Gulf University prioritised delivering services to students in a manner that guaranteed the quality of educational outcomes and academic success (Ayoub et al., 2024). The school concentrated on using innovative learning methodologies, including online and remote education, to maintain the provision of high-quality educational services to its students, as advised by higher education authorities (Ayoub et al., 2024). Arabian Gulf University sought to circumvent temporal, locational, and emergency constraints resulting from the Covid-19 pandemic to ensure the continuity of the educational process. The university administration was eager to sustain educational courses in the second semester by offering students exceptional educational offerings via available e-learning platforms. The university's established information technology infrastructure facilitated this objective. The Arabian Gulf University and its College of Graduate Studies, with their considerable expertise in pedagogy and research, were leading this evolution. Their pioneering position in distance learning was particularly significant in the current educational landscape.

The implementation of ERT at Arabian Gulf University was analysed through the frameworks of the activity theory and the crisis management theory as proposed by (Herrero & Pratt, 1996). Activity theory offers a paradigm for comprehending the interactive dynamics among students,

technology, and instructional content within an ERT-driven learning environment (Hashim & Jones, 2007). The implementation of ERT at the Arabian Gulf University yielded numerous benefits, such as increased flexibility and accessibility for students (Ayoub et al., 2024). The provision of educational resources to students from varied geographic locations, particularly rural or underserved areas, signified a substantial advancement in educational equity and accessibility. However, it is crucial to acknowledge issues such as dependence on technology, which engendered a digital divide, and the possible deficiency in student engagement and teacher-student interaction in a distance learning framework (Afzal et al., 2023). The Arabian Gulf University intends to progressively incorporate ERT lessons into its educational framework to address acute problems and serve as a long-term approach to improve the learning experience.

2.3.4.5 Indonesian, Malaysia, Singapore, and Thailand Universities

The experience of Indonesian, Malaysia, Singapore, and Thailand university students and teachers in ERT and learning during the Covid-19 was similar to those in other institutions. In Indonesia, nationwide school closures began on March 23, 2020. Educators suddenly had to set up online modules and teach students through digital platforms (Ginting et al., 2021). Indonesia and three other Asian countries (i.e., Malaysia, Singapore, and Thailand) faced the challenges posed by the pandemic in similar ways. Shifting education from face-to-face teaching to online teaching was the main immediate challenge for these universities, regardless of the lack of infrastructure and teachers' unpreparedness for hosting remote classrooms. Moreover, students from rural areas were already disadvantaged, and existing education gaps were exacerbated (Du Preez & le Grange, 2020). The pandemic created an emergency during which educators suddenly had to set up online modules and teach students through digital platforms. Their approach to transition from conventional instructional delivery to ERT was similar to other institutions. The transition to these modes of teaching and learning was not seamless (Rahiem, 2020). Similarly, academics experienced challenges such as lack of preparedness to use of online instructional delivery, and technological barriers. The use of various LMSs caused confusion and difficulties managing online classes and assignments, and the academics struggled creating effective online modules and video lessons; they particularly struggled to determine the appropriate length and content (Jyoti & Banerjee, 2020).

In summary, the experiences of Wits, UKZN, UNIVEN, Arabian Gulf University, Indonesian, Malaysia, Singapore, and Thailand Universities illustrated how different institutions navigated

the challenges of ERT, each employing unique strategies to support their academic communities and enhance their remote teaching and learning capabilities. A common experience at all these institutions was that they experienced the three zones mentioned by Fullan et al. (2020) during the disruption, transition and reimagining phases. During the disruption zone, institutions like Wits and the Arabian Gulf University seem to have swiftly adopted online platforms and provided resources to support students and staff, while other universities struggled in the beginning and managed to transition at some point. In the learning zone, these universities evaluated their responses and aimed to improve the quality and effectiveness of the new remote setting. The growth zone involved recognising technology as essential and moving beyond temporary solutions to create more flexible and innovative teaching models. This phase saw a focus on wellbeing, collaboration, and the effective use of technological affordances for teaching and learning. The next section compares the teaching and learning approaches.

2.4 A Comparative Analysis of Learning Environments: Emergency Remote Teaching, Online Learning, and Face-to-Face Instruction

ERT as defined by Hodges et al. (2020) is a plan put in place to rapidly and reliably offer temporary access to training and instructional assistance during an emergency or crisis, rather than replicating a comprehensive educational environment. ERT is a temporary response to crises, heavily reliant on technology, and lacks pre-planning. ERT involves minor modifications to face-to-face materials before they are provided in an online format. In ERT, the educational ecosystem is not recreated but rather adapted to ensure students have access to resources. Online teaching and learning involve the deliberate development of online study materials, meticulously analysed at every stage of the design process to ensure effective teaching and learning outcomes (Hodges et al., 2020). Online learning is a planned, structured mode of online learning that offers flexibility and various forms of interaction (Paechter & Maier, 2010; Pascu & Petcovici, 2021). Face-to-Face learning is the traditional in-person method that emphasises direct interaction and immersive learning experiences. In traditional classroom settings, class meetings are held at designated times and locations according to a predetermined schedule.

Structurally, these modes differ in that online teaching uses regular interactive online tools and activities such as quizzes, polls, and self-assessment techniques. Online courses offer students the autonomy to set their own pace for completing a significant portion of the coursework

(Pascu & Petcovici, 2021). In an online setting, students opt for this mode of studying, whereas in an ERT setting, students are compelled to adapt to this mode (Hodges et al., 2020). Online learning entails the use of various resources such as human capital, intellectual assets, and technical tools, along with a significant investment of time. Research suggests that the adaptation of a standard course for online instruction, encompassing planning, preparation, and development, typically spans between six to nine months (Hodges et al., 2020).

The primary distinction between online learning, ERT and face-to-face teaching and learning lies in their origins and approaches (Hodges et al., 2020; Knoetze & Du Toit, 2022). Online learning is the outcome of meticulous instructional design and planning, necessitating an investment in a comprehensive ecosystem of learner support that evolves over time. Conversely, ERT arises as a reactionary measure to a crisis, and involves a temporary transition of instructional delivery to an alternative mode that relies entirely on remote solutions (Hodges et al., 2020). This shift substitutes face-to-face, blended, or hybrid course delivery methods with fully remote alternatives (Hodges et al., 2020).

Each learning environment, namely ERT, online learning, and face-to-face instruction, offers distinct advantages and disadvantages, and these are shown in Table 2.1.

Table 2.1 Learning environments

Advantages	Disadvantages
Emergency Remote Teaching	
• **Flexibility:** ERT allows for rapid adaptation in emergency situations, such as natural disasters or pandemics to ensure continuity of education. • **Accessibility:** ERT can potentially reach a wider audience, including students who may have geographical or physical limitations that prevent them from attending traditional classes. • **Innovation:** It encourages educators to explore and adopt new technologies and teaching methodologies to effectively deliver content in a remote setting (Ferri et al., 2020; Gelles et al., 2020; Hodges et al., 2020; Knoetze & Du Toit, 2022).	• **Limited preparation time:** ERT often occurs suddenly in response to unforeseen circumstances, leaving little time for thorough planning and preparation, which can impact the quality of instruction. • **Technological barriers:** Access to technology and reliable internet connections may be uneven among students, leading to disparities in learning experiences and outcomes (Ahmed & Firdous, 2020). • **Lack of interactivity:** It may be difficult to let ERT replicate the interactive and collaborative aspects of traditional classroom settings, potentially resulting in reduced student engagement and participation (Gelles et al., 2020; Hodges et al., 2020; Knoetze & Du Toit, 2022).
Online Learning	
• **Flexibility:** Online learning offers unparalleled flexibility, allowing students to access course materials and engage in learning activities at their	• **Isolation:** E-learning can be isolating for some students because it lacks the face-to-face

Advantages	Disadvantages
own pace and convenience, which is particularly beneficial for working professionals or students with busy schedules (Means et al., 2013). • **Accessibility:** It provides accessibility options for students with disabilities by offering customisable learning experiences tailored to individual needs (Means et al., 2013). • **Cost effectiveness:** E-learning eliminates the need for commuting or physical classroom infrastructure, potentially reducing costs for both students and institutions.	interactions and social connections that are inherent in traditional classroom environments. • **Self-discipline:** The flexibility of e-learning requires strong self-discipline and time management skills from students to stay motivated and on track with coursework, which may be challenging for some learners. • **Technical issues:** Technical glitches, such as software malfunctions or internet connectivity issues, can disrupt the learning process and hinder access to course materials (Ferri et al., 2020; Mpungose, 2020; Paechter & Maier, 2010).
Face-to-Face Instruction	
• **Interactivity:** In face-to-face settings, instructors can facilitate immediate feedback, foster discussions, and encourage active participation to promote deeper engagement and understanding among students. • **Social interaction:** It provides opportunities for socialisation and collaboration among students, facilitating the development of interpersonal skills and a sense of community in the classroom. • **Hands-on-learning:** Certain subjects or activities, such as laboratory experiments, performing arts, or hands-on training, are better suited for face-to-face instruction to allow students to gain practical skills and experience in a real-world environment.	• **Limited accessibility:** Face-to-face instruction may pose accessibility challenges for students with disabilities or those who face barriers to physically attending classes, such as geographical distance or mobility issues. • **Logistical constraints:** Face-to-face instruction requires physical infrastructure and resources, such as classrooms and transportation, which can be costly and logistically challenging to maintain, especially in densely populated areas. • **Risk of disruptions:** External factors, such as inclement weather, public health crises, security threats or protests, can disrupt face-to-face instruction and impact continuity of learning (Ananga & Biney, 2021; Paechter & Maier, 2010; Pascu & Petcovici, 2021).

In summary, each mode has its own strengths and weaknesses that makes it suited to different contexts and needs. ERT is a reactive approach, online learning is planned and flexible, and face-to-face instruction offers rich interaction but is prone to logistical challenges.

2.5 State-of-the-art Reviews from Other Researchers on Emergency Remote Teaching, Online Learning, and Face-to-Face Learning

Knoetze and Du Toit (2022) explored both academics' and students' perceptions of ERT and identified self-regulated learning as a major challenge. The study investigated whether students exhibit inferior self-regulated learning strategies in ERT by falling further behind when compared to a face-to-face setting. Academic self-regulation is defined as the degree to which students are metacognitively, motivationally, and behaviourally engaged in reaching their learning goals (Zimmerman & Schunk, 2012). In this investigation, Knoetze and Du Toit

(2022) measured how far behind students were using student access log-data from four undergraduate modules offered at Stellenbosch University in the 2019 (face-to-face setting) and 2020 ERT setting academic years. They used an analysis of variances model to test whether there was a difference in the number of days that students were behind for the two modes of teaching and learning. The results indicated that students are more likely to fall behind during ERT than in face-to-face teaching and learning, thus exhibiting inferior self-regulated learning (Knoetze & Du Toit, 2022).

Instructors in ERT encountered challenges providing emphasis and contextualisation to the face-to-face materials used in the online environment. They struggled to gauge in real time when students required additional input or clarification. When developing an online course, instructors must be mindful of these missing elements and carefully consider how to compensate for their absence (Santiago Iglesias-Pradas et al., 2021). Consequently, the rapid transition from face-to-face material to ERT often leads to a decline in the quality of teaching and learning outcomes. Sangster et al. (2020) highlighted that most instructors reported that students were less engaged in their studies during ERT, which could lead to students falling behind and a greater dropout rate.

Fogarty (2020) reflected on the impact of the Covid-19 pandemic on accounting education in and highlighted the necessity for students to adapt by becoming more self-regulating, particularly when asynchronous techniques such as ERT were employed. The author succinctly captured this shift by stating that "being able to access study materials anytime can easily become accessing them at no time" (Fogarty, 2020, p. 568). This sentiment has been echoed by students who expressed difficulties with various aspects of self-regulated learning during ERT, including time management, managing their study environment, and maintaining motivation (Fadda, 2019).

Students who had more self-control avoided the temptations of procrastination and neglect. Better time management skills were needed for students who had returned to their parental homes (Forgaty, 2020). However, students vary in self-efficaciousness, and those who thrive only with additional amounts of encouragement or handholding should not be forsaken. Fogarty (2020) mentioned that the decline of the support structures of higher education during the pandemic contributed to an increased need for students to be more self-regulating. Self-regulated learners create task-specific learning goals and use appropriate strategies to achieve them. They monitor and assess their progress and adjust their learning strategies as needed.

Despite distractions, they motivate themselves and remain focused on studying. They seek assistance when they need it and keep their learning environment favourable to learning.

Hodges et al. (2020) shared some characteristics between ERT and online teaching and mentioned that these characteristics include the asynchronous nature of teaching and learning, the shared education medium being online, and the need for self-regulated learning. This is in line with literature on students' perception of online teaching and learning by Francis et al. (2019) and Paechter and Maier (2010). Students get greater flexibility with ERT and online learning as attendance at specific times or locations is not mandated (Ferri et al., 2020). However, increased flexibility necessitates enhanced self-regulated learning (Mahlaba, 2020; Paechter & Maier, 2010).

Lynch and Dembo (2004) reviewed literature on distance education and self-regulation to identify learner self-regulation skills predictive of academic success in a blended education context. They collected data from 94 students in a blended undergraduate marketing course at a west coast American research university. They identified the following five self-regulatory attributes likely to be predictive of academic performance: intrinsic goal orientation, internet self-efficacy for learning and performance, time, help seeking, and study environment management.

Fadda (2019) revealed similar self-regulation components that are crucial for online learning. They investigated distant education by specifically focusing on the existing body of research on self-regulation. A total of 70 students enrolled in a blended undergraduate English language course at the Saudi Electronic University in Riyadh, Saudi Arabia, were included in the data collection. The author wanted to determine the self-regulatory traits, as measured by the subscales of the motivated strategies for learning questionnaire, that are likely to be indicative of successful academic performance in a blended educational setting. Fadda identified the following fundamental components of online learner autonomy:

- Motivation, which consists of two elements, namely efficacy beliefs and goal orientation;
- Efficacy beliefs, which represent a learner's assurance in their ability to effectively complete a learning assignment;
- Goal orientation, which pertains to the motivations behind a learner's participation in a learning activity;

- Internet self-efficacy, which enhances the learner's confidence in properly using technology for learning purposes;
- Time management, which refers to the learner's capacity to effectively and efficiently allocate study time while juggling other time commitments in their life;
- Management of the study environment, which refers to the learner's capacity to effectively control and modify their study environment to create a conducive atmosphere for learning; and

Learning assistance management, which refers to the learner's capacity to actively and appropriately seek help when needed, use the right channels, the ability to recognise when assistance is required, being aware of where to find that assistance, understanding how to ask for assistance, and being able to assess the efficiency of the assistance received (Aleven et al., 2003). These components of learner autonomy are self-regulatory learning traits that have been recognised in the self-regulation literature as significant aspects in classroom-based learning (Fadda, 2019).

In summary, ERT offers a quick solution during crises, but it might be challenging because it is impromptu and lacks extensive planning. Students struggle with motivation in ERT and online learning (Ferri et al., 2020; Francis et al., 2019). In ERT and online teaching and learning, students experience a loss of instructor immediacy (Baker, 2004), peer-to-peer connection, and social connection (Gelles et al., 2020). According to Forgaty (2020), students should be resilient enough to handle rapid transitions. Nevertheless, drawing from the experience of the Covid-19 pandemic, it is imperative for academics, students, and management to be prepared for any potential disruptions. Previous experiences provide valuable lessons that should serve as a guide for the future. Online education provides flexibility and individualised learning experiences, but it necessitates proficient digital skills and support and may lack face-to-face interaction. Traditional in-person teaching facilitates direct interaction and fosters social growth, but it may be limited by practical considerations. Every mode of instructional delivery has its own benefits and drawbacks, and its success is influenced by aspects such as the requirements of the students, the resources at hand, and the context. It is evident that remote teaching and learning can be enabled by affordance of technologies.

2.6 The Efficacy of Digital Technology Enabled Education

Technology is crucial in facilitating students' connectivity, engagement, and motivation. This was evident during the shift from face-to-face instruction to ERT amid the Covid-19 pandemic. Technology holds the promise of significantly improving the educational process (U.S. Department of Education, 2017). It has the capacity to enhance the bonds between teachers and students, revolutionise learning methods and collaboration, and tailor learning experiences to individual needs (U.S. Department of Education, 2017; Roy, 2019).

Teaching and learning is taking on a new dimension because of the profound effects of technology on educational institutions. There is now a means for teachers to successfully communicate and share ideas for improving their teaching abilities. Teachers now have access to an inexhaustible supply of resources that may be used to provide students with the necessary assistance to enhance their knowledge and skills. Learning technology researchers also view the internet not only as a platform for content delivery but also as a valuable tool to improve the quality of learning experiences and outcomes (Means et al., 2013).

Technology enhanced learning focuses on using technologies to facilitate learning, whether it occurs in a local setting, such as on campus, or remotely, such as at home or in the workplace. In the past, these technologies encompassed instructional films, radio, and television (Westera, 2010), but now technology enhanced learning primarily involves the use of computer-based technologies, including smartphones and other smart devices. According to Dlamini (2023), technology enhanced learning involves the incorporation of digital tools and technologies into education for the purpose of enhancing teaching and learning using the internet. Technology enhanced learning is defined as a method of teaching that employs a range of technology enhanced educational strategies (McLaughlin, 2018; Sen & Leong, 2020). These are teaching and learning strategies such as online, hybrid and blended methods of teaching and learning (McLaughlin, 2018). e-Learning can enhance learning experiences, save teachers time, enable teachers to better tailor learning to meet student needs, aid in tracking student progress, and provide transparency into the learning process. According to Fogarty (2020), without the technological tools that make remote education possible, higher education would have had to pause during the pandemic.

The effective application of technology in education have altered the face of education and expanded educational options. Teachers have learned how to integrate technology into their classrooms, and students are becoming increasingly engaged in technology-based learning.

Modern educational technologies allow students and teachers to collaborate in real time (Roy, 2019). Technology has digitalised classrooms through digital learning tools such as laptops, iPads, cell phones, and smart digital whiteboards, and it has enhanced student engagement and drive to learn and expanded course possibilities. Technology is valued because it is very convenient.

Technology facilitates active learning material interaction and makes the learning process interactive, and students acquire knowledge through engagement, research, and feedback. This makes students enthusiastic about their studies (Bektashi, 2018; U.S. Department of Education, 2017). Students can form online groups using the internet or software applications. Technology allows students and educators to develop virtual communities that connect them with other students and educators from around the globe in real time (U.S. Department of Education, 2017). They can obtain feedback from their teachers and discuss their lessons with questions and concerns. By listening to and reading about the ideas and feedback of others, students sharpen their thought processes, achieving greater levels of comprehension and deeper knowledge (Bektashi, 2018). Online communities also offer students the chance to communicate with people from around the globe (Bektashi, 2018). The majority of technology-based tasks involve analytical and problem-solving abilities.

In summary, technology plays a pivotal role in enhancing students' connectivity, engagement, and motivation, as demonstrated during the transition from face-to-face to remote learning amid the Covid-19 pandemic. It significantly improves the educational process by strengthening teacher-student interactions, revolutionising learning methods, and personalising education (Roy, 2019; U.S. Department of Education, 2017). Technology enhanced learning, or e-learning, includes online, hybrid, and blended methods that enrich learning experiences, save time, and tailor education to individual needs (McLaughlin, 2018; Sen & Leong, 2020). Technology facilitates real-time collaboration, interactive learning, and global communication, making education more engaging and comprehensive (Bektashi, 2018; Roy, 2019). However, the effectiveness of e-learning also depends on factors like digital literacy, which is crucial for its success (Fadda, 2019). Digital technology can enable education if it is inclusive of factors that contribute to the success of e-learning (Fadda, 2019), and one of these factors is digital literacy.

2.6.1 Digital Literacy

The ever-changing advancements in digital technologies are resulting in new and flexible ways of working, studying, and engaging with the world. To make the most of the opportunities and face the challenges that digital technologies and online environments provide both now and, in the future, it is essential that learners and educators become digitally literate. Digital literacy is about more than just using computers. In the context of HEIs, educators and learners must develop a range of skills to become digitally literate. They must be able to use technology to create content, search for content, solve problems, and innovate (Spante et al., 2018). They must be able to connect and effectively communicate online, learn, collaborate with peers, and discover and share new information. This was observed during the Covid-19 pandemic period, when it was not feasible to conduct face-to-face teaching and learning due to the lockdown. Institutions globally were forced to transition to online learning, which meant thoughtfully designing online instructions. During the pandemic period, the delivery of material needed be uploaded to Google Classroom in formats such as voice-over PowerPoint presentations, video files of the lesson presentation prepared using screen recording software, and live online sessions via Zoom, Teams or Google Meet. All of this required some level of digital skill and competency (Hallal et al., 2020).

Hallal et al. (2020) mentioned that an assessment of strengths and weaknesses helped the Chemistry Department at the Lebanese International University develop a model of online learning that took advantage of the readily available online tools such as Google Classroom while modifying the format of content delivery and assessment with minimal potential for disruption by inadequate internet, interruptions in electricity, and limited access to expensive hardware and software. Strengths, weaknesses, opportunities, and threats analysis of the model was done based on a survey that was given to the chemistry instructors in the department. The authors' findings are set out in Table 2.2.

Table 2.2 Strengths, weaknesses, opportunities, and threats analysis: Online learning experience (Hallal et al., 2020)

Strengths	**Weaknesses**
• Instructors promptly established contact using easily accessible online platforms such as Google Classroom, Zoom, Google Meet, WhatsApp, etc. • Instructors promptly adjusted to the demands of student learning by primarily assessing students' online learning and effectively transforming their lecture notes into video files using screen recording software for distribution to their students. • Students readily adjusted to fulfilling their obligatory duties, quizzes, assignments, assessments, etc. • Students acquired greater self-sufficiency and appreciated the increased flexibility of the timetable.	• Insufficient internet connectivity for some students and educators. • Inadequate availability of personal computers for some students and instructors. • Some teachers lacked the necessary technological competence to create lecture files suitable for online learning. • Students encountered difficulties effectively managing their time, and occasionally felt overwhelmed by the amount of material uploaded by their lecturers.
Opportunities	**Threats**
• Exposing instructors and students to online learning tools enable the seamless integration of online learning tools with traditional face-to-face learning, resulting in enhanced student engagement and more effective delivery of ideas. • Students who have other commitments such as employment or being stay-at-home parents will have an equal chance to pursue a university degree compared to those who are entirely dedicated to their studies. • Online learning can offer equitable opportunities to students with learning difficulties and disabilities. • Online learning can improve instructors' overall expertise. • This good experience could serve as a basis for enacting new legislation to embrace online learning.	• Insufficient or unreliable internet connectivity. • Students lacking personal computer access and only dependent on smartphones or tablets. • An unresolved issue of academic dishonesty can have a detrimental effect on student development and employment. • Insufficient substitution for the practical experience that students obtain from hands-on laboratory work.

Udeogalanya (2022) explored the relationship between digital literacy and student academic achievement during the pandemic. The author found that as the Covid-19 pandemic moved through the communities of the United States, institutions of higher education shifted to exclusively online methods of teaching and learning. Before the pandemic, internet education was considered less important than face-to-face teaching and learning. Approximately 20% of the classes were conducted entirely online, while the remaining 80% were conducted in person in many higher learning institutions (Udeogalanya, 2022). The inclusion of digital literacy in the curriculum was minimal, with mainly the departments of computer information systems

and computer sciences addressing this topic. Academics, students, staff, families, and communities lacked the necessary training to handle the demanding nature of exclusively online education. A significant portion of them were unfamiliar with most digital literacy tools. During the pandemic, both instructors and students were compelled to acquire proficiency in computer usage and digital literacy skills to navigate through the first semester in 2020.

(Gilster, 1997) coined the term digital literacy in the late 1990s, defining it as the capacity to comprehend and use information from various sources in different formats, specifically when delivered through computers. This term is recognised in several reviewed papers as the 'know-how' (Gilster, 1997; Gourlaya et al., 2014). Gourlaya et al. (2014) state that digital literacy, like media literacy and computer literacy, is rooted in a skill-oriented comprehension of the notion. Therefore, it pertains to the practical use of technology and the ability to adjust one's skills. Recent articles indicated that definitions of digital literacy emphasise cognitive skills and competences (Mishra et al., 2017). Digital literacy includes the skills of finding, analysing, assessing, and presenting digital information (Mishra et al., 2017; Schroeter & Higgins, 2015). Chan et al. (2017) discussed cognitive skills and provided the definition of digital literacy as the capacity to comprehend and use information in various formats, with a focus on critical thinking rather than solely on abilities related to information and communication technology (ICT).

In summary digital literacy in the context of this study refers to the ability to effectively use the connections and communication capabilities of digital technology. This includes the capability to create, modify, digitise information, reuse, and distribute new knowledge, in addition to accessing pre-existing information (Stewart, 2013).

2.7 Digitalisation: Enhancing Teaching and Learning Experience

Digitalisation encompasses the use of digital technology and capabilities to transition to a digital business. This involves modifying business models and operational procedures (Monton, 2022). For universities, digitalisation meant transforming their instructional mode of delivery to online teaching, which entailed redesigning the process of preparation of material and teaching. Digitalisation goes beyond simply converting materials into digital formats and also involves leveraging digital technologies to transform teaching practices, enhance learning experiences, and improve educational outcomes. During the pandemic era, all the teaching materials were digitised into audio, recordings and videos. Academics had to use online learning platforms, interactive apps, virtual classrooms, or educational software to engage

students in new ways (Hallal et al., 2020; Spante et al., 2018). They had to integrate multimedia resources, simulations, or collaborative tools into their lessons to create more interactive and personalised learning experiences. Digitisation is the process of converting information into a digital format (Seethal & Menaka, 2019). Digitalisation concerns the use of technology to renew, simplify and improve processes, tasks and products (Tømte et al., 2019). Digitalisation of education involves various aspects of quality, ranging from organisational issues and technological infrastructure to pedagogical approaches (Bates, 2015). All these factors must be considered to realise success in digitalisation.

Ngcamu (2019) mentioned that digital technology interferes with academic and non-academic staff systems, business processes, student learning and teaching. Digital technology is needed in South Africa for learning, teaching, research, community participation, administration, management, and leadership (Ngcamu, 2019). The well publicised student uprisings, such as #FeesMustFall, #DecolonisedCurriculum, and #RhodesMustFall, made it necessary to digitalise academic institutions. Due to campus chaos and rioting, educators had trouble communicating with students during this volatile period. Digital tools favoured economically viable and sustainable students and disadvantaged unprivileged students (formerly disadvantaged). Some academic staff members lack digital literacy in terms of knowledge, skills, and competences and feel disadvantaged by students who are considered 'digital natives/indigenous' and who possess knowledge about digital change. The conundrum is exacerbated by rigid policies, deteriorating infrastructure, and a lack of familiarity with digital technologies. This dilemma poses an additional obstacle to the efforts of academics and students who attempt to use technology (Ngcamu, 2019).

Flynn (2021)highlighted that universities are recognised as a means of achieving economic prosperity through digitalisation, which has facilitated greater student enrolment in HEIs. Previously published literature indicated that the digitalisation of universities has resulted in inequality among students (Flynn, 2021). This phenomenon was witnessed during the pandemic when certain students were unable to keep up with their peers.

Hillier (2017) examined a proposal for an offline e-learning platform that enables students and educators who lack digital connectivity to participate in the modern ICT-driven environment. For isolated and independent learners, this offers a dilemma in terms of engaging with modern e-learning options. Remote learners who lack connectivity are unable to access and interact with the increasingly prevalent ICT-enhanced learning materials that are essential for acquiring skills in an ICT-driven world. Hillier (2017) adopted a systems approach to address the problem

by considering the various aspects such as hardware, connectivity, economics, support, and skills that are relevant in remote and developing countries. The approach seeks to align with the existing infrastructure rather than an idealised version of it. It enables the integration of modern digital learning courses into a portable and autonomous e-learning platform that does not require a continuous network or internet connection to operate. The toolbox uses cost-free and open-source components and is compatible with a variety of outdated equipment, ensuring inexpensive accessibility.

South African universities are attractive to students who are either digitally native or immigrants, often known as digital learners, who have a strong preference for digital platforms. However, some of the leaders in these universities lack digital skills and knowledge (Ngcamu, 2019). Academics who serve as leaders have a crucial role to integrate digital tools into their teaching and learning methods, which directly affects the academic performance, marketability, and employability of students. In addition, digital leaders foster a digital culture on campuses by establishing a relationship of trust between students and academics (Ngcamu, 2019). The remarkable aspect the authors mentioned is the presence of leaders in the teaching and learning space advocating for digitisation, even though techniques, systems, business processes, and educational models are becoming outdated. This suggests that digital technologies are not deeply integrated into the strategic plans of the university, nor are they effectively coordinated by senior management, making it unlikely that they will be implemented at lower levels.

In summary, digitised education is crucial. The advent of technology has brought about a paradigm shift in the education industry. Digitised education is highly beneficial for students because it allows them to learn from the comfort of their own homes using their smart phones, tablets, or laptops. The adoption of innovative technology in classrooms by teachers enthralled students, diverting their attention from the conventional technique of teaching using chalk and conversation. The digitalisation of processes includes relooking at pedagogical approaches and leveraging the affordances of instructional delivery modes of teaching and learning.

2.8 Modes of Instructional Delivery

Before discussing the modes of teaching and learning, it is important to note the existence of synchronous and asynchronous experiences (Kreijns et al., 2014; Yamagata-Lynch, 2014). Synchronous teaching and learning refer to when teaching and learning occur at the same location and time, for example, a physical, brick-and-mortar classroom or the same digital

space such as Zoom, Google Meet, or a phone call (Kreijns et al., 2014; Yamagata-Lynch, 2014). Asynchronous teaching and learning refer to when teaching and learning do not occur in the same location and time, such as working in a shared Google document or an online learning platform at different times, posting to a discussion board, or using email (Kreijns et al., 2014; Santiago Iglesias-Pradas et al., 2021; Yamagata-Lynch, 2014). There are various modes of instructional delivery, but this study focused on online, blended, hybrid, flipped and face-to-face learning.

2.8.1 Online Learning

Online teaching and learning refer to education that occurs over the internet. A large number of institutions in the United States and other countries are transitioning from traditional face-to-face sessions to entirely online and web-based courses (Adebo, 2018; Means et al., 2013). Online education, often known as distance education or web-based education, is currently the most common kind of distance education. This concept has been studied for decades. Numerous research studies, theories, models, standards, and evaluation criteria focused on quality online learning, online teaching, and online course design. Since the Covid-19 pandemic in 2020, online learning has become an essential component of numerous university programmes and has been fully embraced by South African universities.

Online learning requires careful instructional design and planning using a systematic model for design and development (Dousay & Maribe Branch, 2015). The design process and the careful consideration of different design decisions have an impact on the quality of the instruction (Hodges et al., 2020). Well-planned online learning experiences are meaningfully different from courses offered online in response to a crisis or disaster without much planning (Hodges et al., 2020). One of the most comprehensive summaries of research on online learning came from Means et al. (2014). They described how online learning is being used in both secondary and higher education settings as well as in learning outside of school. Online learning technologies, such as massive open online courses (MOOCs), multiplayer games, learning analytics, and adaptive online practice environments, are described in terms of design principles, implementation, and contexts of use. The authors synthesise research findings on the effectiveness of different types of online learning, but their biggest message is that student outcomes arise from the joint influence of implementation, context, and learner characteristics interacting with technology. The authors identified nine dimensions of online learning, each of

which have numerous options, which highlights the complexity of the design and decision-making process. The following are the nine dimensions of online learning (Means et al., 2014):

1. **Modality of instructional delivery:** Fully online, blended, web-enabled, or face-to-face;
2. **Pacing:** Self-paced (open entry, open exit), class-paced, and class-paced with some self-paced;
3. **Student-instructor ratio:** <35 to 1, 36–99 to 1, 100–999 to 1, and 1 000 to 1;
4. **Pedagogy:** Expository, practice, exploratory, and collaborative;
5. **Role of online assessments:** Determining whether students are ready for new content, configure the system to support the student (adaptive instruction), provide student or teacher with information about learning state, input to grade; and identify students at risk of failure;
6. **Instructor role online:** Active instruction online, clear instructions, and small presence online;
7. **Student role online:** Listen or read, complete problems or answer questions, explore simulation and resources, and collaborate with peers;
8. **Online communication synchrony:** Asynchronous only, synchronous only, and asynchronous and online; and
9. **Source of feedback:** Automated, teacher, and peers.

An effective online teaching and learning strategy must consider the unique needs of each learner (Hodges et al., 2020; Means et al., 2014). The choice of synchrony should really depend on the learners' characteristics and what best meets their needs. Adult learners require more flexibility, so asynchronous is usually best, perhaps with optional synchronous sessions, whereas younger learners benefit from the structure of required synchronous sessions (Hodges et al., 2020). Some students have a strong focus on practical application and a strong interest in tools and technologies (Gudivada et al., 2013).

In line with Means et al. (2014), Adebo (2018) recommended that the instructor follows the following seven principles for successful online teaching:

> "Encourage student participation, encourage student cooperation, encourage active learning, give prompt feedback, emphasise time on task, communicate high expectations, respect diverse talents and ways of learning, address individual differences, motivate the student, avoid information overload, create a real-life context,

encourage social interaction, provide hands-on activities, and encourage student reflection."

2.8.2 Blended Learning

Blended learning, often described as a combination of traditional face-to-face instruction and online teaching methods, merges the strengths of both approaches (Bliuc et al., 2007; Boelens et al., 2015; Shetu et al., 2021; Siegelman, 2021; Yuen, 2014). Boelens et al. (2015) offered a comprehensive definition of blended learning as learning that deliberately combines online and classroom-based interventions to enhance learning outcomes. It integrates traditional teaching with online activities to create a dynamic learning environment that supports both synchronous and asynchronous learning (Mpungose, 2020; Pascu & Petcovici, 2021). Blended learning is designed to be offered in a proportion of 25/75, where 75% of learning occurs in a traditional face-to-face setting and 25% being online instruction.

Blended learning fosters a community of inquiry (CoI) that consists of cognitive presence, social presence, and teaching presence, which enhances meaningful learning experiences (Garrison & Kanuka, 2004). Garrison and Kanuka (2004) noted that blended learning aligns with the values of traditional HEIs and has the potential to improve learning effectiveness and efficiency. This can be accomplished through an LMS, which facilitates the administration, documentation, tracking, and delivery of educational resources and enable students to gain access to a variety of materials such as articles, videos, quizzes, and interactive activities outside of class (Boelens et al., 2015; Khoza & Mpungose, 2020; Oliveira et al., 2016).

Yuen (2014) explored the pedagogical use of technology in blended learning, focusing on teachers' and students' experiences in higher education. The author identified key teaching approaches in blended learning, including online discussions, online resources, course management enhancement, and pedagogical support. These approaches are seen as evolving pedagogical practices that address issues in higher education blended learning research. In line with Yuen's (2014) key teaching approaches, Miller (2012) proposed the following strategies to maximise student engagement:

- **Leverage virtual class meetings with collaborative work:** Create collaborative work for students to enable them to solve problems together, collaborate on projects, and use virtual breakout rooms for guided practice (Anderson et al., 2001; Miller, 2012).
- **Create the need to know:** Create authentic projects where students see the relevance and need to do the work, whether the work is online or in the physical classroom. An

example is game-based learning, where students can be engaged in playing games about viruses and bacteria, and then teachers can use the game as a hook for students to learn content online or offline. Through metacognition and a 'need-to-know' activity, students 'buy in' to the learning, no matter when and where that learning occurs (Garrison et al., 1999; Miller, 2012).

- **Reflect and set goals:** Students must be aware of what they are learning as well as their progress towards meeting standards. Teachers must build in frequent moments, both as a class and individuals, to reflect on the learning and set SMART goals (specific, measurable, attainable, relevant, and time-bound; (Miller, 2012). Through these measurable and student-centred goals, students can become agents of learning rather than passive recipients.
- **Differentiate instruction through online work:** Individualise instructions by using the online work to meet individual student needs (Miller, 2012).
- **Use tools for mobile learning:** Use mobile devices apps like Khan Academy, BrainPop, YouTube and WhatsApp as part of the learning environment. Leverage the flexibility of where students can learn and engage them outside the classroom walls (Miller, 2012; Mpungose, 2020).

The effective integration of instructional components in blended learning hinges on various contextual factors, including learning objectives, course design, target audience, and resource equity (Pascu & Petcovici, 2021). Dziuban et al. (2018) highlighted three crucial elements for the success of blended learning, namely access, achievement, and students' perceptions of their learning environment. The authors mentioned that these elements contribute to the efficacy of blended learning initiatives.

2.8.3 Hybrid Learning

Hybrid learning, also known as blended learning, represents a dynamic educational approach that seamlessly integrates both in-person and virtual elements into the learning environment. While the terms 'hybrid' and 'blended' are often used interchangeably, Olapiriyakul and Scher (2006) mentioned that there are subtle distinctions. Hybrid courses differ in that their online components are strategically designed to replace a portion of face-to-face class time (Linder, 2017). Hybrid learning is planned to offer teaching that is equally balanced between online learning and face-to-face learning. The difference between blended and hybrid is based primarily on the proportion of face-to-face and online sessions and/or instructional material in

each course. A hallmark of any good hybrid course is the seamless integration of online and face-to-face activities. This integration necessitates a thoughtful focus on the student experience, so students are presented with engaging material and prompted to interact with it in innovative ways. The possibilities of how students interact with content and with each other are greatly expanded in a hybrid course because just having them read articles online and then meeting to discuss these in class takes no real advantage of a class format that can otherwise be a transformative experience. In the more than 10 years that hybrid learning has been widely practiced, numerous studies have been done on its effectiveness. The results showed that not only do students tend to prefer hybrid learning, but the learning outcomes and academic achievements are stronger for hybrid learning than for either face-to-face or online learning alone (College of Dupage, 2015).

The University of Wisconsin-Bothell's Learning Technology Center offered the following helpful insights: adaptation from (College of Dupage, 2015).

- The instructor of a hybrid course typically determines which instructional activities should be online or face-to-face, depending on the learning goals, course objectives, content, and available resources.
- The instructor lectures and facilitates class discussions in the face-to-face classes, students complete online assignments based on these classroom activities, and then these online assignments are posted to asynchronous discussion forums for online discussion.
- An instructor places lectures online using voice-over PowerPoint or streaming media for students to review, and then in class, students use these preliminary online materials to engage in face-to-face small group activities and discussions.
- Students prepare small group projects online, post them to discussion forums for debate and revision, and then present them in the face-to-face class for final discussion and assessment.
- A typical practice is for an instructor to meet with the class face-to-face for a couple of weeks and then go online for a week or how the class might see fit. This should be an open discussion.

Linder (2017) further delineated hybrid teaching as a pedagogical approach that harnesses technology to offer students diverse learning experiences. Through hybrid learning, students who are unable to physically attend classes can participate synchronously in the virtual

classroom via online platforms. This simultaneous engagement in face-to-face and online instruction offers flexibility and accessibility by catering to diverse student needs and preferences. An added advantage to this approach is how courses are taught, how students can engage with material and demonstrate learning, and how they interact with each other and the instructor. Whereas with face-to-face or online instruction, one format is chosen and used exclusively, and thus cut off from the benefits of the other, hybrid learning can offer the best of both in one unified experience.

The hybrid model proves particularly advantageous for students residing in different geographical locations or those balancing part-time studies with full-time employment. Beyond the typical benefits of blended courses, such as enhanced flexibility and accessibility, hybrid learning alleviates the need for frequent travel to physical classrooms. Studies also suggested that hybrid learning leads to lower rates of attrition and more efficient use of campus resources, especially classrooms and parking (College of Dupage, 2015). Consequently, students can engage with coursework at their own pace and convenience, empowering them to learn where it suits them best.

2.8.4 Face-to-Face Learning

Face-to-face learning is widely regarded as the traditional method of education and typically occurs in physical classrooms where students and teachers interact directly. Historically, African universities have relied on this approach (Cuban, 1986; Mgqwashu, 2017). This method often overlooks individual learning experiences because lectures are delivered through traditional means such as textbooks, discussions, and chalkboards. Challenges such as student protests and pandemics can hinder access to physical classrooms (Mpungose, 2020). Despite these challenges, face-to-face education offers immediate resource access, peer interaction, and prompt feedback during structured contact hours (Black, 2010). This mode of teaching allows for real-time engagement that can be challenging to replicate online. It facilitates dynamic discussions, group work, presentations, and immediate feedback by leveraging visual cues and direct interaction to enhance learning. This setting fosters deeper relationships between students and instructors, creating a strong sense of community that is often difficult to achieve in virtual environments.

2.8.5 Flipped Learning

The flipped classroom, also known as the student-centred approach, entails introducing students to course materials before class to enable them to engage more deeply during class

time (Alexander et al., 2019; Aydin & Demirer, 2022; College of Dupage, 2015). Essentially, this method, supported by blended learning principles, reverses the traditional model of instruction by providing learning materials online for students to access outside of class. It merges typical homework activities into the classroom setting (Ullah et al., 2019). Students gain foundational knowledge through pre-class readings, podcasts, or videos, and then further develop their understanding through in-class activities with the guidance of the instructor. In this way, more time is allocated in the classroom to answer the students' questions and focus on challenging skills, such as solving real-life problems and active learning events (Yean, 2019). According to Bergmann and Sams (2012), the main purpose of the flipped classroom is to maximise the efficiency of time spent on face-to-face in the learning process. In flipped learning, the traditional education is flipped and tasks such as obtaining information are realised by the students before attending the class. The flipped classroom model offers active and social learning opportunities by providing collaborative and interactive learning activities. Therefore, this model is regarded in many studies as based upon active learning theory that depends on a constructivist approach (Cho et al., 2021; Lewis et al., 2018; Williams et al., 2018). The social constructivist approach is particularly taken as the theoretical basis of the flipped classes in different studies (Mehring & Leis, 2018; Moreno-Guerrero et al., 2020). Teachers in flipped classrooms have the role of guidance and provide opportunities for students to learn by experience. Thus, learners have the chance to develop themselves by constructing their knowledge. This approach makes the class time more productive and provides a wide range of practices for creative social learning activities.

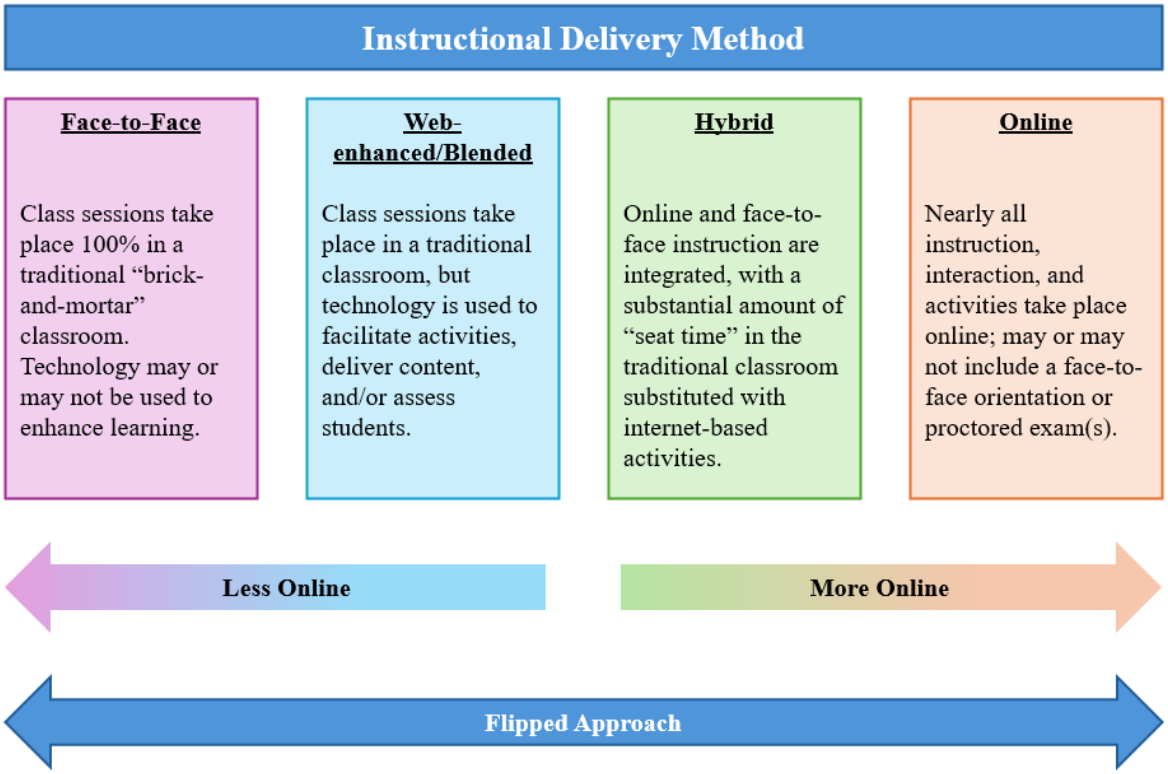


Figure 2.2 Instructional delivery methods (College of Dupage, 2015)

In summary, face-to-face teaching represents a conventional approach to instruction; online teaching and learning occur solely online; blended learning integrates both online and face-to-face delivery methods; and hybrid learning combines in-person instruction with synchronous online learning. Each of these methods may incorporate elements of flipped learning, emphasising a shift towards student-centred education rather than traditional teacher-centred approaches. In comparing these communication synchronies, online learning has a lot to offer, though it carries the stigma of being lower quality than face-to-face learning, despite research showing otherwise. Having discussed the modes of instructional delivery, it is important to examine the digital education affordances for student performance, which is discussed in the next section.

2.9 Affordances of Digital Education for Student Performance

In the context of this study, academic achievement, also known as academic performance, refers to the extent to which a student, teacher, or institution has met their short- or long-term educational objectives. Academic achievement is demonstrated by the completion of educational benchmarks such as diplomas and bachelor's degrees. Considering the contrast outlined in the introductory section between ERT and online and face-to-face teaching and

learning, as well as the common decision-making elements involved in transitioning teaching to the online space, this section delves into the variances in academic performance identified in prior research between face-to-face learning, ERT and online learning.

Academic performance refers to an individual's or a group's achievement and accomplishments within an educational setting, typically measured through various quantitative and qualitative metrics (Hattie & Timperley, 2007). These metrics may include grades, test scores, completion rates, participation levels, research output, critical thinking abilities, problem-solving skills, creativity, and overall mastery of subject matter. Academic performance reflects the effectiveness of learning, understanding, and application of knowledge, as well as the development of relevant skills and competencies within a particular academic discipline or programme (Hattie & Timperley, 2007). It can be influenced by factors such as motivation, study habits, learning environment, teaching quality, socio-economic background, and individual differences in cognitive abilities and learning styles.

ERT differs from previous transitions to mixed, online, or flipped classrooms in that it occurs abruptly and without prior planning as a response to crisis situations. In the abrupt need for universities to resume teaching immediately Gopal et al. 2021) and with no time to design specific learning and assessment systems for the online model (Mielgo-Conde et al., 2021), previous studies reported several losses in learning that led to a decline in students' academic performance, while others reported success in learning leading to an increase in students' academic performance (Hevia et al., 2022).

In cases of ERT, academics are confronted with the responsibility to ensure teaching continues. In many cases, especially during the Covid-19 pandemic, academics were not prepared for any transition. Higher education instructors had to make the necessary changes and adjustments overnight (Crawford et al., 2020). They had to come up with strategies and decisions for supporting asynchronous tools like content management systems, message boards, email, and pre-recorded videos, or synchronous tools such as chat, video conferencing, real-time collaboration systems, and instant messaging. These decisions also entailed modifications in assessment activities or criteria (Santiago Iglesias-Pradas et al., 2021).

Mielgo-Conde et al. (2021) reviewed the online educational guidance during the Covid-19 pandemic in order to examine the scientific literature about online educational guidance. They were guided by the PRISMA model and looked at and analysed a total of 42 articles. They found that academics or instructors were disadvantaged and in a stressful situation as they did

not have the necessary digital training because the change occurred abruptly, without the opportunity to prepare or plan resources and tools for effective teaching. Digital competency became crucial during this period as both educators and students had to rely solely on technology to manage their tasks. The implementation of this teaching exposed the inequalities among the student population. Some students faced significant challenges because they lacked electronic devices or reliable internet connections to effectively engage in e-learning activities. This situation was particularly burdensome for families who had limited access to devices, which are often shared among multiple family members (Ahmed & Firdous, 2020).

Santiago Iglesias-Pradas et al. (2021) examined the transition to ERT in the School of Telecommunication Engineering at the Universidad Politécnica de Madrid. They looked at the effects of organisational changes, instructional variables such as class size and synchronous/asynchronous delivery methods, and the use of digital tools on students' academic outcomes. They used both quantitative data from academic records across 43 courses in a Telecommunication Engineering bachelor's degree programme and qualitative insights from a questionnaire distributed to 43 course coordinators. The authors compared students' academic performance during the Covid-19 pandemic to that of the previous years. The findings suggested a positive trend in students' academic achievements during ERT, highlighting the potential influence of organisational factors on the successful implementation of this teaching approach, which further indicates that students' overall academic performance under emergency remote conditions was significantly better than that of traditional face-to-face instruction (Santiago Iglesias-Pradas et al., 2021). Santiago Iglesias-Pradas et al. (2021) further highlighted that the academics did not have a problem transitioning from conventional teaching to ERT, but that the problem was the adaptation time. During the pandemic, they were given a short time to familiarise themselves with the use of new digital tools and the changes in the learning processes. The authors underscored the importance of ongoing training for using digital educational tools and integrating them into traditional practices in order to ease transitions during times of crisis.

Gonzalez et al. (2020) investigated the impact of Covid-19 lockdown measures on the self-directed learning outcomes of higher education students. Their study is relevant to the third sub-research question of the current study because it compares the results or performance of the students before and after the pandemic era. The study was conducted through a field experiment involving 458 students across three different disciplines at the Universidad Autónoma de Madrid (Spain), and the authors examined variations in performance by dividing

students into two distinct groups. The first group comprised students from academic years 2017/2018 and 2018/2019, and the second group comprised students from 2019/2020 who experienced interruptions to their face-to-face activities due to the lockdown. Their results demonstrated the significant positive effect of the Covid-19 lockdown on students' academic performance. Notably, this effect remained significant even for activities that maintained their original format post-lockdown. Furthermore, the study revealed the significance of this effect across subjects with both increased and unchanged assessment activities, as well as those with consistent student workloads. Additionally, an analysis of students' learning strategies prior to the lockdown indicated a lack of continuous study habits. Consequently, based on these findings, the authors concluded that the Covid-19 lockdown altered students' learning approaches to more consistent patterns, ultimately enhancing their overall efficiency.

An alternative perspective is presented through meta-analyses. Current meta-analytic studies generally upheld the notion that either students' academic performance, indicated by final course grades, in online learning surpasses that in face-to-face courses, or there are negligible disparities between the two modalities. For example, Shachar and Neumann (2010) conducted a meta-analysis research and estimated and compared the differences between the academic performance of students enrolled in distance education courses in relation to those enrolled in traditional settings, as demonstrated by their final course grades/scores, over a 20-year period from 1990 to 2009. The authors discovered that distance education students excel in comparison to face-to-face students. Jahng et al. (2007) conducted a meta-analysis and examined research from 1995 to 2004 to compare student performance in online distance education and face-to-face education (Borenstein, 2021). The aim was to understand how technological advancements impacted student achievement in online distance education over the past decade. They found that when comparing the average effect size of student achievement, there was no significant difference between online distance education and face-to-face education. Meanwhile, Means et al. (2013) conducted a meta-analysis to statistically combine research that compared learning outcomes between entirely online or hybrid learning environments and face-to-face classroom education. The meta-analysis revealed that, on average, students in online learning environments achieved somewhat better results compared to those who received face-to-face instruction. They found a considerable advantage of mixed learning over traditional face-to-face teaching and learning, but not for solely online instruction compared to face-to-face instruction.

2.10 Technology Enabled Assessment

Digitalisation meant the integration of digital technologies into every area of education, such as online courses, virtual classrooms, and digital textbooks incorporating e-assessments, also known as technology enhanced or technology enabled assessments. E-assessment is a complementary component of technology enabled education (Mackenzie, 2019). Technology enabled assessments cover the use of a computer in any activity linked to assessment, be it summative, formative, or diagnostic assessments (Jordan, 2013). This involves activities such as submitting assignments online for evaluation by a human, assessing e-portfolios or reflective blogs, providing feedback through audio files recorded on a computer, and conducting online computer-marked quizzes. It is the use of digital tools and platforms to evaluate learners' knowledge, skills, and competencies. As educational technology advances, e-assessments are becoming increasingly prevalent in both academic and professional contexts (Jordan, 2013). Therefore, it is important to discuss the alignment of assessment, teaching and learning, benefits, and challenges as well as the academic integrity of technology enabled assessments.

2.10.1 Alignment Between Assessment, Teaching and Learning

Technology enabled assessment is gaining popularity. Assessment is widely recognised as a key driver of student development. It is commonly acknowledged that assessing student achievements requires appropriate systems, and therefore, alignment between these systems and teaching and learning is critical to ensure the evaluation of students is not burdensome to academics and students. According to Ashton and Thomas (2019), the interconnection between assessment, teaching and learning is unquestionable. Technology enabled assessment or e-assessment in education is still a challenge. Its main purpose is to enhance efficiency and lower expenses by replicating the features and rationale of traditional assessments. However, the emphasis has been on automating tasks that are straightforward to execute rather than on measuring what truly needs to be evaluated. Consequently, this approach fails to enhance the alignment between learning and assessment.

In addressing the misalignment between assessment, teaching and learning, Ashton and Thomas (2019) considered the possibility of assessing the application of knowledge rather than its acquisition. Their findings revealed key issues such as design, accessibility and security that must be taken into consideration. To address the educational demands of the 21st century, assessment must encompass the essential skills required for 21st century learning, including self-assurance, effective communication, collaboration, and critical thinking. Furthermore,

assessment should facilitate learners' examination of their own learning and should align with constructivist approaches of learning (Ashton & Thomas, 2019).

2.10.2 Benefits and Challenges of Technology Enabled Assessment

Jordan (2013) and Mackenzie (2019) explored the features of the e-assessment system and mentioned that some computer-based formative assessments offer the following benefits; Immediate and equally detailed feedback to students; interactive delivery responses and guidance to students to enable students to collaborate on assignments or projects; enable students to repeat the test and check their understanding to prepare for future study; and resource saving. In addition to improved reliability, computerised assessment can result in time and resource savings (Dermo, 2019).

As much as there are benefits that comes with technology enabled assessments, there are challenges around lack of secured or reliable networks and plagiarism with summative assessments. The following has been highlighted as challenges with technology enabled assessments: Passwords collaboration and collusion among students; cheating; impersonation; item banking requiring more effort and time; instructors' lack of technical expertise; lack of immediate technical support; instructors struggling to move away from traditional task types; issues of task design; lack of agreed and enforced institutional policy on e-assessment; discrimination against 'non-digital native' students; limited availability of internet-connected computers at home, in halls of residences, and on campus; lack of availability of large computer rooms for examinations; lack of clear roles for technical services, administration, support services and departments (Ashton & Thomas, 2019; Dermo, 2019; Jordan, 2013; Mackenzie, 2019).

The following are recommended as strategies to effectively manage e-assessments: Randomising the questions selection and question content or methods of assessments; the capability of recording detailed results; reliable and secured systems through various methods; continuous recording of data to mitigate against machine or network failures; tutor moderation to monitor performance; and proving informative feedback on student and question performance to tutor for future improvements (Ashton & Thomas, 2019; Dermo, 2019; Mackenzie, 2019). In addition, Mackenzie (2019) mentioned that it is important to use technology not only to compute and evaluate assessments but also to enhance the quality of questions. One way to achieve this is by employing machine learning techniques to create answer-matching rules based on analysed student responses to short-answer free-text questions

(Jordan, 2013). However, Jordan (2013) argued that the use of computers should be limited to situations where it is suitable and suggested that a combination of different approaches may be more efficient at times. The author advocated for the use of computers to perform tasks that they excel at, such as alleviating human markers from the monotonous aspects of marking and allowing them to dedicate their time to evaluating aspects that require their unique expertise and authenticity. However, this does not help with learning continuity in cases of learning interruptions such as protest and pandemic situations. Perhaps research still need to be conducted on effective technology enabled assessments for summative assessments.

2.10.3 Academic Integrity of Technology Enabled Assessments

The Covid-19 pandemic necessitated the swift incorporation of digital tools and technologies for various methods of assessment in higher education because of the implementation of ERT and online learning (Neto et al., 2022; Villarroel et al., 2020). The urgent and swift incorporation of ICTs in assessment potentially jeopardised academic integrity in these assessments. This can be ascribed to the universities' lack of readiness for academic disruptions. Hussein et al. (2020) found that although remote teaching and learning can be effectively conducted, doing e-assessments is accompanied with significant challenges and risks. It is important to ensure academic integrity during e-assessments (Coniam et al., 2021; Dermo, 2019; Jordan, 2013).

Although remote education maintained the continuity of teaching and learning, it is also important to acknowledge the moral and ethical challenges that arose from academic integrity infractions. The integration of digital technologies into academic activities and assessments has consistently been associated with potential electronic cheating (Coniam et al., 2021; Dermo, 2019; Holden et al., 2021; Jordan, 2013). Previous research consistently showed that remote instruction amplifies the difficulties associated with cheating, plagiarism, and procrastination (Ashton & Thomas, 2019; Dermo, 2019; Jordan, 2013; Mackenzie, 2019). The allure of academic integrity violations among students is more prevalent in virtual environments than in traditional learning spaces Abdulhafeez et al. (2013), indicating that students have been more likely to engage in unethical behaviour during ERT periods. ERT may have worsened the situation because universities may not have developed sufficient ways to assess students' learning in distant settings while maintaining academic integrity.

2.10.4 Integration of Artificial Intelligence into Education

The integration of AI into education, particularly in technology enabled assessments, raises important considerations for academic integrity. AI can enhance the assessment process by providing personalised feedback, automating grading, and identifying patterns in student performance (Muhammad Tahir et al., 2024). However, it also introduces challenges related to maintaining academic honesty and preventing cheating.

AI can streamline the assessment process by automating grading and providing real-time feedback, allowing educators to focus more on teaching and less on administrative tasks (Muhammad Tahir et al., 2024). AI-driven tools can analyse student performance data to identify areas where students may need additional support, thereby personalising learning experience (Abbas et al., 2023). However, the use of AI in assessments must be carefully managed to prevent academic dishonesty. This includes implementing strong authentication methods to ensure the student taking the assessment is the one enrolled in the course (Harry, 2023; Muhammad Tahir et al., 2024). AI can also be used to detect plagiarism and other forms of cheating by analysing patterns in student submissions and comparing them to a database of known sources. It is crucial to ensure AI algorithms used in assessments are transparent and fair. This involves regularly auditing the algorithms to check for biases and ensuring they provide equitable outcomes for all students (Conijn et al., 2023). Educators should be trained to understand how AI tools work and how to interpret the results they provide, ensuring that they can effectively use these tools to support student learning. Institutions should develop clear policies and guidelines for the use of AI in assessments by outlining the responsibilities of both educators and students in maintaining academic integrity.

In summary, the shift to digital assessments, accelerated by the Covid-19 pandemic, has raised concerns about academic integrity because remote learning environments can exacerbate issues like cheating and plagiarism (Coniam et al., 2021; Hussein et al., 2020). While e-assessments offer significant advancements, such as flexibility and real-time feedback, they also require careful management of technical, infrastructural, and ethical challenges to ensure their effectiveness and maintaining academic standards. It is important to note the challenges AI introduces and address them meticulously to maintain academic integrity and ensure fair and equitable outcomes for all students (Abbas et al., 2023; Conijn et al., 2023; Harry, 2023; Muhammad Tahir et al., 2024).

The efficacy of digital technology enabled education depends on sufficient and effective infrastructural resources, pedagogical approaches and technological affordances. Some of these investments require the government's participation. To alleviate poverty, the government should prioritise equitable digital education for all students, therefore it is important to discuss the SDGs next.

2.11 Sustainable Development Goals

The 2030 Agenda for Sustainable Development, embraced by all United Nations (n.d.) members in 2015, introduced 17 global SDGs. These goals aim to foster "peace and prosperity for all people" by addressing poverty and other forms of deprivation, while also promoting strategies to enhance health and education, mitigate inequality, and stimulate economic growth. These SDGs are the following: (United Nations, n.d.)

1. No poverty
2. Zero hunger
3. Good health and wellbeing
4. Quality education equality
5. Gender equality
6. Clean water and sanitation
7. Affordable and clean energy
8. Decent work and economic growth
9. Industry, innovation and infrastructure
10. Reduced inequalities
11. Sustainable cities and communities
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Peace, justice, and strong institutions
17. Partnerships for the goals

Despite these lofty objectives, reports and results showed a difficult journey. The achievement of the goals by 2030 is highly improbable due to the escalating disparities, climate change, and loss of biodiversity, which are significant challenges impeding development. As we reach the midpoint of the 2030 Global Development Plan, South Africa continues to face the pressing

issues of poverty, inequality, unemployment, and the destructive impacts of climate change (Statistics South Africa, 2023). The Covid-19 pandemic worsened these difficulties by highlighting disparities in schooling, with certain pupils being able to sustain their learning while others were disadvantaged because of limited resources. The most severe consequences of the Covid-19 pandemic were experienced by socioeconomically disadvantaged parts of the population.



Figure 2.3 SDG 1

In relation to this study, only SDG 1 and SDG 4 are discussed in detail. SDG 1 focuses on eradicating poverty to eliminate all manifestations of extreme impoverishment, including deficiencies in access to essential resources such as food, clean water, and sanitation. A key strategy towards realising this objective involves fostering equitable access to education, thereby addressing socio-economic challenges, and fostering sustainable progress.



Figure 2.4 SDG 4

SDG 4 focuses on quality education to achieve universal access to quality education to ensure education is inclusive, equitable, and conducive to lifelong learning opportunities for all individuals. Key indicators for this goal include primary school attendance rates, completion rates for primary education, and participation rates in tertiary education. These metrics are assessed through parity indices to safeguard against the marginalisation of disadvantaged student populations. Additionally, South Africa has inadequate school facilities, including access to essential amenities such as electricity and internet. Most students in rural areas do not have access to resources and are unlikely to afford university education. Ensuring quality education for all is a multifaceted endeavour that requires comprehensive strategies and sustained efforts from governments. Governments should prioritise allocating sufficient financial resources towards education, including funding for infrastructure, teacher salaries, instructional materials, and educational programmes. Adequate funding is essential to maintain high-quality educational standards. Governments must work towards eliminating barriers to education and ensuring equitable access for all students, regardless of their socio-economic background, geographical location,

gender, ethnicity, and disability status. This includes providing financial assistance, scholarships, and other forms of support to disadvantaged students, implementing inclusive policies and accommodations for learners with special needs, and finally, leveraging technology to enhance the quality and accessibility of education. Governments should invest in digital infrastructure, provide access to computers and the internet, and integrate technology into teaching and learning processes. This includes using online learning platforms, educational software, multimedia resources, and virtual classrooms to supplement traditional instructional methods and facilitate personalised learning experiences.

The South African president mentioned that South Africa has achieved significant progress in enhancing the wellbeing of its population by allocating more funds to essential services and social welfare, expanding the availability of high-speed internet and achieving a noteworthy decrease in carbon dioxide emissions (Statistics South Africa, 2023). The president also mentioned that in the face of the difficulties presented by a world recovering from the pandemic and growing environmental dangers, South Africa will persist in pursuing a comprehensive development plan to tackle poverty and inequality by promoting inclusive social and economic progress, addressing unemployment through the creation of jobs, enhancing the capabilities of the state, expanding investment opportunities and economic growth, and ensuring human dignity and security for all.

2.12 Concluding Remarks

This chapter reviewed extensive regional and global literature on the transition from face-to-face learning to ERT and online learning. It used case studies from various universities to extract lessons on resilience and innovation in higher education during the pandemic. The discussion covered the effectiveness of digital technology in education, the digitalisation of instructional delivery methods, the impact of digital education on student performance, technology enabled assessments, and the alignment with SDGs. The next chapter delves into the theoretical frameworks that underpinned this study.

CHAPTER 3: THEORETICAL FOUNDATION

3.1 Chapter Overview

The preceding chapter provided a review of the literature that informed this study. This study was underpinned by the CoI framework proposed by Garrison et al. (1999). The chapter presents empirical and theoretical research about the origin and evolution of CoI, reflections on studies that were underpinned by the CoI frameworks, an examination of the frameworks, the gaps in the frameworks, and the development of the framework.

3.2 Community of Inquiry Framework

The CoI framework theory, methodology, and instruments were created as part of a research project by (Garrison et al., 1999). The initial study focused on developing a model of a CoI that consists of three fundamental components of an educational experience, namely cognitive presence, social presence, and teaching presence (Garrison et al., 1999). The results of the initial project Garrison et al. (1999) were documented in scholarly journals, leading to several subsequent research investigations that used and expanded on the original CoI theory, methodology, and tools.

3.3 Reflections on the Community of Inquiry Framework

Before discussing other scholars' perspectives of the CoI framework, this section briefly recaps Garrison's interview on *The Reflective Teaching in a Digital Age* podcast (Garrison, 2020). Garrison talked about the origins of the CoI paradigm and its importance to build effective online education. He emphasised that the CoI paradigm, which was developed over two decades ago, seeks to generate meaningful collaborative-constructivist learning experiences through the three interrelated components of social presence, cognitive presence, and teaching presence (Garrison et al., 1999).

Garrison et al. (1999) noted that CoI was created to ensure online education met the same standards as traditional face-to-face instruction, especially for working professionals pursuing master's degrees. The framework encourages active student participation and collaboration through asynchronous interaction, allowing students to read, reflect, and contribute. Garrison observed that the CoI is most effective in smaller class sizes, usually about 20 students, because bigger groups can impede interaction. He defined social presence as encouraging trust and open communication, cognitive presence as facilitating collaborative research, and teaching presence as critical to guiding and sustaining the learning community. Teaching presence

entails fostering a collaborative learning atmosphere and emphasising student responsibility for their own learning, such as self-evaluation and active engagement. Figure 3.1 shows the CoI model.

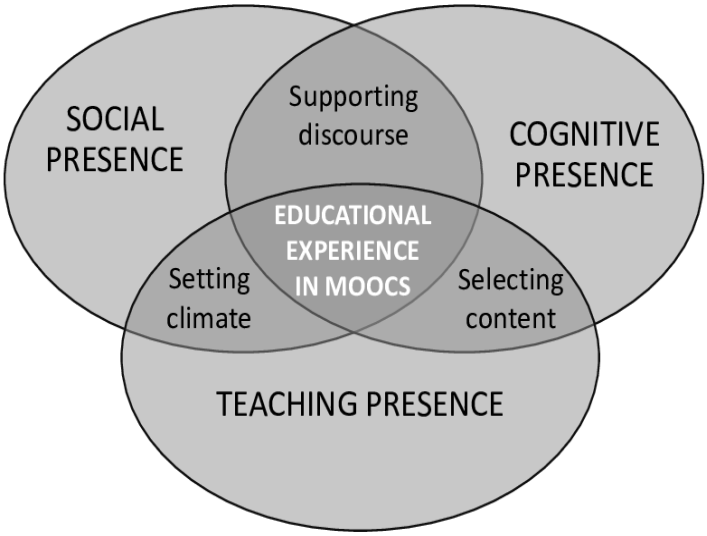


Figure 3.1 The original CoI model by Garrison et al. (1999)

Garrison et al. (1999) emphasised that while graduate students adapt well to collaborative learning, undergraduates also benefit from such techniques. He advocated for evaluating individual performance rather than group outcomes and emphasised the need for pre-planning learning materials and providing technical support. Garrison also addressed the practicality of teaching all topics online, stating that while practical subjects such as sciences present obstacles, a well-designed curriculum and simulations can address these issues. He concluded that, with the necessary adaptations, the CoI model can be applied for a variety of educational environments.

3.4 Examining Community of Inquiry Framework

The next section presents a summary of the findings of research studies that used the CoI as a theoretical framework or focused on one or more presence of the framework to explore the dynamics of online and blended learning.

3.4.1 "Learning Presence: Towards a Theory of Self-Efficacy, Self-Regulation, and the Development of a Communities of Inquiry in Online and Blended Learning Environments" (Shea & Bidjerano, 2010)

Shea and Bidjerano (2010) analysed the CoI framework proposed by Garrison et al. (1999), and posited that the model may be improved by a more comprehensive delineation of online

learners' roles. The authors reported the findings of a study, involving 3 165 students enrolled in online and hybrid courses across 42 two- and four-year institutions, that investigated the correlation between learner self-efficacy measures and their evaluations of learning quality in virtual settings. They determined that a positive correlation existed between components of the CoI framework and elements of learning presence. The authors additionally proposed that learning presence encompasses factors such as self-efficacy, along with other cognitive, behavioural, and motivational elements that facilitate online learner self-regulation. The researchers stated that an additional presence is necessary because effective learning requires the presence of the learner. Learners enhance knowledge building in technology-mediated environments, hence augmenting the descriptive and explanatory capacity of the CoI framework (Shea & Bidjerano, 2010). Figure 3.2 shows Shea and Bidjerano's revised CoI model.

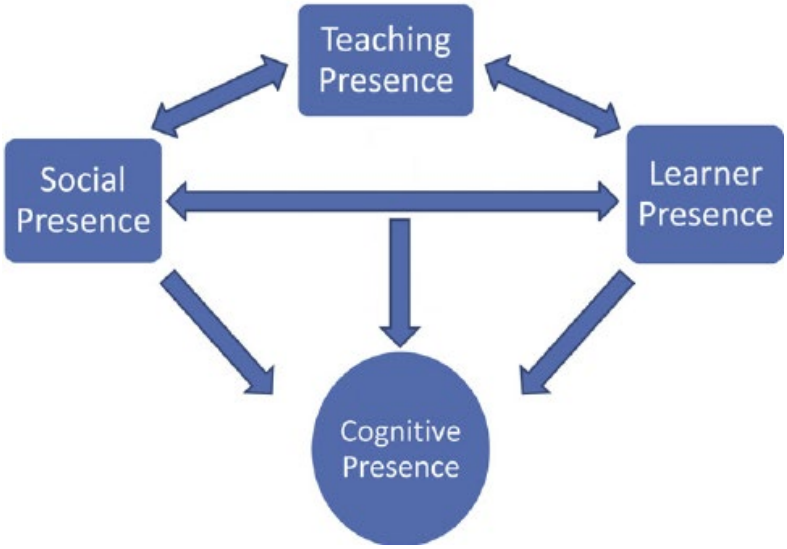


Figure 3.2 Revised CoI model by Shea and Bidjerano (2010)

3.4.2 "How Communities of Inquiry Drive Teaching and Learning in the Digital Age" (Anderson, 2017)

Anderson (2017) explored the current state of CoI in teaching and learning in the digital age, including the technology to support learner presence (Shea & Bidjerano, 2010) and personal learning environments. Anderson also argued for the CoI model to evolve into a learning model that recognises the importance of motivation, self-efficacy and personal skills in effective CoI. Anderson (2017) reflected on the key insights from the CoI model and speculated on its future developments. According to Anderson (2017), the current CoI model's biggest flaw is that while it aids in the construction and definition of an effective teaching model, it ignores the

fact that the effectiveness of teaching is equally dependent on the learners. Anderson agreed that a new presence, the learner presence, should be added to the framework. The author mentioned that the model is robust enough to be useful when applied to a variety of intercultural contexts and technologies used to support distributed learning, such as blogs (Angelaina & Jimoyiannis, 2012), immersive reality systems (McKerlich & Anderson, 2008), synchronous technologies (Fayram, 2014), and MOOCs. Research showed results of model implementation in practice and detailed associated challenges, including technological issues, lack of familiarity, less than enthusiastic adoption, and how the absence of one of the presences, especially effective teaching presence, can decrease the efficacy of the learning (Anderson, 2017). In the researchers view, the inclusion of technological tools and synchronous technologies makes it necessary to integrate the technology factor into the existing framework. For effective teaching and learning to occur, there ought to be technology ubiquity for all students. The continuing popularity of the CoI model through different technologies shows that group-based learning is still highly valued and the most common way for young people to engage in both formal and informal learning. However, we expect the future to see increasing opportunities to develop and benefit from networks and set models that are based upon ubiquitous and increasingly powerful and flexible digital networks. For this to exist, robust infrastructures must be in place.

In addition, Anderson (2017) indicated that over the past two decades, the framework has also seen the call for additional presences to describe the educational experience. These include vicarious presence emotional presence (Cleveland-innes & Campbell, 2012) and autonomy presence (Lam, 2015). Anderson (2017) mentioned that there have been efforts to expand the social presence category in the CoI model to include affective association, emotional presence, community cohesion, instructor involvement, interaction intensity, and knowledge and experience (Whiteside, 2015). However, the author argued that each of these already exists in the original model. According to Anderson (2017), the biggest concern with the existing CoI model is that while it helps construct and define an effective teaching model, the effectiveness of teaching is equally dependent on the learners. Thus, Anderson supported the addition of a learner presence as described and measured by (Shea & Bidjerano, 2010).

3.4.3 "Exploring Communities of Inquiry in Massive Open Online Courses" (Kovanović et al., 2018)

Kovanović et al. (2018) provided an assessment of the CoI survey instrument created by Arbaugh et al. (2008) and assessed within the framework of MOOCs. The findings confirmed the reliability and validity of the CoI survey instrument to evaluate the essential elements of the CoI model, namely teaching presence, social presence, and cognitive presence. Kovanović et al. (2018) incorporated three elements pertaining to the resolution phase of cognitive presence and course organisation and design within teaching presence, and affective communication within social presence. The authors asserted that the disparities in factor structure arose from the notable pedagogical distinctions between conventional online courses and MOOCs, highlighting the distinctive attributes of MOOCs in fostering communities of research. Although this paradigm is regarded as peculiar to the MOOC setting, the researcher believed it remains insufficiently inclusive to address the needs of South African students impacted by inequality and a lack of other essential elements that facilitate seamless digital technology education. Figure 3.3 shows how the model was adapted.

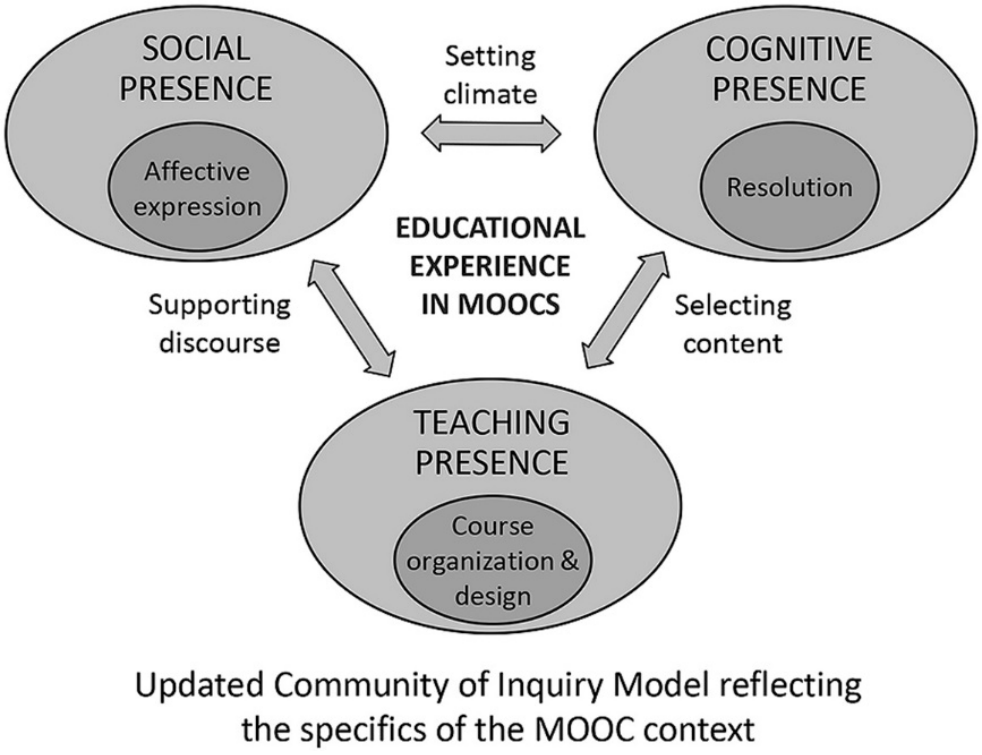


Figure 3.3 CoI specific for MOOCs (Arbaugh et al., 2008)

3.4.4 "20 Years of the Community of Inquiry Framework" (Castellanos-Reyes et al., 2020)

Castellanos-Reyes et al. (2020) presented the CoI as a collaborative-constructivist process model that delineates the fundamental components of an effective online higher education learning experience (Garrison, 2017). This approach comprises three components, known as presences, namely cognitive presence, social presence, and teaching presence. Cognitive presence, as defined by Castellanos-Reyes et al. (2020), pertains to the degree to which learners can develop knowledge through discourse and reflection. The absence of connectedness and limited collaboration was a criticism of computer-mediated communication. To counter this criticism, social presence fosters a collaborative online learning environment. Castellanos-reyes et al. (2020) defined social presence as the capacity of learners to experience an emotional connection with peers and to perceive their complete personality through computer-mediated communication (Garrison et al., 1999; Garrison & Kanuka, 2004). Teaching presence, as articulated by Castellanos-Reyes et al. (2020), involves facilitating and overseeing tasks. The authors appear to have employed the CoI model without alterations, suggesting that the framework was pertinent and facilitated the attainment of their goals. This study was conducted in the setting of North Carolina, United States.

3.4.5 "A Re-examination of the Community of Inquiry Framework: Social Network and Content Analysis" (Shea & Bidjerano, 2010)

Shea and Bidjerano (2010) evaluated the CoI framework and raised conceptual and methodological problems. Their objective was to enhance research in online learning and the evolution of the CoI model by employing innovative conceptual and methodological instruments. The authors indicated that this research lacked an effort to verify predictions derived from prior studies that showed online knowledge building through the interplay of all model components. This avenue of investigation has notably lacked 'learning', or more importantly, "deep and meaningful learning", which is the presumed objective of all higher education. Prior studies (Garrison et al., 1999; Garrison & Kanuka, 2004) indicated that students enrolled in online courses frequently fail to attain advanced levels of cognitive presence, specifically integration, application, and resolution. Consequently, it was essential for them to rectify these deficiencies and voids in the research. This paper examined assumptions derived from current theoretical research concerning the evolution of knowledge

building within the CoI framework (Shea & Biderjano, 2009). This research was done at the State University of New York.

Shea and Bidjerano (2010) concurred with the inclusion of learner presence as it pertains to the learning experience, with learners being the end outcome. The model's performance was assessed through the learners' achievement in the educational process. The researcher disagrees with Cleveland-Innes and Campbell (2012) on the inclusion of emotional presence and autonomy presence and contended that these two components are encompassed by the existing cognitive presence. Cognitive presence, as defined by Garrison et al. (1999) refers to the collaborative learning approach and inquiry process that manifests when a student asserts, 'I can accomplish this with ease'. Shea and Bidjerano (2010) state that it is unsurprising that the CoI elements correlate with student outcomes in online education, and specifically, the CoI presences are associated with outcomes such as satisfaction and actual learning in this context.

3.4.6 "Designing a Community of Inquiry in Online Courses" (Fiock, 2020)

Fiock (2020) proposed a pragmatic approach for integrating instructional techniques into an online course to cultivate a CoI. The author introduced the CoI framework via a literature review that focused on CoI teaching approaches. The author structured CoI instructional exercises according to Sorensen and Baylen's (2009) seven principles of effective practice. Fiock (2020) contended that while the presence of CoI is important, it is inadequate for educators or instructional designers who lack explicit guidance on fostering it in online environments. The author presented the subsequent instructional methods for each presence: Student-teacher interaction, collaboration among students, active learning, timely feedback, engagement in tasks, articulation of high expectations, and acknowledgement of multiple learning modalities (Sorensen & Baylen, 2009).

3.4.7 "Interactivity, the Heart and Soul of Effective Learning: The Interlink Between Internet Self-Efficacy and the Creation of an Inclusive Learning Experience" (Dlamini, 2023)

Dlamini (2023) emphasised the significance of active engagement in the prevalent learning environment. The author proposed the development of CoI as an intellectual framework that facilitates educators' implementation of digital education. The author developed multiple presences, as illustrated in Figure 3.4, to facilitate interaction and reflection within a socio-epistemological framework. This study aimed to gather pertinent facts regarding digital education and to understand its practical implications. While the author examined significant

challenges related to digital devices, digital capital, and digital fluency among academic staff and students, it neglected impoverished students lacking access to these resources, thereby further marginalising historically disadvantaged individuals. However, the study addressed staff with a lack of online instructional design principles and the digital capital necessary for developing digital educational resources to facilitate the transition to digital education.

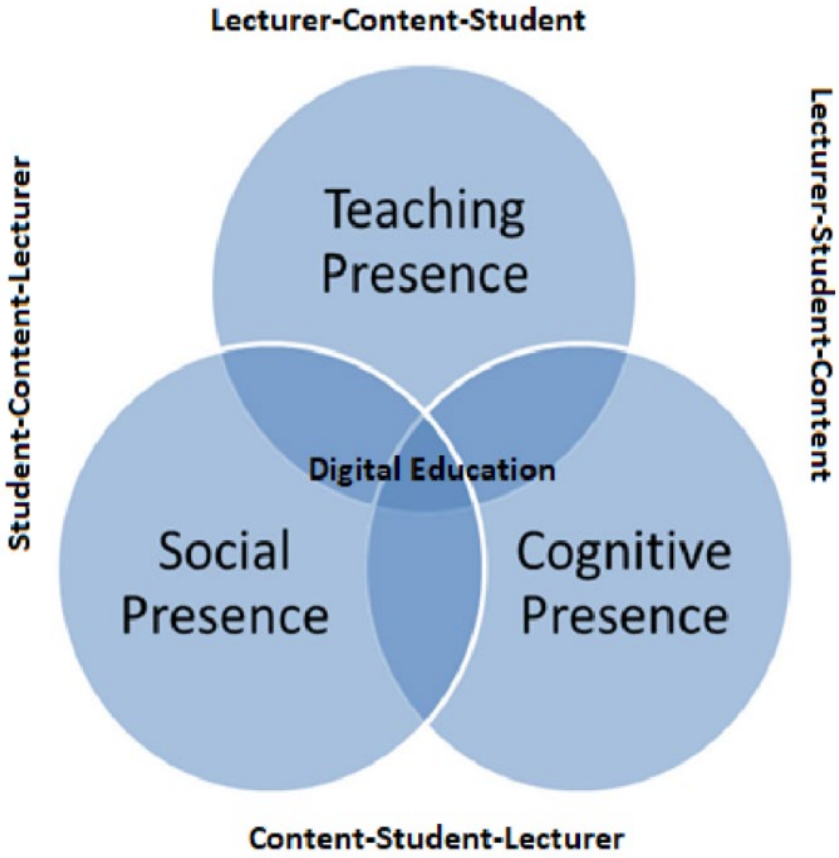


Figure 3.4 Interaction in a teaching and learning community (Dlamini, 2023)

3.4.8 Gaps in the Existing Theorical Frameworks

This research was conducted through the lens of the CoI framework; however, the framework presents gaps and limitations for inclusive and equitable digital education for South African HEIs. Table 3.1 shows the gaps presented by the scholars that have used CoI as the lens for their research.

Table 3.1: Gaps from the existing theorical frameworks

Research Title	Authors	Methodology	Identified Gap
"Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education"	Garrison et al. (1999)	Different units of analysis were used. Academics and undergraduate students were sampled. The study adopted a qualitative research method.	The CoI framework does not explicitly address the socio-economic barriers that impact students' ability to engage in online learning environments. The CoI framework assumes the availability of basic infrastructure, which is not always present in rural South African contexts.
"Learning Presence: Towards a Theory of Self-Efficacy, Self-Regulation, and the Development of a Communities of Inquiry in Online and Blended Learning Environments"	Shea and Bidjerano (2010)	Quantitative research method with closed-ended questions	The study adapted the CoI framework to include learner presence, however their revised model does not address the South Africa context. While this model emphasises self-regulation and self-efficacy, it does not sufficiently address the need for additional support systems that are crucial for student success in disadvantaged contexts.
"How Communities of Inquiry Drive Teaching and Learning in the Digital Age"	Anderson (2017)	Systematic review	The study emphasises the importance of technology to support learner presence and personal learning environments. However, the assumption of ubiquitous technology access does not hold true for many South African students, leading to significant educational inequalities. The CoI model and its proposed evolutions do not explicitly address the socio-economic barriers that impact students' ability to effectively engage in online learning environments. This oversight can hinder the model's applicability in contexts where students face significant financial and social challenges. The model's robustness in intercultural contexts is mentioned but there is a lack of specific guidance on how to accommodate diverse cultural and linguistic backgrounds in online learning. This can affect students' sense of belonging and engagement, particularly in a diverse country like South Africa.

Research Title	Authors	Methodology	Identified Gap
			The CoI model emphasises the importance of teaching presence and learner presence but does not sufficiently address the need for additional support systems that are crucial for student success in disadvantaged contexts. This gap can limit the effectiveness of the model in supporting students who require more comprehensive support. The CoI model assumes the availability of basic infrastructure, which is not always present in rural South African contexts. This assumption can limit the model's applicability and effectiveness in these areas.
"Exploring Communities of Inquiry in Massive Open Online Courses"	Kovanović et al. (2015)	EFA	The researchers added three factors related to the resolution phase of cognitive presence, course organisation and design to teaching presence, and affective communication to social presence, but, the model is not relevant for the South African HEIs context.
"20 Years of the Community of Inquiry Framework"	Castellanos-Reyes et al. (2020)	Content analysis	Cognitive presence: Students in marginalised areas may have limited opportunities for meaningful discourse and reflection due to lack of access to collaborative tools and resources. The development of knowledge through discourse and reflection may be hindered by socio-economic and infrastructural barriers. Social presence: Students in rural and marginalised areas may struggle to establish emotional connections with peers due to limited access to technology and social platforms. Creating a collaborative online learning environment is challenging when students lack the necessary tools and resources. Teaching presence: Teachers in marginalised areas may lack the training and resources to effectively facilitate and oversee online learning. Providing adequate support and guidance to students in rural areas is challenging due to infrastructural and resource constraints.

Research Title	Authors	Methodology	Identified Gap
"A Re-examination of the Community of Inquiry Framework: Social Network and Content Analysis"	Shea and Bidjerano (2010)	Mixed methods (social network analysis and quantitative content analysis)	Access to technology and internet connectivity: Poor infrastructure in these areas limits the ability to effectively implement and sustain online education. Socio-economic barriers: Students from impoverished backgrounds may struggle to afford the costs associated with online learning, such as data, devices, and other learning materials.
"Designing a Community of Inquiry in Online Courses"	Fiock (2020)	Literature review	The study assumes that students have access to the necessary technology to participate in online courses. This assumption does not hold true for many South African students, leading to significant educational inequalities. The instructional techniques proposed do not explicitly address the socio-economic barriers that impact students' ability to effectively engage in online learning environments. This oversight can hinder the model's applicability in contexts where students face significant financial and social challenges.
"Interactivity, the Heart and Soul of Effective Learning: The Interlink Between Internet Self-Efficacy and the Creation of an Inclusive Learning Experience"	Dlamini (2023)	Concept paper	It emphasises the importance of internet self-efficacy and active engagement in digital education but does not adequately address the lack of access to digital resources for impoverished students. This oversight further marginalises historically disadvantaged individuals who are unable to fully participate in digital learning environments.

3.4.9 Summary of Gaps identified in this study

The following section presents gaps that emanated from the CoI framework which led to the need of the development of the conceptual framework.

Digital Divide

The issue of the digital divide presents a significant barrier to educational equity for many students in rural and marginalised areas. These students frequently experience insufficient access to reliable internet and essential digital devices, which hampers their ability to fully engage in online learning environments. This divide is particularly pronounced in South Africa, where the assumptions underpinning the Community of Inquiry (CoI) survey instrument and its application in Massive Open Online Courses (MOOCs) presume that all students possess the requisite technology necessary for effective participation. However, this assumption fails to account for the reality of many South African students. Consequently, the digital divide leads to considerable educational inequalities, impeding the academic progress of those who are already at a disadvantage.

Socio-Economic Barriers

In addition to the digital divide, socio-economic barriers pose another substantial challenge for students, particularly those from impoverished backgrounds. These students often grapple with additional difficulties, including inadequate study spaces, financial constraints, and the necessity of balancing work commitments alongside their educational pursuits. The CoI model, along with its adaptations for MOOCs, lacks explicit acknowledgment of these socio-economic barriers that profoundly impact students' ability to effectively engage in online learning environments. This oversight undermines the model's applicability in contexts where students are confronting significant financial and social challenges, potentially exacerbating existing inequalities.

Cultural and Linguistic Diversity

Cultural and linguistic diversity is a hallmark of South Africa, and it necessitates that educational content and delivery methods be adapted to foster inclusivity. However, the CoI model does not offer specific guidance on accommodating diverse cultural and linguistic backgrounds within MOOCs. This deficiency can adversely affect students' sense of

belonging and engagement, particularly in a multifaceted society like South Africa. Without an adapted approach that acknowledges and respects the cultural and linguistic nuances of its student population, the effectiveness of the CoI model in promoting a sense of community and belonging in online learning experiences remains limited.

Support Systems

Moreover, students in marginalised areas often struggle with the lack of access to essential academic support services, including tutoring, counseling, and mentorship. While the CoI model emphasises the significance of teaching presence, social presence, and cognitive presence in enhancing the educational experience, it does not adequately address the necessity for additional support systems vital for student success, especially in disadvantaged contexts. This gap limits the effectiveness of the CoI model in catering to the diverse needs of students who may require more comprehensive support, ultimately impacting their learning outcomes.

Infrastructure and Resources

The infrastructure and resources available in rural areas significantly affect the capacity for online education. Many of these regions lack essential infrastructure, such as consistent electricity supply and adequate physical learning spaces, necessary to sustain effective online learning. The CoI model inherently assumes the availability of such basic infrastructure, an assumption that does not reflect the realities faced by students in many rural South African contexts. This disconnect further constrains the model's applicability and effectiveness in areas where infrastructural challenges persist, potentially leaving many students without the educational opportunities they need to succeed.

Contextual Gap

Overall, the CoI framework presents a contextual gap in its relevance to South African universities. As it currently stands, the model does not adequately account for the unique challenges faced by students in this context, which limits its potential to inform effective online learning strategies. The integration of contextual factors into the CoI model is essential to enhance its applicability and effectiveness in promoting student engagement and success in diverse educational environments.

3.5 Development of the Conceptual Framework

The development of the conceptual framework was guided by the constructivism and connectivism learning theories because knowledge is accumulated through life experiences and self-reflection about those experiences. In today's technologically advanced society, individuals have become increasingly dependent on digital information to obtain answers and access information. In the past, students would consult libraries to find answers, but now they can easily rely on digital technology affordances and the ubiquitous infrastructures. Undoubtedly, technology is revolutionising the teaching and learning modalities to enable students to acquire knowledge both within and beyond the confines of the classroom. Instead of acquiring knowledge from traditional sources such as professors and textbooks, modern pupils rely on cell phones and computers as central sources of information. The growing use of technology as a teaching instrument has transformed the educational environment.

3.5.1 Learning Theories

This study is guided by the constructivism and the connectivism learning theories.

Constructivist learning is the theory of social constructivism that was developed by Vygotsky (1978). At the foundation of this theory is the belief that knowledge is not a copy of an objective reality but is rather the result of the mind selecting and making sense of and recreating experiences. It is the idea that knowledge is accumulated through life experiences and self-reflection about those experiences (Sarbah, 2020). This type of learning characterises adult learners because adult learners has gone through a lot of experience, as opposed to children who are not provided with pre-experience. According to Sweany (2020), the constructivist approach to learning argues that through experience, people develop their own knowledge. The context of where the learning takes place is important, so the aim is to strive for real-world contexts and authentic settings. The emphasis is not on retrieving information but rather on creating a solution to a problem by assembling different pieces of data.

Connectivism learning is the integration of principles explored by chaos, network, complexity and self-organisation theories. According to Bates (2015), "in connectivism, it is the collective connections between all the 'nodes' in a network that result in new forms of knowledge". This is a digital age type of learning where knowledge is self-directed and occurs spontaneously and in collaborative groups. The idea of an educator verbally transferring the information to the learners is changing because the internet contains more information. There is no need to entirely rely on educators. Students must be metacognitive in a learning community. According

to Garrison (2017), metacognitive is the ability to cognitively achieve meaningful learning. Students must be able to access information from the internet like they are accessing their brain content. Connectivism is aligned to learning in the digital age and is the learning theory used for learning in the 21st century (Corbett & Spinello, 2020). These theories are in line with Garrison's (1999) ideology of knowledge creation. Garrison stated that learning manifests through collaboration, interaction and engagements in communities.

3.5.2 Conceptual Framework

South Africa has a distinctive political history, culture, and social landscape. When the researcher analysed the CoI framework developed by Garrison et al. (1999), she found that it does not wholly address the specific challenges faced by South African HEIs. The researcher further reviewed other studies that used the CoI framework and discovered similar limitations, though there were some elements that could address the gap. The CoI framework and other adapted CoI frameworks are based on collaboration, deep learning, instructional design principles and practical inquiry (Anderson, 2017; Dlamini, 2023; Garrison et al., 1999; Shea & Bidjerano, 2010) and are social constructivist in nature (Vygotsky, 1978). While these frameworks have strengths, they still have some gaps and neglect inclusive digital education, though they do create learning communities with meaningful interactions and facilitate active learning and cognitive presence. Therefore, to address these gaps, the researcher proposes the development of a conceptual framework with the epistemic of social constructivism and connectivism that integrates technological affordances, social affordances, skills, ubiquitous infrastructures and conducive learning environments as enablers of digital technology education that are inclusive for all students, regardless of their background.

Given the positive correlation that exists between the elements of the CoI framework and elements from the literature, this study posits that learning manifests in an epistemically integrated and interactive community with social presence, teaching presence, cognitive presence, student skills, academic skills, technology, infrastructure and environment. The researcher believes all these factors are central to creating equitable digital education for all South African HEIs. The framework's performance is assessed by the learners' achievement in the educational process, which is impossible without the interconnectedness of these factors. The reach the final framework, the relationships between the constructs had to be established and tested.

3.5.3 Correlation of the Constructs

Figure 3.5 and Figure 3.6 show the relationship between the constructs of the academics' dataset and the students' data set that have led to the development of the conceptual framework of the study (refer to Figure 6.5)

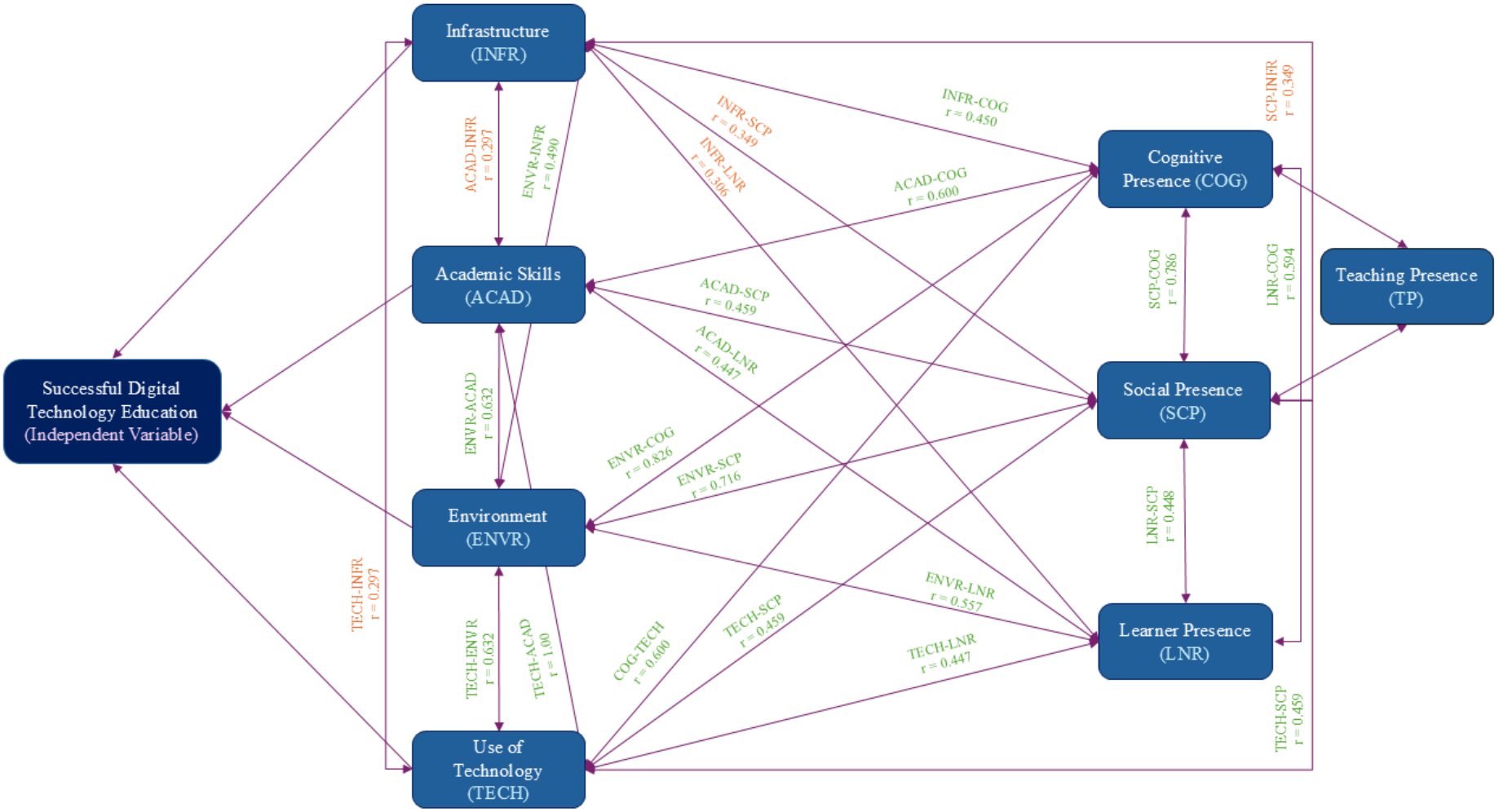


Figure 3.5 Convergent validity: academics' dataset

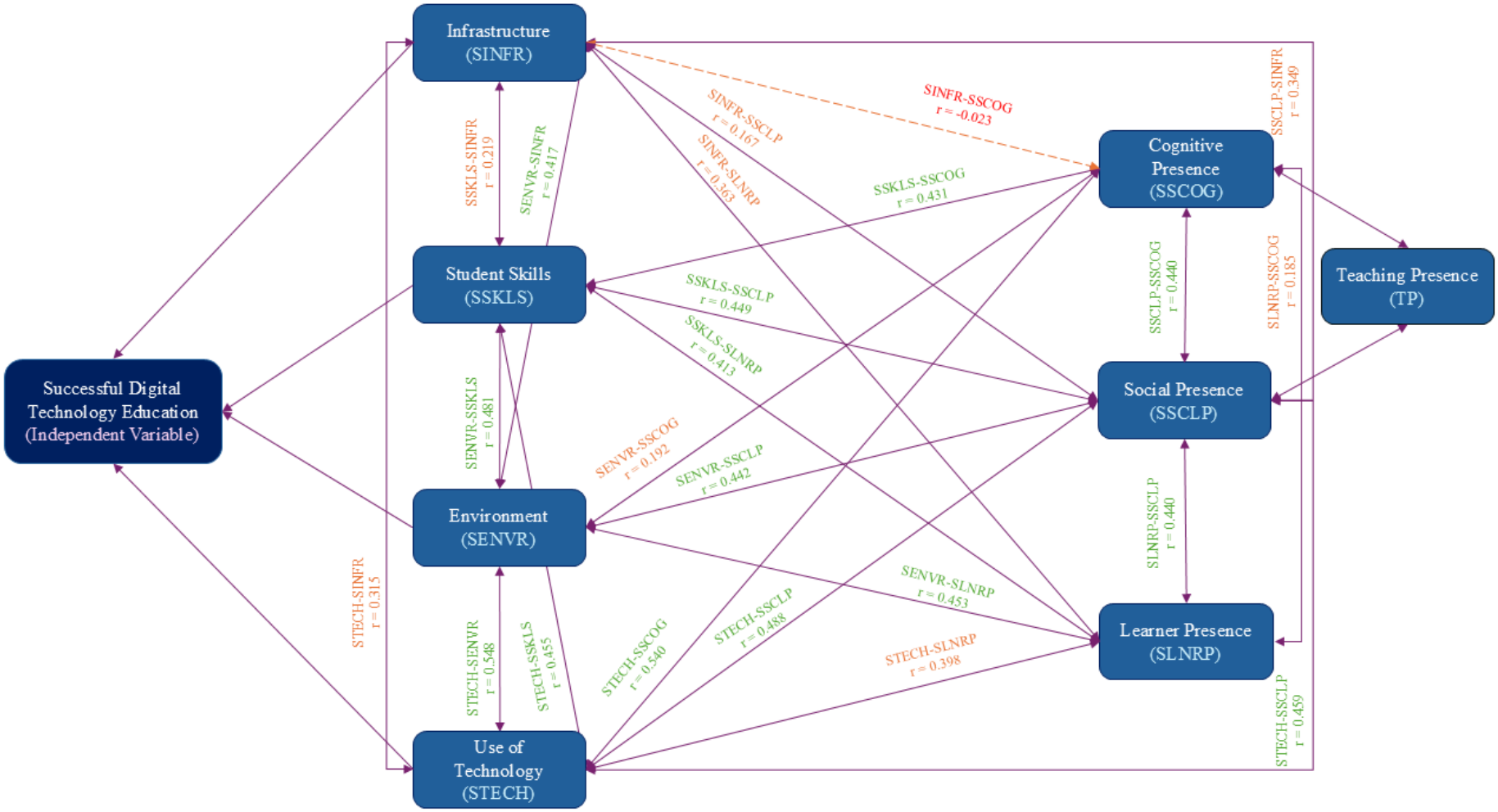


Figure 3.6 Convergent validity: Students' dataset

3.5.4 Constructs of the Conceptual Model

Given the explosive growth of online learning over the last two decades, it is tempting to wonder what the next decade will bring as countless new technologies continue to be developed. In no time, digital education will be considered the traditional form of learning. There is acknowledgement that digital education will continue to play an increasingly significant role in education and the lives of the students. It is the responsibility of educators to create the most effective and compelling online instruction for the benefit of the students.

By embracing the core principles of effective instruction and translating them into the technology of the moment, all students can receive education and be ready for whatever new development is around the corner (Fitzgerald et al., 2013); this was proven during the pandemic period. However, it is imperative to take cognisance of the factors that should be considered to ensure inclusive digital education. Table 3.2 is a summary of the constructs hypothesised to be contributing to the success of digital technology enabled education in HEIs. These factors emanated from the literature review, the theory underpinning this study, and the data collected and tested through convergent validity and confirmed through factor analysis.

Table 3.2 Factors contributing to the success of digital technology enabled education

Social presence	Participants' ability to identify with the community, communicate purposefully in a safe environment, and cultivate interpersonal relationships by projecting their own personalities (Arbaugh et al., 2008; Garrison & Arbaugh, 2007; Kreijns et al., 2014). These include communication; mutual trust among the students; structures, systems, and opportunities that support social interaction in online learning and collaboration between the students; students expressing their feelings, emotions, values, and beliefs; students feeling secure to communicate on online platforms; and group cohesion (Matadi & Uleanya, 2022).
Cognitive presence	This refers to the design of the learning activities and assessments as well as the facilitation of the course (Arbaugh et al., 2008; Garrison & Arbaugh, 2007; Kreijns et al., 2014). It is about students being able to explore, integrate and apply the knowledge, high level thinking tasks/application type of activities, and peer review discussions.
Teaching presence	Refers to academic influence, expertise and views on online instruction delivery modes (Garrison et al., 1999; Garrison & Arbaugh, 2007). Online learning will continue to play an increasingly important role in education and the lives of students. It is therefore the responsibility of educators to create the most effective and compelling online instructions for the benefit of the students. In line with cognitive learning theory, teachers must play an active role in ensuring the information presented is well organised to enable students to learn and easily digest it. These also refers to the tools used to transfer that knowledge (Matadi & Uleanya, 2022).

Learner presence	Refers to students' role and participation. Collaboration between learners and teacher is important (Anderson, 2017; Kovanović et al., 2015). In line with cognitivism learning, students should be encouraged to use effective learning techniques such organising the information and evaluating information to develop knowledge (Ertmer & Newby, 2013). Therefore, learner participation and engagement is crucial in the learning process (Garrison & Arbaugh, 2007). This also refers to self-efficacy, the individual's belief in their capacity to execute behaviours necessary to produce specific performance attainments.
Academic skills	Academic skills in the context of this study and the literature refers to the skills that academics ought to have to effectively conduct or facilitate online instructional delivery. This refers to technical skills; understanding basic computer hardware and software with the ability to perform computer operations, such as using keyboard and mouse; digital skills (the ability to use technology, to find, use and critically evaluate information, to organise, data and media sources, and to communicate, collaborate and participate in online environments); and computer literacy (the ability to use basic computer applications).
Student skills	Student skills in the context of this study and literature refer to the skills that the students ought to have to effectively learn online. This refers to technical skills; understanding of basic computer hardware and software with the ability to perform computer operations, such as using keyboard and mouse; digital skills (the ability to use technology, to find, use and critically evaluate information, to organise data and media sources, and to communicate, collaborate and participate in online environments); and computer literacy (the ability to use basic computer applications).
Technology	Technology in the context of this study refers to the use of digital technology tools and applications that enable online learning and effective collaborations between students and academics.
Infrastructure	Infrastructure encompasses the buildings, technology, and resources required to support teaching and learning, such as classrooms, internet connectivity, digital technology tools and applications. Ubiquitous infrastructure is crucial for effective teaching and learning. A report by the European Commission (2010) indicated that high-quality infrastructure is essential for sustainable growth. According to Kumo et al. (2012), infrastructure development is essential for poverty alleviation and job creation in impoverished nations. The swift modernisation of infrastructure is essential for the sustainable development of industrialised economies. Strong infrastructure guarantees improved living circumstances for the entire populace.
Environment	The environment in the context of this study refers to the environment in which teaching and learning occurs. This refers to conducive and safe environments that cultivate interpersonal relationships between facilitator and students and engaging and collaborative environments.

3.6 Concluding Remarks

This chapter presented the theoretical foundation of this study and the theoretical frameworks, and it examined the studies that used the CoI framework as their lens of research. The researcher then identified the gaps from these frameworks as well as the CoI and used them as a lens to develop the framework for this study. The next chapter presents research methodology.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Chapter Overview

This chapter delineates the methodology applied in this research endeavour, including the research paradigm, strategy, approach, and methods. The chapter justifies why the mixed methods case study approach was adopted for this study. In addition, the chapter elucidates how the questions were answered, the data generation methods, the instruments used to answer the research questions, and the sampling methods. Lastly, the chapter explains how the validity and reliability of the instruments were ensured, and it ends with a discussion of the ethical considerations.

4.2 Research Paradigm

It is crucial to strategically situate a research paradigm within the broader context of other research methods. This orientation involves the researcher's beliefs regarding the fundamental nature of reality (ontology) and the nature of knowledge (epistemology) (Merriam, 2009). Conventional research paradigms operate on specific assumptions about the nature of the world. A paradigm is defined as an essential set of views shared by scientists about how to understand problems, how to view the world, and how to conduct research (Rahi, 2017). As a result, paradigms contain foundational sets of beliefs or assumptions that influence research questions. Researchers are expected to uncover an objective reality when they conduct their investigation. According to Rahi (2017), paradigms are simplified versions of actual complex world views that drive various study approaches. It is a form of belief and practice upon which the research is based on. The most used paradigms are positivism, interpretivism, advocacy, and pragmatism. To construct an effective study design for the current study, the researcher took into account these research paradigms and selected the appropriate paradigm for this study (Mills et al., 2006).

This research uses the pragmatism paradigm because it did not limit the researcher in uncovering the truth. It is open to the mixed methods research approach and enabled the researcher to employ all approaches to comprehend the problem statement. Pragmatism emphasises that research involves decisions about which goals are most meaningful and which methods are most suitable. According to Weaver (2018), "pragmatic inquiry is concerned with evaluating and transforming features of real-world psychological, social, and educational phenomena". The experience and science offered by pragmatists may disclose ways to find an objective basis for the criticism of

institutions and practices. In this scenario, the problem is more essential than the method, and researchers should employ all approaches to comprehend the problem statement. The goal of this paradigm is to use a mixed methods approach to uncover the study's shortcomings and strengthen it (Rahi, 2017). Proponents of this paradigm claimed that a mixed methods approach can yield actual knowledge (Lieber, 2009).

4.3 Research Strategy

A research strategy is a systematic approach that provides direction and guidance for conducting research to enable the researcher to effectively accomplish their study objectives (Denscombe, 2010). Formulating a research plan can help elucidate research questions, identify sources, structure data, and communicate findings. A case study approach was adopted for the current study, and it was guided by the type of research questions this study intended to answer. According to Ivankova et al. (2006), a case study approach enables the researcher to delve into the occurrences of a phenomenon in order to provide a detailed account of the events, connections, experiences, or processes that occur in the current problem. The case study strategy is a written description of a problem or a situation. It presents small group problems or focuses on a particular issue. Case study is preferred when the researcher has little control of events (Ivankova et al., 2006). It allows the researcher to generalise in the same circumstance and also to study the various perspectives held by participants (Ivankova et al., 2006).

It is for this reason that this investigation was conducted at Wits, which represented endowed universities, also known as historically advantaged or established university; UKZN, which represented semi-rural universities in South Africa; and the UNIVEN, which represented non-endowed universities, also known as historically disadvantaged institutions.

4.4 Research Approach

Research approaches are the strategies and methodologies employed when conducting research and includes the progression from overarching assumptions to specific techniques for gathering, analysing, and interpreting data (Creswell, 2014). Research can be conducted using three different approaches, namely quantitative, qualitative, and mixed methodologies. A qualitative approach comprises constructivism and transformative worldview, a quantitative approach includes positivism and post-positivism, and a mixed methods approach uses pragmatism (Grover, 2015).

This study employed the mixed methods approach that combines quantitative (QUAN) and qualitative (QUAL) methods (Fernando, 2018). Qualitative and quantitative data differ in that qualitative research generates textual data while quantitative research produces numerical data. Quantitative research allows a broader scope of research by using techniques such as surveys with close-ended questions, while the qualitative research approach is more in-depth and uses techniques such as individual interviews, group discussions, focus groups and open-ended questions.

The mixed methods research approach encompasses collecting, analysing, and integrating quantitative and qualitative data. The underlying concept of these designs is that combining approaches yields a more thorough, detailed, and fuller understanding of research concerns than either method alone (Klassen et al., 2012). The mixed methodology in this study was beneficial because the results obtained through various methods enriched and improved the researcher's understanding of the topics under study and fostered new ideas about them, allowing the researcher to answer questions that are difficult to respond to using a single method (Lopez-Fernandez & Molina-Azorin, 2010).

The researcher chose this approach for two reasons. Firstly, the study explored digital education affordances in higher learning to investigate how digital capabilities enrich education and improve student learning. The study investigated how ERT and online learning affected student performance and explored how the advantaged and disadvantaged institutions transitioned from face-to-face to digital learning. This required understanding several variables that had to be tested and analysed. Secondly, some research questions developed for the study were designed in a way that embedded both quantitative and qualitative research questions:

- RQ1: What is the efficacy of digital technology enabled education in HEIs?
- RQ2: How does digitalisation enhance student performance and experiences in HEIs?
- RQ3: What is the impact of digital education on student performance?
- RQ4: Which factors contribute to successful digital technology enabled education?
- RQ5: What framework can be implemented to ensure the successful integration of digital technology enabled education at HEIs?

To fully answer all these questions, participants had to be asked closed-ended questions as well as open-ended questions, and the researcher had to review documents and the literature to justify their response.

The researcher preferred mixed methods because it provided a deeper grasp of the study concerns than qualitative or quantitative approaches alone could (Palinkas et al., 2011). Furthermore, quantitative methods are seen as tools to test and confirm hypotheses based on an existing conceptual model, whereas qualitative data can increase the breadth of understanding of predictors and quantitative outcomes (Klassen et al., 2012; Tashakkori & Teddlie, 2010). In the end, the researcher was able to close the gaps that were identified with quantitative methods. Combining qualitative and quantitative approaches overcame the weaknesses of each while maximising the strengths of each and improved the understanding of the data that would otherwise have been missed using a single approach (Creswell & Clark, 2007; Klassen et al., 2012; Leech & Onwuegbuzie, 2009).

4.4.1 The Convergent Design

This study followed the convergent design in which quantitative and qualitative data are collected and analysed at the same time (Ivankova et al., 2006). Figure 4.1 shows how the convergent mixed methods design used in this study. This design allowed the concurrent collection and analysis of QUAN + QUAL data while keeping the types of data separate (Klassen et al., 2012). When data are collected concurrently, the two types of data, QUAN and QUAL, are independent of one another, but when data are collected sequentially, the two types of data are associated or connected. In this study, the results derived from the analysis phases of the QUAN and QUAL were not dependent on the results of another Creswell & Clark (2007) but rather corroborated each other. The data were merged or compared during the interpretation phase. During this phase, the convergence or divergence of the results from the two methods was noted.

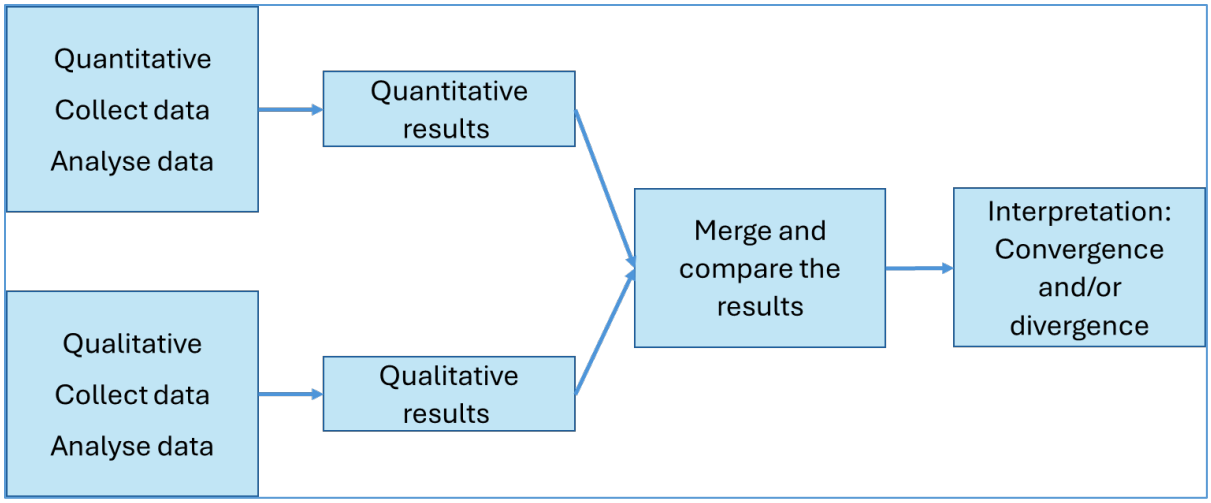


Figure 4.1 Convergent mixed methodology (Creswell & Clark, 2007)

4.5 Sampling

The targeted population of this study was academics and students. According to Rahi (2017), the term population refers to all individuals or items being studied, whereas sampling refers to the process of picking a subset of the population to investigate.

The academics were approached mainly because they are responsible for educating the learners and would be able to give input on the modes of instructional delivery. They responded to the questions based on experience. Students were also approached because they are at the receiving end of the instruction. It was interesting to discover how they were affected by the transition from face-to-face learning to ERT and online learning.

Sampling is the process of selecting a portion of the population to represent the entire population (Etikan & Bala, 2017). Sampling in mixed methods research depends on the research designs chosen for the study. Having considered all the sampling methods, the researcher used a mixed methods sampling approach that incorporated both probability and purposive sampling techniques, which ensured everyone had an equal chance of being chosen (Etikan et al., 2016; Palinkas et al., 2011; Rahi, 2017). These sampling techniques can be described as follows:

- **Probability sampling:** This method was used to ensure every unit in the population had an equal chance of being chosen. Specifically, stratified sampling was adopted, where only third- and fourth-year students were asked to complete the questionnaire. This was done because these students would have experienced both face-to-face and online learning.

- **Purposive sampling:** This technique enabled the researcher to select participants who were believed to be best suited to the study. The goal of purposive sampling is to create a sample that can appropriately address the research questions. Expert knowledge of the target population was used to select a sample that represented a cross-section of the population in a non-random manner.

The three universities (metropolitan, rural, and semi-rural) were chosen based on specific criteria to ensure a representative sample of different types of institutions. The selection criteria included the following:

- **Geographical location:** To capture diverse educational environments, one university was selected from a metropolitan area, one from a rural area, and one from a semi-rural area.
- **Institutional characteristics:** The universities were chosen to represent both historically advantaged and historically disadvantaged institutions in South Africa.
- **Availability of participants:** The universities were selected based on the availability and willingness of both students and academics to participate in the study.

4.5.1 Sampling Frame

According to Rahi (2017), sampling is picking a sample of units from a data set to assess the people's qualities, beliefs, and attitudes. The sampling frame for this study consisted of the three South African universities. The sampling frame represented endowed universities and non-endowed universities. The researcher initially intended to gather data from a sample of 180 individuals, encompassing both students and academics. However, the final number of participants who answered and provided data was 165, falling short of the intended sample size. Out of the total count of 165 individuals, 77 were academics and the remaining 88 were students, encompassing all three universities. Table 4.1 shows a breakdown of the participants.

Table 4.1 Participants' demographics

Universities	Academics	Students
Metropolitan	30	30
Semi-rural	26	33
Rural	21	25
Total	77	88
Total population	**165**	

4.6 Research Instruments

It was vital for the researcher to understand the kind of data that were required to achieve the research objectives, develop a well-thought-out strategy for collecting and analysing data, and prepare a thorough presentation of the findings. An online questionnaire comprised of closed- and open-ended questions and document analysis were used to collect data. The use of the questionnaire enabled the researcher to collect a substantial percentage of viable responses from a sizeable sample. Three widely employed methodologies in opinion research involve the elicitation of opinions and beliefs, namely (1) the Thurston technique, (2) the Likert method, and (3) the semantic differential. In the online questionnaire survey for this research, the researcher employed the Likert method, as it was more suitable for the investigation.

4.6.1 Online Questionnaire Surveys

According to Check and Schutt (2012), survey is a method of gathering data from a sample of individuals through their responses to the same questions, which can be about their sentiments, opinions, qualities, or features of a specific topic. McMillan and Schumacher (2010) described a questionnaire as a written series of questions. Surveys were used as part of the quantitative data collection process for RQ1, RQ2, and RQ4 (see Section 1.5).

The study included semi-structured questionnaires that comprised a combination of 5-point Likert-scale questions, multiple-choice questions, and a limited number of dichotomous questions that required a binary response of either ‘Yes’ or ‘No’. Additionally, both closed- and open-ended items were included in the questionnaire. The open-ended questions allowed participants to elaborate on their responses and to offer their unique perspectives on the themes under discussion. By doing so, participants were able to provide further insights into aspects that were not addressed by the closed-ended questions.

Following authorisation from the respective universities, a web-based tool called Google Forms was used to develop an online questionnaire survey instrument. This instrument was then distributed to the participants. Participants were emailed a hyperlink to access the online questionnaire survey. The purpose of the online questionnaire survey was explained in the electronic correspondence sent to the participants.

4.6.2 Document Analysis

Document analysis was used as part of the qualitative data collection process to respond to RQ3 (see Section 1.5). Document analysis is defined as a systematic procedure for reviewing or evaluating documents, both printed and electronic material (Bowen, 2009). The objective of this question was to explore the level of student performance in HEIs prior to and after transitioning to ERT and online learning. To answer this question, annual reports, websites, and other relevant higher education reports were reviewed. According to Bowen (2009), documents that can be used for systematic evaluation as part of a study come in many different forms. Documents can include advertisements, magazines, agendas, attendance registers, meeting minutes, manuals, background papers, books, brochures, event programmes, letters, and many more.

4.7 Data Analysis

According to (Creswell & Clark, 2007b), data analysis in mixed methods research consists of analysing the quantitative data using quantitative methods and the qualitative data using qualitative methods. Both quantitative and qualitative data were collected concurrently. An analysis of this data occurred afterwards. This investigation method was preferred because it enabled the researcher to validate the findings generated by each method through evidence produced by the other. Table 4.2 demonstrates the model of the convergent mixed methods design procedure to explain the data analysis procedures and the interpretation stage applied in the current study.

Table 4.2 Data collection, analysis and interpretation process (Creswell, 2007)

STEP 1 **Data Collection**	Concurrent data collection of QUAN + QUAL data using a questionnaire with 5-point Likert scale, and close- and open-ended questions	
STEP 2 **Data Analysis**	QUAN data analysis: Data screening (Missing data, univariate, multivariate, etc.) Descriptive statistics Crosstabulation analysis	QUAL data analysis: Thematic content analysis Coding Categorisation of themes EFA
STEP 3 **Merge Results**	QUAN results: Descriptive statistics Crosstabulation analysis	QUAL results: Similar and different themes Cross thematic matrices EFA
STEP 4 **Interpretation**	Integration and interpretation of QUAN and QUAL results	

Table 4.3 demonstrates how data were generated and analysed for the current study to answer each research question.

Table 4.3 Data collection and analysis process

Question	Research Questions	Instrument	Data Source	How Data was Analysed
RQ1	What is the efficacy of digital technology enabled education in HEIs?	Online questionnaire: Open-ended and dichotomous questions	Academics Students	Descriptive statistics Crosstabulation analysis Thematic analysis
RQ2	How does digitalisation enhance student performance and experiences in HEIs?	Online questionnaire: Open-ended and dichotomous questions	Academics Students	Descriptive statistics Thematic analysis
RQ3	What is the impact of digital education on student performance?	Document analysis	Annual reports Websites Magazines	Content analysis Thematic analysis
RQ4	Which factors contribute to successful digital technology enabled education?	Online questionnaire: 5-point Likert scale and open-ended questions	Academics Students	Descriptive statistics Thematic analysis EFA
RQ5	What framework can be implemented to ensure the successful integration of digital technology enabled education at HEIs	Online questionnaire: 5-point Likert scale and open-ended questions	Academics Students	Descriptive statistics Thematic analysis EFA

4.7.1 Thematic Analysis

Thematic analysis was used to analyse the textual responses provided to the open-ended questions and simple descriptive statistics was used to analyse the closed-ended questions. Braun and Clarke (2012) referred to thematic analysis as a research methodology that facilitates the identification, analysis, and interpretation of patterns of meaning, commonly referred to as ‘themes’, within qualitative data. The versatility of thematic analysis renders it applicable for the analysis of a diverse array of data types. This method can be applied to textual data derived from qualitative surveys, just like in this study (Terry et al., 2017).

Thematic analysis is used to analyse qualitative data by systematically examining a dataset and identifying recurring patterns, called themes, in the underlying meaning of the data. The approach

requires the researcher to actively reflect on their subjective experience to interpret the data. The following six phases were followed during the thematic data analysis process for this study.

- **Familiarisation:** This phase provided the researcher with an opportunity to engage with the data and gain insight about it. The researcher needed to be observant, notice patterns, and make notes as opposed to absorbing the provided information (Riger & Sigurvinsdottir, 2016). Finally, the researcher synthesised the observations and notes into ideas. Having developed a sense of the overall dataset, the researcher began generating codes.
- **Coding:** The systematic and thorough creation of meaningful labels attached to specific segments of the dataset that have meaning relevant to the research questions. In line with Terry et al. (2017), the researcher identified the relevant data within each data item and tagged them with words that captured the meaning of the data segment.
- **Theme development:** This is when the researcher established a deep understanding of the dataset through familiarisation and then began constructing themes (Terry et al., 2017). This development is an active process of pattern formation and identification because the researcher built on earlier engagement to shape a first version of salient patterning in the data. The research questions were used as a guide for this process to help determine the relevance of data in terms of potential clusters of patterned meaning. They provided a foundation for the researcher to make choices about what data segments were relevant and what was important to say about them to ensure the themes told a coherent and relevant story about the data. The data were rich and enticing, and therefore, it was easy to get lost in the analysis, but keeping oriented to the research questions helped the researcher keep the analysis relevant.
- **Theme review:** This involved examining the codes and associated data, and combining and collapsing codes together into bigger or more meaningful patterns that helped identify rich and complex codes that potentially captured a number of other codes within its boundaries, which could then be 'promoted' to provisional themes (Chamaz, 2000). Thinking and effort were required to identify features of similarity and relationship across a range of different codes that meant they could be clustered together into a possible theme. During this process, the researcher had to identify a central organising concept. A central organising concept is a clear core idea or concept that underpins a theme that is shared across the range of codes (Braun et al., 2015). This central organising concept helped

determine what a theme is about and whether any code fits within it. This helped the researcher gain clarity about what sense the research was making of the codes and the data. It was key to remember at this stage that patterning must be identified across the dataset and not just within a single data item.

- **Mapping:** In order to facilitate this process of shifting mapping of various patterns, the researcher used thematic maps (Braun et al., 2013). Mapping aids are tools that enhance the researcher's ability to identify and understand potential themes in relation to each other and the overall dataset. Such tools provide a way to identify the boundaries of and relationships between each theme as well as how different themes work together to tell an overall story about the data.
- **Defining themes:** This was a quality control exercise to ensure the themes work well in relation to the coded data, the dataset, and the research question (Terry et al., 2017). The researcher checked whether the candidate themes captured the meaning of the collated, coded data segments. The researcher had to ascertain whether the analysis could work at this level and that all the data extracts that the themes represent were clearly related to the central organising concept of the theme, and that the diversity of meaning around the central organising concept was captured. Each theme needed to account for the important things captured by the coded data that was relevant to the central organising concept, and the range of those important meanings and each theme needed to be distinctive. The reviewing process continued as the researcher moved into defining and naming themes. At this point in the analysis, the researcher moved away from a summative position (thinking about these themes as lists of codes and collated data) to an interpretative orientation. This involved telling a story that was based on and about the data that made sense of the patterning and diversity of meaning. This phase ensured the clarity, cohesion, precision and quality of the developing thematic analysis. Theme definitions are short summaries of the core idea and meaning of each theme. The process of writing definitions can confirm whether there is enough depth and detail for each theme to stand alone as a key chapter in the analytic story.
- **Producing the report:** Writing the report offered the final opportunity to make changes that strengthened the analysis and effectively communicate the researcher's story of the data (Terry et al.,2017).

4.7.1.1 Approaches to Thematic Analysis

A hybrid approach was adopted that combined elements of deductive and inductive thematic analysis based on the research questions and available data. The choice between these approaches were directed by the nature and the goals of this study.

Deductive (*a priori*) thematic analysis is when the researcher starts with a predefined set of codes or themes based on existing theories, prior research, and the research questions. This approach was useful because it enabled the researcher to test or extend existing theories. The data collected were thoroughly reviewed and coded to create and refine themes to enable the analysis process. Lastly, the data were interpreted in the context of the predefined themes. This approach was appropriate because there were theories that needed to be tested.

Inductive (data-driven) thematic analysis is a more flexible and open-ended approach in which themes emerge directly from the data without preconceived categories. This approach allowed the researcher to discover new and unexpected patterns in the data and to explore new or understudied topics that generated new theories or insights. Codes were generated without preconceived categories by letting patterns emerge from the data. Code sorting and collation were done to organise codes into potential themes. Themes were then reviewed and defined based on the collated codes. In some cases, themes were refined and adjusted during the analysis process, and then the findings were interpreted in relation to the themes.

4.7.2 Descriptive Analysis

Descriptive analysis is used to analyse quantitative data. This analysis involves the use of statistical methods to accurately describe, combine, and display the constructs of interest or the relationships between these constructs. This design is commonly employed in mixed methods studies to elucidate quantitative findings in explanatory investigations, facilitate questionnaire construction in exploratory studies, and authenticate and substantiate findings in convergent studies (Doyle et al., 2016).

Descriptive qualitative research is associated with pragmatism, where decisions on the research methodology are determined by the study's objectives and context (Neergaard et al., 2009). The pragmatic researcher does not adhere to a specific perspective on knowledge creation or a specific

approach, but instead, the researcher relies on the concepts or phenomena under investigation to inform their decision-making in the research process (Ormston et al., 2014).

During the descriptive analysis process (Doyle et al., 2016) the researcher identified which aspects of data needed to be described and analysed. The researcher then cleaned the data to ensure it was free from errors. This step was crucial for the accuracy of the descriptive analysis. The researcher chose descriptive statistics from the data set by selecting the appropriate descriptive statistics based on the nature of the data. Common descriptive statistics include measures of central tendency (mean, median, and mode) and measures of variability (range and standard deviation). The summarised data distribution was presented using the frequency distributions and graphical representations. This step enabled the researcher to understand how the values were spread across different categories or ranges, and to visualise the data using charts and graphs.

4.7.3 Factor Analysis

Factor analysis is a method of modelling the covariation among a set of observed variables as a function of one or more latent constructs (Bandalos & Finney, 2018; Matsunaga, 2010; Suhr, 2006; Zeynivandnezhad et al., 2019). The term 'construct' refers to an unobservable but theoretically defensible entity, such as intelligence, self-efficacy, or creativity. Such constructs are typically considered to be latent in the sense that they are not directly observable. The purpose of factor analysis is to help the researcher identify and understand the nature of the latent constructs underlying the variables of interest (Bandalos & Finney, 2018). It is used mainly to develop objective instruments for measuring constructs that are not directly observable in real life (Bandalos & Finney, 2018; Suhr, 2006; Zeynivandnezhad et al., 2019). According to Zeynivandnezhad et al. (2019), factor analysis is a diagnostic tool for the evaluation of data collected in line with the theoretical model, or the expected target constructs under study. It is a technique mainly examining the systematic interdependence among set of observed variables and the researcher's focus is to determine the base commonality among these variables.

There are two categories of factor analysis, namely the EFA and CFA. EFA can be described as orderly simplification of interrelated measures. Traditionally, EFA has been used to explore the possible underlying factor structure of a set of observed variables without imposing a preconceived structure on the outcome (Bandalos & Finney, 2018; Suhr, 2006). CFA is a statistical technique used to verify the factor structure of a set of observed variables (Bandalos & Finney, 2018). CFA

allows the researcher to test the hypothesis that a relationship between observed variables and their underlying latent constructions exists. The researcher uses their knowledge of the theory and empirical research, or both, to postulate the relationship pattern *a priori* and then statistically tests the hypothesis (Suhr, 2006).

These methods can be used to either confirm *a priori* established theories or identify patterns and relationships. They are confirmatory when testing hypotheses or existing theories and concepts, and exploratory when searching for latent patterns in the data in case there is no or little knowledge on how the variables are related. When EFA is applied to a data set, the method searches for relationships (variables with high correlation are grouped together) between the variables to reduce a large number of variables to a set of composite factors (Bandalos & Finney, 2018).

According to Bandalos and Finney (2018), EFA should be used for situations where the variables to be analysed are either newly developed or have not previously been analysed together, or when the theoretical basis for the factor analysis model (i.e., number of factors, level of correlation among factors) is weak. It is for this reason that this study employed EFA. The study was not verifying the factors of a set of observed variables but rather exploring and examining them. None of these constructs were analysed in South African universities as factors to be considered for digital technology enabled education. The researcher developed a scale to measure the variables against their items. These items emanated from the CoI framework, the literature, and the collected data.

The Statistical Package for the Social Sciences (SPSS) tool was used to examine the systematic interdependence among sets of these variables, and the researcher's main focus was determining the base communality among these variables. The related variables were grouped together, and the principal component analysis was used to extract factors from the data. Rotation technique was applied to make the factors more interpretable, while varimax methods were used to adjust the factor loadings to make them more distinct and easier to understand. The factor loadings showed how strongly each variable was related to each factor. In this study, the researcher needed to determine whether the items representing the underlying constructs would load together; for example, the social presence factor items coded between SCLP1 and SCLP9 needed to load together for the researcher to examine the association between these items. High loadings indicated that a variable was strongly associated with a particular factor. The minimum factor loading in this

study was set to 0.50. The communality of the scale that indicated the amount of variance in each dimension was also assessed to ensure acceptable levels of explanation.

According to Zeynivandnezhad et al. (2019) and Matsunaga (2010), EFA is used for the following purposes:

- Reduce the number of variables;
- Test structure or relationships between variables;
- Detect and assess unidimensional theoretical constructs;
- Evaluate the validity of a scale, test or instrument;
- Gain simple analysis and interpretation of the phenomena under study;
- Address multicollinearity (high correlation of two or more variables that are correlated with each other);
- Develop theoretical structures; and
- Approve or disprove the proposed theories.

The aim of the factor analysis was to analyse and find an answer to the following question: Which factors contribute to successful digital technology enabled education? (RQ4) To answer this question, a questionnaire with about 30 close- and open-ended questions was distributed to academics and students across three South African universities to extract the factors related to digital technology enabled education. EFA was used to determine the number of factors related to digital technology enabling education. Only 77 academics and 90 students responded to the questionnaires that were sent out. A five-point Likert scale, comprised of *not important*, *slightly important*, *moderately important*, *important*, and *very important*, was used to capture the responses to each question (see Annexure 4).

The following steps were followed in the process of analysis.

- **Preparation of the data:** The data were prepared to ensure it was suitable for this purpose. The sample size, normal distribution, linearity, outliers and correlation among factors were examined.
- **The ERF requirements:** The researcher conducted the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test and checked the communality of variables. The correlation among the variables was analysed and presented the range as follows: >0.9 is marvellous, >0.8 is

meritorious, >0.7 is middling, >0.6 is mediocre, >0.5 is miserable, and <0.5 is unacceptable. Bartlett's test of sphericity tests the hypothesis of whether the population correlation matrix is an identity matrix. The existence of the identity matrix puts the correctness of the factor analysis under suspicion. P-values less than 0.05 shows that the population correlation matrix is an identity matrix. The KMO measure of sampling adequacy is an index used to examine the appropriateness of factors analysis. It is statistics that show the proportion of variance for variables included in the study. A high value of statistics ranging from 0.5 to 1 indicates the appropriateness of the factors analysis for the data, and a low value below 0.5 indicates the inappropriateness of the factors analysis. Barlett's test of sphericity tests the statistics used to examine the hypothesis that the variables are uncorrelated in the population, meaning that the population correlation matrix is an identity matrix where each variable correlates perfectly with itself (r = 1) but has no correlation with other variables (r = 0). No correlation with other variables means variables cannot be grouped. A significant result of <0.05 indicates that the matrix is not an identity matrix, meaning that the variables do not relate to one another enough to run a meaningful EFA. The KMO and Bartlett tests were applied to weigh the overall significance of the correlation matrix through Bartlett's test of sphericity and provided a measure of the statistical probability that the correlation matrix has significant correlations among its components.

- **Communality:** The communality was to be greater than 0.5. Communality is the amount of variance a variable share with all the other variables being considered (Hardy & Bryman, 2009). There is also a proportion of variance explained by the common factor. Small values less than 0.5 indicate variables that do not fit well with the factor solution and should be dropped from the analysis.
- **Appropriate factoring techniques:** The principal component method was applied to summarise the information in the larger set of variables into fewer factors. This was also used to transform a set of interrelated variables into a set of uncorrelated linear combinations of these variables. This method is applied when the primary focus of the factor analysis is to determine the minimum number of factors that attributes maximum variance in the data. In this case, the researcher grouped the variables together. The obtained factors are often referred to as the principal components.

- **Number of factors:** According to Bandalos and Finney (2018), a major decision in EFA studies is determining the number of factors to retain. Methods to determine the number of factors can be classified as statistically based, mathematically based, or more heuristic. The researcher must then conclude on the number of final factors.
- **Percentage of the variance:** Bandalos and Finney (2018) recommended that the amount of variance explained by the championed solution and by each factor should be reported. Researchers should note the variance explained by the solution and by each factor before rotation. The percentage of variance that can be attributed to each factor relative to the total variance of all the factors must be provided.
- **Eigen value:** This represents the total variance explained by each factor. Factors with eigen values over 1 were selected for further study.
- **Scree plot:** This is a plot of eigen values and factor numbers according to the order of extraction. This plot was used to determine the optimal number of factors to be retained in the final solution. The number of factors that should be included in the model are those for which the cumulative percentage of variance reaches a satisfactory level. The general recommendation is that the factors explaining 60–70% of variance should be retained in the model.
- **Factor rotation:** The researcher applied the varimax rotation method. This is the most used common orthogonal approach that reduces the number of variables that have high loadings.
- **Factor loading**: This is also referred to as factor variable correlation and is about correlations between the variables. Varimax maximises the number of variables with extreme loadings (high or low) on a factor. This minimises the correlation between factors and makes it possible to identify a variable with a factor. Rotation that allows for correlation are called oblique rotations. Rotations that assume the factors are not correlated are called orthogonal rotations. Varimax returns factors that are orthogonal, and oblimin allows the factors to not be orthogonal. This study applied the varimax method of rotation.
- **Model fit:** This was the final step during which the researcher determined the fitness of the factor analysis. In factor analysis, the factors are generated based on observed correlation between the variables. The degree of correlation between the variables can be reproduced. For an appropriate factor analysis solution, the difference between reproduced and

observed correlation should be less than 0.05. A model that is a good fit will have less than 50% of the non-redundant residuals with absolute values that are greater than 0.05.

4.8 Validity and Reliability

Validity is the degree to which a research instrument accurately measures what it purports to measure (Bolarinwa, 2015). According to Bolarinwa (2015), validity pertains to the extent to which the findings accurately reflect their apparent subject matter. The concept of validity can be divided into two distinct categories, namely internal validity and external validity (Bolarinwa, 2015). Internal validity refers to the degree to which a research instrument accurately measures the specific construct it was intended to measure in accordance with the researcher's objective. External validity pertains to the extent to which the data can be generalised to the entire population (Bolarinwa, 2015). Nha (2021) mentioned that validity and reliability are crucial principles for substantiating the quality of research. A reliable instrument consistently produces dependable results. This study's reliability was enhanced by developing a survey instrument that accurately assessed the pertinent variables and constructs.

4.8.1 Thematic and Descriptive Analysis Validity

Thematic analysis validity was used as a qualitative method of analysis in this study to detect and examine recurring patterns (themes) within the data, and descriptive analysis was used to methodically investigate and present the data to offer a concise overview of its primary characteristics. Descriptive statistics analysis focuses on summarising and presenting data in an understandable manner. The basic purpose of descriptive statistics is to provide a short and understandable summary of a dataset by describing and summarising its principal aspects. Ensuring validity and reliability in thematic and descriptive analysis was crucial to maintain the rigour and trustworthiness of the findings. The following strategies were used in this study to enhance validity and reliability.

- **Clear definitions:** The researcher established precise definitions for variables and measures used in the study and offered detailed explanations of terminology and concepts to prevent any confusion or uncertainty.
- **Pilot testing:** The data collection instrument underwent pilot testing to evaluate the respondents' understanding of the questions. Pilot testing enabled the researcher to assess

the accuracy of questions and the anticipated consistency of data obtained prior to finalising the survey (Fraser et al., 2018). Rephrasing was done for questions that were considered unclear or open to several interpretations.

- **Data familiarity:** The researcher extensively engaged with the data to get a profound understanding of its contents. The researcher engaged in multiple readings of the data to have a thorough understanding of the context and subtle details.
- **Triangulation:** This refers to using various sources of data or methods to validate and support the research conclusions (Burns, 2010; Merriam, 2009). Triangulation is used to verify the reliability of several data sources by comparing and cross-referencing the consistency of information obtained at different points in time (Hussein, 2009). This can include the comparison of data from various people, the use of diverse data collection methods, or the incorporation of several researchers in the analysis. The researcher used the input of academics and students in response to a semi-structured questionnaire from the sampled institutions and across various faculties. The purpose of this was to collect a comprehensive amount of information that could subsequently be verified for accuracy.
- **Peer review:** The researcher engaged in peer review by regularly engaging in discussions with experienced colleagues or peers to share and evaluate her interpretations and findings. The researcher found it beneficial to have an external perspective to recognise biases or consider alternate perspectives (Merriam, 2009). This was extensively done in this study.
- **Prolonged engagement:** The researcher dedicated ample time to the data to ensure the interpretations were not quickly formulated. Extended involvement improved the level of comprehension and aided in grasping the intricacy of the information (Aguinis & Solarino, 2019; Merriam, 2009).
- **Consistency in coding:** The researcher ensured code consistency by implementing a clear and well-defined coding scheme. The researcher consistently verified the coding in relation to the study topic and data to ensure congruence.
- **Audit trail:** The researcher meticulously documented the analytical method, including the decisions made during coding and theme development. The presence of this audit trail facilitated transparency and a meticulous examination of the researcher's analytic procedure (Merriam, 2009). Aguinis and Solarino (2019) recommended providing detailed descriptions of data coding, data analysis, and data disclosure.

- **Reflexivity:** Finally, the researcher engaged in introspection to examine biases, assumptions, and preconceived notions throughout the study process. The researcher disclosed their positionality and acknowledged the potential impact on the analysis (Merriam, 2009).

4.9 Reliability of Construct

Construct validity refers to how consistently a method measures what it is intended to measure. According to Green and Salkind (2011), a measure is reliable if it produces consistent scores across administrations, and therefore, the results are reliable. In line with Quansah (2017), the reliability of the items on the Likert scale could not be overlooked as it was necessary to estimate the reliability of the scale that was used to measure the construct of interest. Data were collected from academics and students and is presented as such.

Before the reliability of constructs could be tested, the constructs for both academics' and students' data needed to be coded to test the reliability.

4.9.1 Academics' Dataset

Table 4.4 delineates the coding of items for the academics' dataset.

Table 4.4 Coding of items: Academics' dataset

Variables	Items	Item Coding	Metrics Coding
Social presence	Identify with the community Communicate purposefully in a safe environment Cultivate interpersonal relationships	SCLP	SCLP1–SCLP9
Cognitive presence	Explore, integrate and apply the knowledge Application of tasks Critical thinking Peer review Grouping of students	COGP	COGP1–COGP6
Learner presence	Self-efficacy Environment	LNRP	LNRP1–LNRP2
Academic skills	Technical skills Digital skills Computer literacy	ACAD	ACAD1–ACAD3

Variables	Items	Item Coding	Metrics Coding
Technology	Intelligent tutoring systems Applications that enable online learning Applications that enable effective collaborations between student and teachers Digital learning platforms or LMSs	TECH	TECH1–TECH4
Infrastructure	Network infrastructures Reliable network, data, or digital bandwidth Reliable electricity Connectivity	INFR	INFR1–INFR4
Environment	Students have a conducive and safe environment Environment that cultivates interpersonal relationships between facilitator and students Engaging and collaborative environment	ENVR	ENVR1–ENVR3

In the current study, the reliability estimate for items on the Likert scale for the academics' dataset was measured using the reliability method known as Cronbach's alpha. Cronbach's alpha is a coefficient that measures how well a set of items in a scale or questionnaire correlate with each other (Taber, 2018). Researchers frequently use Cronbach's alpha to show that scales and tests created or used for a research project are appropriate for their intended use. Cronbach's alpha values of 0.7 or higher indicate acceptable internal consistency (Taber, 2018).

The researcher independently tested the Cronbach's alpha of the constructs of the academics' dataset (Table 4.5). The result of this measurement indicated a robust internal consistency for the assessed scales. The social presence scale, consisting of nine items (SCLP1–SCLP9), demonstrated high reliability with a Cronbach's alpha coefficient of 0.933. The cognitive presence scale, comprising six items (COGP1–COGP6), exhibited good internal consistency ($\alpha = 0.876$), while the learner presence scale, encompassing two items (LNRP1–LNRP2), yielded a satisfactory reliability coefficient of 0.756. Additionally, the academic skills scale, comprised of three items (ACAD1–ACAD3), displayed a strong reliability of 0.901. The technology scale, with four items (TECH1–TECH4), showed a good internal consistency of 0.839, while the infrastructure scale, consisting of four items (INFR1–INFR4), exhibited excellent reliability ($\alpha = 0.922$). Finally, the environment scale, composed of three items (ENVR1–ENVR3), demonstrated a high level of reliability with a Cronbach's alpha coefficient of 0.859. A detailed summary of these reliability results is shown in Table 4.5.

Table 4.5 Construct reliability statistics for the Likert scale of the academics' dataset

Constructs/Items	No. of Items	Cronbach's alpha (α)
SCLP	9	0.933
COGP	6	0.876
LNRP	2	0.756
ACAD	3	0.901
TECH	4	0.839
INFR	4	0.922
ENVR	3	0.859

4.9.2 Students' Dataset

Table 4.6 delineates the coding of items for the students' dataset.

Table 4.6 Coding of items: Students' dataset

Variables	Items	Item Coding	Metrics Coding
Social presence	Open communication between the students Students expressing their feelings, emotions, values, and beliefs Collaborative activities between students Students feel secure to communicate Student and facilitator/lecturer communication Collaboration between students and academics Group cohesion (the extent to which students are committed to the group and its goals) Mutual trust among the students Structures, systems, and opportunities that support social interaction in online learning	SSCLP	SSCLP1–SSCLP9
Cognitive presence	Students able to explore, integrate and apply knowledge High level thinking tasks/application type of activities Activities that promote critical thinking and problem-solving skills among students Students-led discussions Peer review discussions Grouping students with different personalities Teacher/facilitator presence during the learning process	SCOGP	SCOGP1–SCOGP7
Learner presence	Self-efficacy Environment	SLNRP	SLNRP1–SLNRP2
Student skills	Technical skills Digital skills	SSKLS	SSKLS1–SSKLS3

Variables	Items	Item Coding	Metrics Coding
	Computer literacy		
Technology	Intelligent tutoring systems Applications that enable online learning Applications that enable effective collaborations between students and teachers Digital learning platforms or LMSs	STECH	STECH1–STECH4
Infrastructure	Network infrastructures. Reliable network, data, or digital bandwidth Reliable electricity Connectivity	SINFR	SINFR1–SINFR4
Environment	Students have a conducive and safe environment Environment that cultivates interpersonal relationships between facilitator and students	SENVR	SENVR1–SENVR2

The researcher conducted independent assessments of the Cronbach's alpha for constructs in the students' dataset, as presented in Table 4.6. The findings indicated a strong internal consistency among all the evaluated scales except one. The social presence scale, comprising nine items (SSCLP1–SSCLP9), showed high reliability with a Cronbach's alpha coefficient of 0.878. The cognitive presence scale, consisting of seven items (SCOGP1–SCOGP7), demonstrated good internal consistency of 0.828, while the learner presence scale, encompassing two items (SLNRP1–SLNRP2), yielded a questionable reliability coefficient of 0.668. The student skills scale, composed of three items (SSKLS1–SSKLS3), exhibited a good reliability of 0.759. The technology scale, with four items (STECH1–TECH4), displayed a good internal consistency of 0.765, whereas the infrastructure scale, consisting of four items (SINFR1–SINFR4), showed good reliability ($\alpha = 0.789$). However, the environment scale, composed of two items (SENVR1–SENVR2), demonstrated a lower level of reliability, with a Cronbach's alpha coefficient of 0.520. Table 4.7 is a detailed summary of these reliability results.

Table 4.7 Construct reliability statistics for the Likert scale of the students' dataset

Constructs/Items	No. of Items	Cronbach's Alpha (α)
SSCLP	9	0.878
SCOGP	7	0.828
SLNRP	2	0.668
SSKLS	3	0.759

Constructs/Items	No. of Items	Cronbach's Alpha (α)
STECH	4	0.765
SINFR	4	0.879
SENVR	2	0.520

4.9.3 Cronbach's Alpha Based on Standardised Items

Once this process was completed, the researcher tested Cronbach's alpha by combining all the constructs to measure the reliability of a group of items inside a scale or questionnaire. The researcher wanted to reflect the extent to which items within instruments measure various aspects of the same construct. The scale spans from 0 to 1, where higher numbers correspond to more reliability. A Cronbach's alpha value of 0.955 in this research indicated a remarkably high level of internal consistency among the items. This implies a strong correlation among the items in the scale, which means they assessed the same underlying concept.

Table 4.8 and Table 4.9 show the Cronbach's alpha based on the standardised items for the academics' and students' datasets. This is an alternative calculation of Cronbach's alpha that relies on the standardised values of the items. Standardising entails converting the initial scores to achieve an average of 0 and a standard deviation of 1. The equivalence between the Cronbach's alpha calculated using standardised items and the original scale's Cronbach's alpha was 0.955 for the academics' dataset and 0.909 for the students' dataset, which indicates that the scale's reliability was strong and was not significantly affected by the scale of measurement or variability in the original items. The number of items denotes the overall count of items included in the scale employed for the calculation of Cronbach's alpha.

In summary, the high Cronbach's alpha values (both original and based on standardised items) indicated that the collection of 31 items portrayed a high level of internal consistency, which was similar to that of the independent items. This suggested that these items reliably measured the same underlying construct. Typically, this is viewed as a favourable result because it indicates that the items in these scales are reliable and consistent in assessing the intended concept.

Table 4.8 Reliability: Cronbach's alpha on all Likert-scale items for the academics' dataset

Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
0.955	0.955	31

Table 4.9 Reliability: Cronbach's alpha on all Likert-scale items for students' dataset

Cronbach's alpha	Cronbach's Alpha Based on Standardised Items	N of Items
0.909	0.909	31

4.10 Construct Validity

Construct validity refers to the extent to which a test effectively measures the exact notion or concept it was designed to evaluate. The measurement instrument assesses the intended notion by evaluating the relationships between variables. Convergent validity is a types of construct validity, and to test convergent validity, the researcher had to check the correlation of all the constructs.

4.10.1 Convergent Validity

Convergent validity is the extent to which two measures of variables are expected to be connected and demonstrate a relationship (Strauss & Smith, 2009). Convergent validity was carried out to test the relationships between the constructs and the results are shown in Table 4.10. This table presents the correlations between the various constructs to provide information about the relationships between the different constructs to help understand the patterns and associations within the dataset.

Table 4.10 Correlations of different constructs within the academics' dataset

		SCP	COG	LNR	ACAD	TECH	INFR	ENVR
SCP	Pearson correlation	1	0.786**	0.448**	0.459**	0.459**	0.349**	0.716**
	Sig. (2-tailed)		<0.001	<0.001	<0.001	<0.001	0.002	<0.001
	N	77	77	77	77	77	77	77
COG	Pearson correlation	0.786**	1	0.594**	0.600**	0.600**	0.450**	0.826**
	Sig. (2-tailed)	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001
	N	77	77	77	77	77	77	77
LNR	Pearson correlation	0.448**	0.594**	1	0.447**	0.447**	0.306**	0.557**
	Sig. (2-tailed)	<0.001	<0.001		<0.001	<0.001	0.007	<0.001
	N	77	77	77	77	77	77	77
ACAD	Pearson correlation	0.459**	0.600**	0.447**	1	1.000**	0.297**	0.632**
	Sig. (2-tailed)	<0.001	<0.001	<0.001		<0.001	0.009	<0.001
	N	77	77	77	77	77	77	77
TECH	Pearson correlation	0.459**	0.600**	0.447**	1.000**	1	0.297**	0.632**
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001		0.009	<0.001
	N	77	77	77	77	77	77	77
INFR	Pearson correlation	0.349**	0.450**	0.306**	0.297**	0.297**	1	0.490**

		SCP	COG	LNR	ACAD	TECH	INFR	ENVR
	Sig. (2-tailed)	0.002	<0.001	0.007	0.009	0.009		<0.001
	N	77	77	77	77	77	77	77
ENVR	Pearson correlation	0.716**	0.826**	0.557**	0.632**	0.632**	0.490**	1
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
	N	77	77	77	77	77	77	77
** Correlation is significant at the 0.01 level (2-tailed)								

The following are the results of the convergent validity test for the academics' dataset:

- **Social presence (SCP) with other constructs:** Strong positive correlations (significant at the 0.01 level) with cognitive presence (COG; r = 0.786), academic skills (ACAD; r = 0.459), technology (TECH; r = 0.459), and environment (ENVR; r = 0.716). Moderate positive correlation (significant at the 0.01 level) with learner presence (LNR; r = 0.448), and positive correlation (significant at the 0.01 level) with infrastructure (INFR; r = 0.349).
- **Cognitive presence (COG) with other constructs:** Strong positive correlations (significant at the 0.01 level) with social presence (SCP; r = 0.786), academic skills (ACAD; r = 0.600), technology (TECH; r = 0.600), and environment (ENVR; r = 0.826). Moderate positive correlations (significant at the 0.01 level) with learner presence (LNR; r = 0.594) and infrastructure (INFR; r = 0.450).
- **Learner presence (LNR) with other constructs:** Moderate positive correlations (significant at the 0.01 level) with social presence (SCP; r = 0.448), cognitive presence (COG; r = 0.594), environment (ENVR; r = 0.557), academic skills (ACAD; r = 0.447), technology (TECH; r = 0.447), and infrastructure (INFR; r = 0.306).
- **Academic skills (ACAD) with other constructs:** Strong positive correlations (significant at the 0.01 level) with cognitive presence (COG; r = 0.600), technology (TECH; r = 1.000), and environment (ENVR; r = 0.632). Moderate positive correlations (significant at the 0.01 level) with social presence (SCP; r = 0.459), learner presence (LNR; r = 0.447) and infrastructure (INFR; r = 0.297).
- **Technology (TECH) with other constructs:** Strong positive correlations (significant at the 0.01 level) with cognitive presence (COG; r = 0.600), academic skills (ACAD; r = 1.000), and environment (ENVR; r = 0.632). Moderate positive correlations (significant at the 0.01 level) with social presence (SCP; r = 0.459), learner presence (LNR; r = 0.447) and infrastructure (INFR; r = 0.297).

- **Infrastructure (INFR) with other constructs:** Moderate positive correlations (significant at the 0.01 level) with social presence (SCP; r = 0.349), cognitive presence (COG; r = 0.450), learner presence (LNR; r = 0.306), academic skills (ACAD; r = 0.297), technology (TECH; r = 0.297), and environment (ENVR; r = 0.490).
- **Environment (ENVR) with other constructs:** Strong positive correlations (significant at the 0.01 level) with social presence (SCP; r = 0.716), cognitive presence (COG; r = 0.826), learner presence (LNR; r = 0.557), academic skills (ACAD; r = 0.632), technology (TECH; r = 0.632), and infrastructure (INFR; r = 0.490).

In summary, most constructs for the academics' dataset showed strong positive and moderate positive correlations with each other, indicating a high degree of interrelatedness. This suggests that changes in one construct were associated with changes in others, highlighting the interconnected nature of the variables within the dataset.

Table 4.11 presents the correlations between the various constructs for the students' dataset to provide information about the relationships between the different constructs.

Table 4.11 Correlations of different constructs within the students' dataset

		SSCLP	SSCOG	SLRNP	SSKLS	STECH	SINFR	SENVR
SSCLP	Pearson correlation	1	0.440**	0.440**	0.449**	0.488**	0.167	0.442**
	Sig. (2-tailed)		<0.001	<0.001	<0.001	<0.001	0.120	<0.001
	N	88	88	88	88	88	88	88
SSCOG	Pearson correlation	0.440**	1	0.185	0.431**	0.540**	-0.023	0.192
	Sig. (2-tailed)	<0.001		0.085	<0.001	<0.001	0.831	0.072
	N	88	88	88	88	88	88	88
SLRNP	Pearson correlation	0.440**	0.185	1	0.413**	0.398**	0.363**	0.453**
	Sig. (2-tailed)	<0.001	0.085		<0.001	<0.001	<0.001	<0.001
	N	88	88	88	88	88	88	88
SSKLS	Pearson correlation	0.449**	0.431**	0.413**	1	0.455**	0.219*	0.481**
	Sig. (2-tailed)	<0.001	<0.001	<0.001		<0.001	0.041	<0.001
	N	88	88	88	88	88	88	88
STECH	Pearson correlation	0.488**	0.540**	0.398**	0.455**	1	0.315**	0.548**
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001		0.003	<0.001
	N	88	88	88	88	88	88	88
SINFR	Pearson correlation	0.167	-0.023	0.363**	0.219*	0.315**	1	0.417**
	Sig. (2-tailed)	0.120	0.831	<0.001	0.041	0.003		<0.001
	N	88	88	88	88	88	88	88

		SSCLP	SSCOG	SLRNP	SSKLS	STECH	SINFR	SENVR
SENVR	Pearson correlation	0.442**	0.192	0.453**	0.481**	0.548**	0.417**	1
	Sig. (2-tailed)	<0.001	0.072	<0.001	<0.001	<0.001	<0.001	
	N	88	88	88	88	88	88	88
** Correlation is significant at the 0.01 level (2-tailed)								
* Correlation is significant at the 0.05 level (2-tailed)								

The following are the results of the convergent validity test for the students' dataset:

- **Social presence (SSCLP) with other constructs:** Strong positive correlations (significant at the 0.01 level) with student skills (SSKLS; r = 0.449), technology (STECH; r = 0.488), and environment (SENVR; r = 0.442). Moderate positive correlations (significant at the 0.01 level) with cognitive presence (SSCOG; r = 0.440), learner presence (SLRNP; r = 0.440), and infrastructure (SINFR; r = 0.167).
- **Cognitive presence (SSCOG) with other constructs:** Moderate positive correlations (significant at the 0.01 level) with technology (STECH; r = 0.540) and environment (SENVR; r = 0.192), Moderate positive correlation (significant at the 0.05 level) with student skills (SSKLS; r = 0.431). Moderate positive correlations with social presence (SSCLP; r = 0.440) and learner presence (SLRNP; r = 0.185) and statistically significant.
- **Learner presence (SLRNP) with other constructs:** Moderate positive correlations (significant at the 0.01 level) with student skills (SSKLS; r = 0.413), cognitive presence (SSCOG; r = 0.185), environment (SENVR; r = 0.453), social presence (SSCLP; r = 0.440), student skills (STECH; r = 0.398), and technology (SINFR; r = 0.363).
- **Student skills (SSKLS) with other constructs:** Moderate positive correlations (significant at the 0.01 level) with social presence (SSCLP; r = 0.449), cognitive presence (SSCOG; r = 0.431), learner presence (SLRNP; r = 0.413), technology (STECH; r = 0.455), and environment (SENVR; r = 0.481). A moderate positive correlation (significant at the 0.05 level) with infrastructure (SINFR; r = 0.219).
- **Technology (STECH) with other constructs:** Strong positive correlations (significant at the 0.01 level) with cognitive presence (SSCOG; r = 0.540), social presence (SSCLP; r = 0.488), learner presence (SLRNP; r = 0.363), student skills (SSKLS; r = 0.455), and environment (SENVR; r = 0.548). A moderate positive correlation (significant at the 0.01 level) with infrastructure (SINFR; r = 0.315).

- **Infrastructure (SINFR) with other constructs:** Moderate positive correlations (significant at the 0.01 level) with learner presence (SLRNP; r = 0.363), student skills (SSKLS; r = 0.219), technology (STECH; r = 0.315), environment (SENVR; r = 0.417), social presence (SSCLP; r = 0.167). Weak correlation with cognitive presence (SSCOG; r = -0.023), indicating that the correlation between these constructs is not statistically significant.
- **Environment (SENVR) with other constructs:** Moderate positive correlations (significant at the 0.01 level) with social presence (SSCLP; r = 0.442), cognitive presence (SSCOG; r = 0.192), learner presence (SLRNP; r = 0.453), student skills (SSKLS; r = 0.481), technology (STECH; r = 0.548), and infrastructure (SINFR; r = 0.417).

In summary, there are significant positive correlations among most of the constructs for the students' dataset, indicating interrelatedness between different dimensions of presences and other factors. It is worth noting the outlier in the students' dataset: The results show no relationship between the infrastructure and cognitive construct, meaning the relationship is statistically insignificant.

4.11 Triangulation

Triangulation is using multiple methods or data sources to develop a comprehensive understanding of a phenomenon (Burns, 2010; Cohen et al., 2002; González, 2010). The goal is to ensure validity or the quality of a study by cross-checking data from different sources (Burns, 2010; Cohen et al., 2002; Mathison, 1988). Triangulation is used to increase credibility and check dependability by obtaining information from different sources to form consistent themes in a study. There are different types of triangulations, namely methods, investigator, theory, data source, and data analysis triangulation. The following triangulation types were used in the current study

- **Methods triangulation:** This is when multiple methods are used to collect the data. In this study, the researcher used a questionnaire instrument with close- and open-ended questions and document analysis, which entailed reviewing and analysing annual reports, websites and magazines (Cohen et al., 2002; Mathison, 1988). The different data collection methods were used at the same time.

- **Theory triangulation:** This refers to the use of different theories to interpret and analyse the data. The researcher used the CoI framework, the collected data, and the literature review to analyse and interpret the findings of this research (Mathison, 1988).
- **Data source:** This refers to using different sampling methods and frames. In this study, the sampling frame consisted of three South African universities and stratified random sampling, in which only third- and fourth-year students participated. This was intentional as the researcher needed responses from a group of people with relevant knowledge and a certain expertise. The researcher also needed responses from people who shared similar attributes and experiences, and these were the students and academics.
- **Data analysis:** This refers to using different approaches of analysis for the same data. In this study, the researcher used inductive and deductive approaches. An inductive data analysis approach is when the researcher draws findings and themes out of the data, and a deductive approach is when the researcher draws and uses the same data to explore or test existing theories and concepts.

Triangulation was crucial in this study because it enabled the researcher to discover the complexities of the phenomena under study and provided insights into the subject matter without generalisation.

4.12 Ethical Issues

Ethics refers to standards and rules of conduct that direct proper choices regarding people's relationships with others and their behaviour (Punjwani, 2015). The researcher considered ethical implications by giving ethical issues great priority in this study. The researcher adhered to the principles of ethics, namely carefulness, integrity, objectivity and honesty. The respondents were informed of the aims of the research and that all data received would be treated with the strictest confidence (Hitesh, 2020). In all the research instruments, confidentiality and anonymity were respected, and respondents were asked for their consent before carrying on with the questionnaire. Names were replaced with pseudonyms. The respondents were not forced to answer questions with which they were uncomfortable. Their autonomy and decisions were respected. Authorisation from all the universities that participated in this study was obtained before the data were collected (Annexures 1–3). All research data, including the questionnaires and consent forms, are stored online on the university drives.

4.13 Concluding Remarks

This chapter discussed the research paradigm, strategy, approach, sampling, research instruments, and data analysis. These were discussed in detail with reference to the context of the study. The validity and reliability of the data, as well as ethical considerations were also discussed. In the next chapter, the researcher answers the research questions.

CHAPTER 5: DATA ANALYSIS AND DISCUSSION OF FINDINGS

5.1 Chapter Overview

The preceding chapter examined the research methods employed in this study. The chapter delineated the research methodology, paradigm, and strategy, and the study design and data gathering methodologies. This chapter analyses the acquired data using descriptive, thematic, factor, and content analysis and EFA methodologies. The results were analysed according to themes and subthemes. The theme is synonymous with the study's purpose. Descriptive analysis characterises the world or a phenomenon by answering questions about who, what, where, when, and to what extent (Loeb et al., 2017). The goal was to identify and describe trends and variation in populations, create new measures of key phenomena, and describe samples in studies to identify causal effects. Description plays a critical role in the scientific process in general and in education research in particular (Loeb et al., 2017). Thematic analysis defines, evaluates and reports on trends or themes within a qualitative dataset. Thematic analysis is a descriptive technique that produces data in a flexible way that suits other methods of data analysis (Braun, 2013). Content analysis provides the opportunity for researchers to understand the significance of a phenomena, which could contribute to a study, through verbal or written communication materials (Bowen, 2009). EFA was used to discover the factor structure of a measure and to examine its internal reliability (Bandalos & Finney, 2018; Suhr, 2006). At the end of this chapter, a summary of the study findings is presented for each theme.

Table 5.1 presents relationships between the research questions, theme, objectives, and the theory used as a lens.

Table 5.1 Research questions, objectives and theoretical lenses used

Research Questions	Research Objectives	Themes	Theories
What is the efficacy of digital technology enabled education in HEIs?	To assess the efficacy of digital technology enabled education in HEIs	• The efficacy of digital technology enabled education • The impact of ERT	• Literature review
How does digitalisation enhance student performance and experiences in HEIs?	To explore how digitalisation enhances student experience in HEIs	• Digitalisation • Modes of instructional delivery • Technology enabled assessments	• Literature review • Content analysis

Research Questions	Research Objectives	Themes	Theories
What is the impact of digital education on student performance?	To explore the impact of digital education on student performance	• The impact of digital education on student performance	• Literature review • Content analysis
Which factors contribute to successful digital technology enabled education?	To analyse the factors that contribute to the success of digital technology enabled education	• Social presence, cognitive presence, learner presence, academics skills, student skills, technology, infrastructure, and environment	• CoI framework • Literature review
What framework can be implemented to ensure the successful integration of digital technology enabled education at HEIs?	To develop a conceptual framework for successful integration of digital technology enabled education at HEIs	• Framework for successful digital technology enabled education	• CoI framework • Literature review

To respond to these research question, this chapter presents the results obtained from the analysis of the frequencies and descriptive statistics of the demographics of the respondents for both academics and students and then responds to the questions sequentially and discusses the themes.

5.2 Descriptive Frequency Analysis

Frequency analysis is a descriptive statistical technique that displays how often each response was selected by the respondents (Field, 2013). The researcher used the SPSS programme to calculate the mean, median and mode to analyse the results to draw conclusions. The following subsections look at the demographics of the academics and the students.

5.2.1 Descriptive Frequency Demographics: Academics

Table 5.2 presents the demographics of the academic participants. The survey received a total of 77 responses from academic participants. The breakdown included insightful information about the demographics of the respondents, such as their affiliated universities, faculties, gender, age groups, and the year of study (YOS) the academics teach. Notably, the researcher categorised the universities instead of using their actual names. The university distribution of the responses was as follows: University classified as metropolitan accounted for 39.0% of the sample (n = 30), university classified as rural contributed 27.3% of the sample (n = 21), and university classified as semi-rural contributed 33.8% of the sample (n = 26). The distribution by faculty portrayed participation from various academic areas. Commerce, Law & Management represented 31.2% of

the sample (n = 24), the Faculty of Health Sciences comprised 9.1% of the sample (n = 7), the Faculty of Humanities constituted 31.2% of the sample (n = 24), and the Faculty of Science accounted for 28.6% of the sample (n = 22). In terms of age distribution, respondents aged 18 to 25 years made up 1.3% of the sample (n = 1), those between 26 and 35 years represented 20.8% of the sample (n = 16), the 36–45 age bracket constituted 28.6% of the respondents (n = 22), individuals aged 46 to 55 contributed 23.4% to the sample (n = 18), and respondents aged over 55 years made up 26.0% of the overall dataset (n = 20). It was interesting to note that the highest percentage of academic respondents were over 55 years of age. The gender distribution revealed that males constituted 57.1% of the sample (n = 44), while females made up 42.9% of the sample (n = 33). In terms of the YOS the academics taught, YOS 1 accounted 59% of the sample (n = 46), YOS 2 accounted for 54.5% of the sample (n = 42), YOS 3 constituted 53.2% of the sample (n = 41), and YOS 4 represented 42.9% of the sample (n = 33).

Table 5.2 Descriptive statistics of the demographics of the respondents: Academics

Factor	Items	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
University	Metropolitan	30	39.0	39.0	39.0
	Rural	21	27.3	27.3	27.3%
	Semi-rural	26	33.8	33.8	33.8%
	Total	77	100.0	100.0	
Faculty	Commerce, Law & Management	24	31.2	31.2	31.2
	Health Sciences	7	9.1	9.1	9.1
	Humanities	24	31.2	31.2	31.2%
	Science	22	28.6	28.6	28.6%
	Total	77	100.0	100.0	
Age	18–25 years	1	1.3	1.3	1.3
	26–35 years	16	20.8	20.8	20.8
	36–45 years	22	28.6	28.6	28.6
	46–55 years	18	23.4	23.4	23.4
	>55 Years	20	26.0	26.0	26.0%
	Total	77	100.0	100.0	
Gender	Male	44	57.1	57.1	57.1
	Female	33	42.9	42.9	42.9
	Total	77	100.0	100.0	
YOS Taught	YOS 1	46	59.7	59.7	59.7
	YOS 2	42	54.5	54.5	54.5
	YOS 3	41	53.2	53.2	53.2

Factor	Items	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
	YOS 4	33	42.9	42.9	42.9
	Total	77	100.0	100.0	

5.2.2 Descriptive Frequency Demographics: Students

Table 5.3 present the demographics of the student participants. The survey garnered a total of 88 responses, which gave insightful information about the demographics of the respondents, such as their affiliated universities, faculties, gender, age groups, and YOS. Notably, pseudonyms were used instead of real names for confidentiality. The university distribution of the responses is as follows: University classified as metropolitan accounted for 34.1% of the sample (n = 30), university classified as rural contributed 29.5% (n = 26), and the university classified as semi-rural contributed 36.4% (n = 32). The breakdown by faculty reflects diverse academic areas: Commerce, Law & Management represented 17.0% (n = 15), Health Sciences represented 1.1% (n = 1), Humanities represented 64.8% (n = 57), and Science represented 17.0% (n = 15). Age-wise, respondents aged 18 to 25 constituted 81.8% of respondents (n = 72), 26 to 35 years represented 14.8% (n = 13), 36–45 years made up 2.3% (n = 2), and 46 to 55 contributed 1.1% (n = 1). Gender distribution showed males at 52.3% (n = 46) and females at 47.7% (n = 42). With regards to YOS, only students registered for YOS 3 and YOS 4 were targeted, given their exposure to Covid-19 and the shift from face-to-face to ERT and online learning. YOS 3 represented 51.1% of the sample (n = 45), and YOS 4 accounted for 48.9% (n = 43).

Table 5.3 Descriptive statistics of the demographics of the respondents: Students

Factor	Items	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
University	Metropolitan	30	34.1	34.1	34.1
	Rural	26	29.5	29.5	63.6
	Semi-rural	32	36.4	36.4	100.0
	Total	88	100.0	100.0	
Faculty	Commerce, Law & Management	15	17.0	17.0	17.0
	Health Sciences	1	1.1	1.1	18.2
	Humanities	57	64.8	64.8	83.0
	Science	15	17.0	17.0	100.0
	Total	88	100.0	100.0	
Age	18–25 Years	72	81.8	81.8	81.8
	26–35 Years	13	14.8	14.8	96.6

Factor	Items	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
	36–45 Years	2	2.3	2.3	98.9
	46–55 Years	1	1.1	1.1	100.0
	Total	88	100.0	100.0	
Gender	Male	46	52.3	52.3	52.3
	Female	42	47.7	47.7	100.0
	Total	88	100.0	100.0	
YOS	YOS 3	45	51.1	51.1	51.1
	YOS 4	43	48.9	48.9	100.0
	Total	88	100.0	100.0	

5.3 The Efficacy of Digital Technology Enabled Education

This section looks at responses related to the first research question:

- **RQ1:** What is the efficacy of digital technology enabled education in HEIs?

In responding to the first research question and meeting the research objective, academics were asked whether the courses they taught included practicals or laboratory work during the pandemic and how they navigated this. This was to ascertain the level of impact Covid 19 had on academics and students and whether their teaching or learning experiences were enhanced or degraded. This question was important as the researcher needed to ascertain the impact of the transition from face-to-face to ERT and online learning as well as the balance between theory and practicals in their courses. Figure 5.1 shows that 49% of respondents indicated that their courses required some practical work, and 51% said their courses did not require practical work.

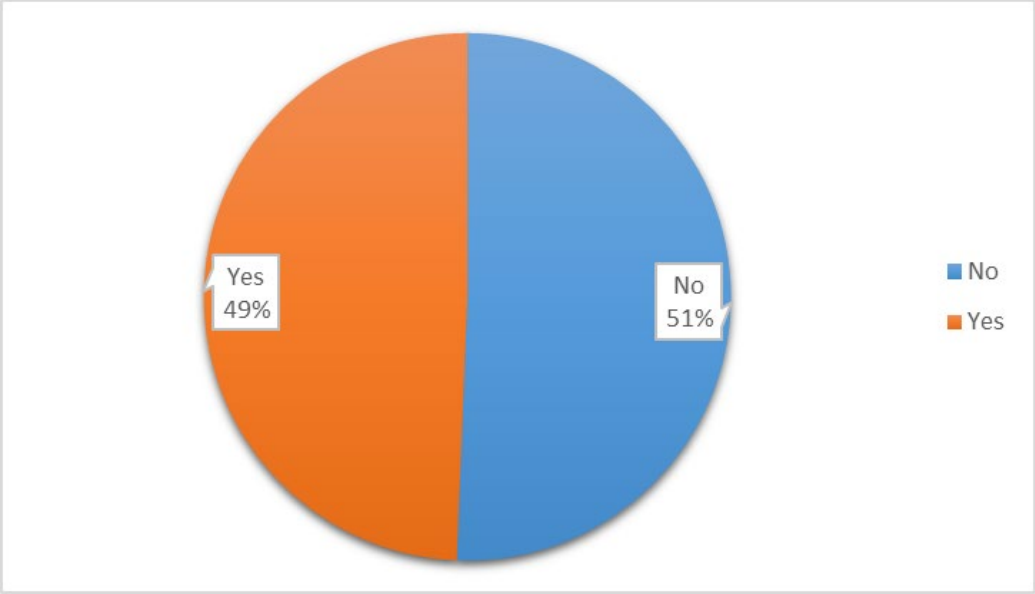


Figure 5.1 Frequencies: Academics who taught courses with practical or laboratory work during the Covid-19 pandemic

As a follow-up question, the researcher asked how the academics managed or conducted the practical or laboratory work and assessments during the pandemic era. Interestingly, the academics said the following:

> I was unable to do much practical work, except in the Experimental Archaeology Class (third year) where students did the experiments at home, and we conducted WhatsApp conversations about them. (Dr Kay)
>
> Students' academic practicals was stopped for a while then slowly commenced with eased restrictions. (Dr Muller)
>
> With great difficulty! But mostly by breaking up classes into smaller groups and with lots of sanitiser/wipes for shared equipment. (Prof Mothoa)
>
> Our practical work (programming) requires a computer, so if students had access to a laptop and the necessary application software, they were good to continue. From a teaching perspective, I applied demonstration and walkthroughs using MS Teams screen sharing functionality. Additionally, to assist to prepare students better or learn and grasp the concepts better I provided students with resources such as links to videos which contained the concepts that we were learning. (Dr Moepi)

> We recorded the practical narration for students to access. Once students have watched the video, we shared an excel file with data and questions to practice what they saw in the narration. Thereafter, students would complete an excel quiz that was shared on the LMS. The quiz was multiple choice to allow for ease of response. (Dr Cebo)
>
> Had online practicals, through recorded demonstrations and other online (external) sources for students to observe expected changes. (Prof Mbele)

Some of these experiences revealed the affordance of virtual online and learning platforms used by educational institutions, such as Moodle, MS Teams, WhatsApp and Google Classrooms (Khoza & Mpungose, 2020; Ma et al., 2021). These virtual online and learning platforms offer many benefits such as flexibility, reduced cost, more free time, increased collaboration, personalised education, enhanced time management skills, and immediate feedback (Fadda, 2019; Francom et al., 2021; Hallal et al., 2020).

Similar to the academics, the researcher asked students whether their courses included practical work such as laboratory or practical assessments. Figure 5.2 shows that 74% of respondents indicated that their courses required some laboratory or practical work, and 26% did not require practical work. It appears that most courses required laboratory or practical work, which attests to the need for courses to have a balance of theory and practicals, regardless of the mode of instructional delivery.

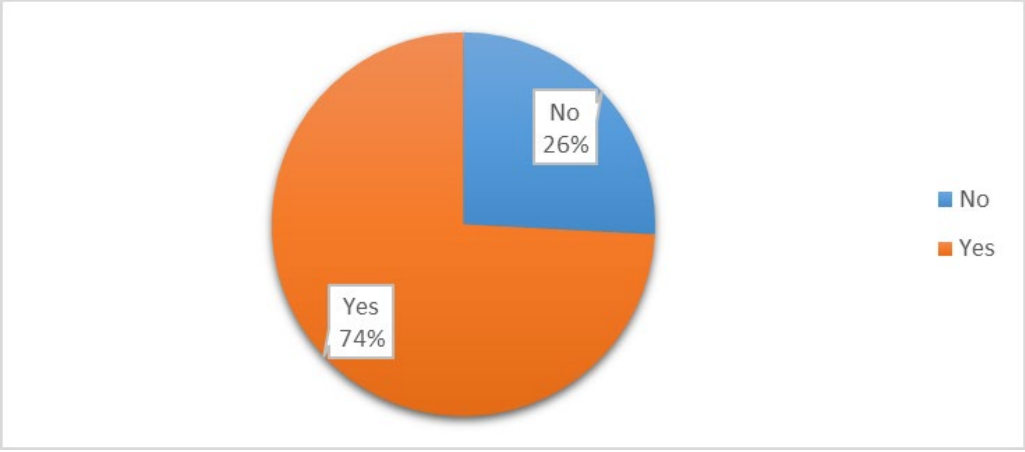


Figure 5.2 Frequencies: Student who had courses with practical or laboratory work during the Covid-19 pandemic

The researcher followed up on this question by asking the students to elaborate on how they managed to conduct their practical work during the pandemic period. They responded as follows:

All practical work had to be converted to theoretical alternatives. (Nomhle)

Practical's were cancelled. (Raven)

During the pandemic period as students we were not able to go to schools to do practical work instead a new digital course for teaching experienced was introduced. (Sipho)

Through online simulations that were provided. (Mpho)

Through using online platforms. (Setsi)

It was not easy but practical work was done online using videos conferencing platforms. (Lesedi)

I used videos to record myself while doing practical. (Bokamo)

We used to conduct online platforms such as Moodle and Blackboard to do the assessments. (Thego)

Digital technologies emerged as a viable answer. Digital technologies have the potential to enhance education in several ways, including facilitating the creation of instructional materials by teachers and offering novel approaches for learning and collaboration (Haleem et al., 2022; Johnstone et al., 2022). Digitised technologies include a wide range of gadgets, including personal computers, tablets, cameras, software and applications, augmented and virtual reality, and intangible forms of technology like the internet.

Some students expressed a favourable attitude towards using virtual learning tools or platforms for educational purposes because they allowed them to connect with peers, access content, interact with teachers, and access other learning resources (Khoza & Mpungose, 2020; Ma et al., 2021; Xue et al., 2023). Dipho mentioned, "we had a support group. we would have sessions via Microsoft Teams". Hallal et al. (2020) emphasised the importance of promoting interaction, collaboration, notifications and engagement.

As much as the use of virtual online learning platform was an option for these universities, it appeared that the swift transition from face-to-face to ERT and online learning was not easy for some students. This could be attributed to educational affordances, technical efficacy, technological affordances, social affordances and access. Pontso stated, "I didn't manage it was hard", while other students managed very well. Rophiwa was positive and said, "It was nice

because it was online". The difference between Rophiwa and Pontso can be attributed to equality and equity issues. While all the universities' disadvantaged students were provided with devices and data, there were other educational barriers that affected their academic performance. In this case, both learners had resources that were deemed necessary to learn online, but one student experienced it as hard. This could be because of barriers such as environment, access, and technology. In addition, for any online learning, time management is very important (Fadda, 2019). Students must be disciplined enough to actively become involved in a class and participate and engage with all the online resources. Hlompho mentioned that he "managed time well", while Lerato said "I didn't have practical work".

In summary, academics and students emphasised the necessity of educational, technical, technological, social, environmental, access, and infrastructure affordances. Educational affordances pertain to the instructional and learning activities that are made possible by the online learning platform. Technological affordances, on the other hand, relate to the perceived ease of use that academics and students experience when using online learning platforms. Social affordances encompass the features of a technological tools that enable and enrich social interactions among its users (Kirschner & Wopereis, 2003; Weidlich & Bastiaens, 2019; Xue et al., 2023). Another element that students emphasised can be linked to inequalities in resources. The sudden implementation of virtual teaching and online learning worsened the existing gap in learning technology in South Africa and particularly affected low-income students who had difficulties accessing computing resources and ongoing courses because of limited internet connectivity and power outages. Dlamini and Ndzinisa (2020) highlighted problems with infrastructure and specifically indicated that obstacles such as limited adoption of ICTs, lack of internet connectivity, and unreliable electricity hindered the shift towards digitalisation. The introduction of virtual teaching and learning tools was a viable answer for certain academics and students, but it did not meet everyone's needs. While some academics successfully transitioned to virtual teaching, others encountered difficulties, which highlights the need for academic training in this area. While some students found online learning to be effortless, others had significant difficulties.

5.4 The Impact of Emergency Remote Teaching

To further answer the first research question, the researcher looked at the impact or ERT on the academics and students.

5.4.1 The Impact of ERT: Academics' Perspectives

In trying to understand the impact of ERT on academics, they were asked how the lockdown that resulted in ERT affected their teaching. It appeared that the pandemic forced academics to swiftly transition from face-to-face teaching to online instructional delivery despite the readiness. Prof Kay said they "switched to online teaching", and Dr Yokong said, "We had to move all activities online". Dr Legong found it very difficult and said the following:

> I had to quickly adapt to a new method of teaching which I had never been exposed to before. It was very challenging in the beginning for both me and the students.
>
> I found that preparation took twice of my time than with in-person teaching, students were less engaged behind screens, students knew material was going to be recorded so they did not diligently attend classes, no personal touch with students and as a result I do not have memory of who was in my class—the whole experience was very impersonal.
>
> Assessments were difficult to do with credibility because students found creative ways to cheat, copy each other and make a lot of excuses for not submitting on time.

Dr Molobye echoed Dr Legong's sentiments and mentioned the following:

> It increased my workload drastically: I used to talk off the cuff with a great deal of interactive discussion during class depending on where the class interest was going (within bounds) and this all changed to strictly prepared lectures with no props to hand round amongst the students.

Most academics alluded to the affordance of digital literacy. Digital literacy refers to the ability to use the internet for tasks such as finding, evaluating, assessing, distributing, and generating content (Spante et al., 2018; Widana, 2020). Academics should prioritise enhancing students' technological abilities through interactions, assessments, and feedback to create successful and relevant learning settings (Donahoe, 2019). Prof Muller stated that while others were moving to

online teaching, his students' activities were paused because "students could not go to facilities to do data collection".

5.4.2 The Impact of ERT: Students' Perspectives

The researcher further needed to understand the impact of ERT on students, and therefore, they were asked how the lockdown which resulted in ERT affected their learning.

> Puseletso mentioned, "It made me feel isolated and disconnected". As such, most of the practices and techniques of the disciplines were compromised by the lack of physical contact teaching and learning. "
>
> Lesedi said, "It drained me emotionally and mentally and I felt overwhelmed by my academics".

Amid the Covid-19 pandemic, students encountered significant levels of stress and mental health issues. Doung et al. (2023) emphasised the significance of academic and innovative initiatives to highlight the value of interactive learning and extracurricular activities. Online learning was new to many students, and with the swift transition, not much preparation was done for the students. They were expected to adapt (Duong et al., 2023).

Dimpho's academics did not go well, and he explained

> "I did not do so well when I was isolated from my peers and without structure".

Lerato touched on one of the critical factors and mentioned

> "My home environment was not conducive for learning, so my grades got affected, also the network was bad. Hlompho struggled due to intermitted connection"

It was difficult to adjust to the workload online and connectivity issues played a role. Pheto found it difficult and mentioned that

> "it was really difficult in the beginning. It was hard to adjust and extremely lonely. It is also much easier to lose concentration".

Individuals residing in unfavourable housing circumstances such as shacks were more prone to experiencing heightened distress during the lockdown, which potentially exacerbated psychosocial health consequences. Due to the enduring socio-economic disparities in South Africa, primarily

resulting from the lasting effects of apartheid, the disadvantaged population has experienced further deterioration in their economic conditions. The Covid-19 pandemic has highlighted the significant economic disparities in South Africa (World Bank, 2018). There is significant disparities in development in South Africa, making it one of the most unevenly developed nations globally. This has consequences for the capacity of various cities, towns, and villages to handle shocks and recover from social and economic hardships.

> Like Dimpho, Sarah said, "It affected me in so many ways, firstly, I had to adjust to online and I had to learn to improve my digital technology use to adapt to the new remote learning". However, Sophie mentioned that "it transformed my approach to learning as the reliance on technology increased massively. It also meant that I had to adjust to less social interaction which is important in a learning space". Doreen said the following:
>
> Made things easier. I could save a lot of money on grocery because I was staying at home. I could also save a lot of time to study because I only needed to stay in one place all the time, as opposed to moving from one class to another, to a library, to residence, etc.
>
> But there were obvious distractions studying from home. Examples include the sudden smell of delicious food coming from the kitchen, my mama vacuum cleaning at the wrong time because she woke up on the wrong side of the bed and everyone has to pay for it, the sibling drama, the twin toddlers, oh the noise and the shouting, the gardener picking the worst time to cut the grass outside, our annoying coloured neighbours with their never-ending obsession with loud music, etc. But I survived :)

In summary, rural areas have limited opportunities, and thus, tackling resource equality the same way will not diminish the disparity. Data and devices provided to the students during the pandemic was meant to help them learn online, yet some still struggled. Before the pandemic, the majority of South African universities exclusively relied on face-to-face instruction. Previously, digital literacy was limited to the departments of computer information systems and computer sciences. However, during the pandemic, universities had to offer training for academics and students to adequately address the pressing needs of the time.

5.5 Digitalisation

This section responds to the second research question:

- **RQ2:** How does digitalisation enhance student performance and experiences in HEIs?

Therefore, the section breaks down the respondents' view on whether they were positively affected, not affected, adapted, or negatively affected by the rapid digitalisation forced on them during the pandemic.

5.5.1 Digitalisation: Academics' Perspectives

It was interesting to discover how the academics were affected by the swift digitisation. Figure 5.3 shows how the academics were affected by the effects of digitalisation of teaching processes.

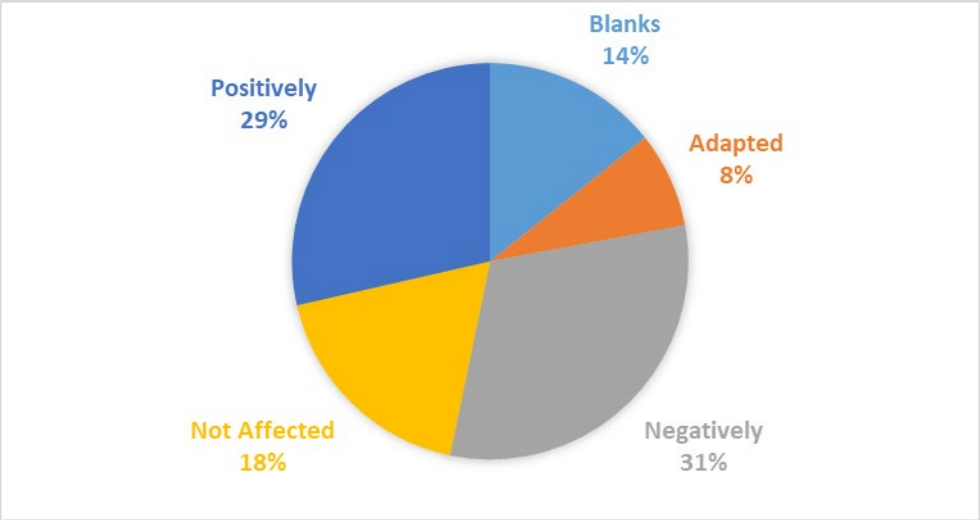


Figure 5.3 Academics' perceptions of the effect of digitalisation on their teaching experience

5.5.1.1 Positively Affected

About 29% of the academics mentioned that digitalisation had a positive impact on them, which suggests that the digital tools and technologies have improved their teaching methods to make them more effective or efficient. The academics made the following comments about being positively affected by digitalisation.

> Well, it enhanced my teaching by way of having to prepare slides and using online white board to write on the touch screen, which my students are all able to see in real time, from the comfort of their space. (Dr Samuel)

For the first time, even the normally quiet students, who wouldn't have been bold to talk in a face-to-face class, are comfortable hiding behind the computer and asking questions. I think it helped that online teaching gave some students the boldness to contribute to class discussions. (Dr Samuel)

Despite the fact that the university had introduced a new LMS as I was joining it, the LMS afforded us the opportunity of sharing slides, videos and other formats. Digitisation for that afforded us the opportunity to reach students better and allow them to learn at their pace before they get to discussions in person in the format of workshops. (Dr Mandla)

It gave me more access to opportunities. Helped me to make my teaching more efficient too. Interestingly these videos are saved and are reused by students, as many times as possible. **(**Dr Zikote)

It resulted in more efficiency and cost saving for the university as we no longer had to print material as we used to. Material could be easily uploaded online, from anywhere and that saves a lot of time and admin. (Dr Phuting)

It saved some of my time by sharing electronic resources with students. (Prof Hlompho)

5.5.1.2 Negatively Affected

About 31% of the academics indicated that digitalisation had a negative impact on academics, which means they experienced challenges incorporating digital technologies into teaching practices, which could be attributed to accessibility and training. The academics responded as follows:

It is not the best way to do teaching, technology is always an issue, not all students have adequate resources such as a stable internet connection or proper laptops—this makes teaching very difficult. (Dr Setlhare)

It was frustrating; there always someone who can't connect. (Dr Sizwe)

Internet access was not an issue thanks to the provision of dongles by my university, however, the main obstacle arose on the students' end, as they experienced difficulties with their own internet connections. Conducting live classes became challenging due to

frequent occurrences of loadshedding and poor internet connectivity in many rural households across South Africa. As a result, I made the decision to opt for pre-recorded videos instead of live lectures. (Dr Mpunguse)

I always used "computers" in teaching, but not seeing students faces while teaching makes it almost impossible to gauge what's happening. (Dr Mongale)

It diminished my interactions with students. (Dr Yolo)

Although I had always used PowerPoint, digitisation meant I had to be far more specific about content in prepared lectures that were put online; I could not tell during a lecture what was of interest or not to students. Some would log in and out and cite network challenges, computers that are not working etc. (Dr Mpho)

I needed training before I digitise my teaching because of new adopted software such as Zoom, and MS Teams and digital divide badly affected my teaching since some of students did not have access to the network in order to connect to the internet. (Dr Clog)

5.5.1.3 Not Affected

About 18% of the academics stated that digitalisation did not affect their teaching. This group perceived minimal changes in teaching methods or outcomes because of the adoption of digital tools. They explained it as follows:

It did not affect the teaching. It was rather switching to another method that is relevant in the 21st century. (Dr Hlompho)

I did not have a lot of issues with adaptation. The only issue was a lack of time as well as difficulty in locating suitable teaching applications and software. But once that was sorted, all was fine. (Dr Mochusi)

Fortunately, I was already quite digitally literate and had been using online platforms such as Ulwazi. However, the whole shift online was difficult for me because of the limited in-person interaction opportunities which, although interaction is possible online, is different to in-person interaction. (Dr Mpedi)

On my side all resources and help were made readily available. I guess a challenge was adapting courses that are designed for face-to-face learning, to now use digital tools.

> Each course has set objectives and some structure to its offering. These were at times challenging to adapt to or modify and offer through digital tools. (Dr Legong)
>
> From the teacher perspective I had no issue as I have all the necessary resources to execute my classes. However, the students as end user, initially had network issues or no data, some had no laptops, some had no working space at home, or their learning was in competition with home chores. (Dr Mothoa)
>
> The adoption of technologies, such as screen recorders, did not really affect me. I'm proficient with all the tools I used. It was more a case of using them more often than when we have contact classes. (Dr Kings)

5.5.1.4 Adapted

About 8% respondents reported that they adapted to digitalisation. These were educators who have adjusted their teaching approaches to accommodate digital technologies, implying a willingness to embrace change. They said the following:

> There was a learning curve that needed to be worked through. (Dr Koos)
>
> It enhanced my teaching. I had to adapt to new ways, but I was already using a bamboo teaching tablet in my classes so that transition was not too tenuous for me. (Dr Dewa)
>
> Initially it was a struggle to adapt to the new approach, especially that the change was sudden. It was a shock response (Dr Leruo)
>
> It was slow at first, but I quickly adapted. (Dr Pheto)

In summary, digitalisation has resulted in a combination of experiences for academics, and they faced significant advantages in terms of accessibility and student involvement, as well as difficulties associated with technology inequities and decreased in-person interaction. The individuals who effectively adapted highlighted the significance of adaptability and a readiness to acquire new skill to augment the efficacy of teaching in the digital era.

5.5.2 Digitilisation: Students' Perspectives

The students were also asked if the digitalisation of learning enhanced their experience. Figure 5.4 shows that 28% indicated that their learning experience was not enhanced, while 72% indicated

that their learning experience was enhanced. More than 70% of students' learning experiences was enhanced, which is in line with the findings of Treve (2021). The author found instances from around the globe that demonstrated that HEIs are rapidly striving to discover suitable solutions to academic challenges. The author mentioned students in Hong Kong who initiated home learning by using interactive applications, and China that enabled almost 120 million pupils to access learning materials through live television broadcasts (World Economic Forum, 2022). In addition, a school in Lebanon implemented online instruction, including for physical education. The Google Meet platform was effectively used in a private school in Georgia that have 950 pupils, and this could be replicated in other countries (Basilaia & Kvavadze, 2020). This suggests that there are growing prospects in digital communication, which enables a novel form of education that could be beneficial for students in the future. Many academic institutions have long been using outmoded classroom- and lecture-based teaching methods. The Covid-19 pandemic has acted as a catalyst for educational institutions to embrace and imbibe innovative technological solutions.

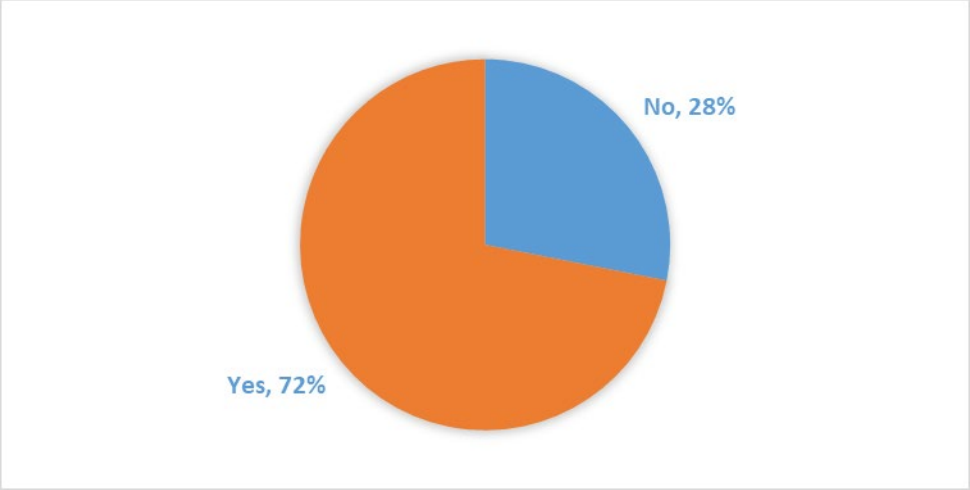


Figure 5.4 Students' perception of the effect of digitalisation on their learning experience

The students were also asked whether their performance was affected in comparison to the years prior to the pandemic because of the digitalisation to ascertain whether digitalisation positively or negatively affected them. The results are in Figure 5.5.

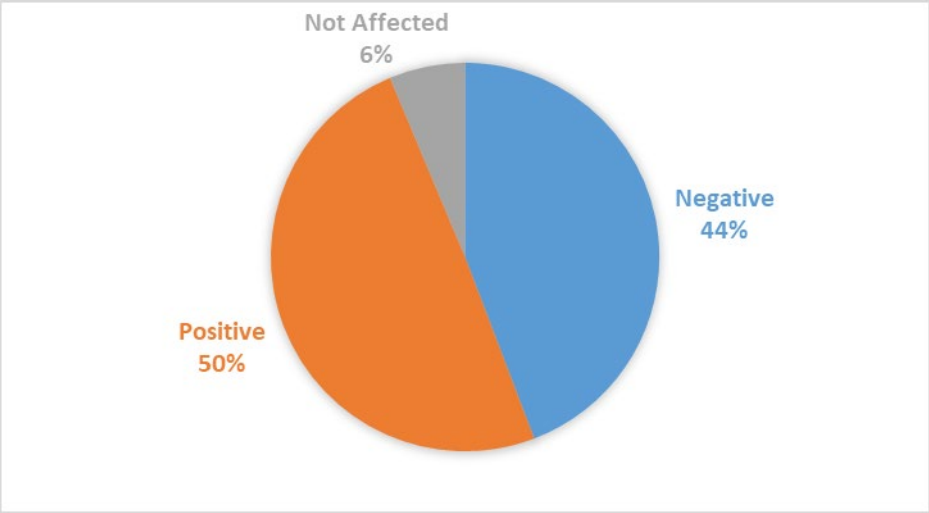


Figure 5.5 The effect of digitalisation on student performance during ERT and online learning

5.5.2.1 Negatively Affected

The students who were negatively affected by the digitalisation of teach and learning said the following about their experiences:

> The pandemic provided an opportunity for online/digital modes to be explored, which was interesting. However, theatre and performance are somatic and ephemeral disciplines that require contact learning for the competency of technique and training to be elevated. (Lesego)

> I no longer had classmates and tutors I could consult, face to face so it made things harder. Also, when I fell behind it was harder to find help. (Lerato)

> It negatively affected my performance as it was harder to concentrate. Being online meant for more distractions such as social media. My performance declined compared to the previous years prior Covid, it was not my usual level of work. (Lesedi)

> It has both positive and negative effects. The negative is the distraction that comes with receiving lectures from home and the personal interaction with other students. (Sibongile)

> I classify myself as part of the Covid cohort. I am now in fourth year and required to transition to face-to-face interactions, I find it difficult to cope with all the work. The

work is now two times more and the travelling in between seems to take up time. My performance has been negatively affected. (Jackson)

5.5.2.2 Positively Affected

Some students found that digitalisation enhanced their learning experience, and they described it as follows:

> Positively, I got to use software I've never used in my life before. (Letlotlo)
>
> Online learning taught me self-discipline as work had to be done on your own when there weren't online lectures. (Mathlatsi)
>
> My performance was affected positively because now I was able to use platforms such as Teams, Zoom, big blue button to learn. I also learned that social media like WhatsApp can also be used to learn and teach, during the pandemic our lecturers and tutors were sometimes communicating and giving instructions via WhatsApp. (Xolani)
>
> I would say both, negatively in the sense that I think attending in person is more engaging than online and positively in that the online (recorded) videos were always available for me to watch and rewatch and learn at my own pace. (Barbie)
>
> I think my experience was affected both positively and negatively. Positive in the sense that the open book aspect of assessments made it easier to achieve better marks and the fact that you could dictate your schedule far more as there was no need to go anywhere. Negative in the sense that you must deal with more technical difficulties, less social interaction and the fact that it was just not an authentic school experience in comparison to the past. (Celiwe)
>
> Both. I did very well because I was able to work at my own pace, but it was also boring because I would lose concentration during online lecturers or be distracted with the other things in the house. (Sindisiwe)
>
> It has both positive and negative effects. The positive is saving petrol and time of driving to campus. (Sibongile)

> Prior to Covid I was performing badly, lecture rooms were intimidating, still are but MS Teams and recorded videos are bearable, and I was able to rewatch as many times as I wanted. (Sipho)
>
> My performance was superb, hence it affected me positively. In the remote learning environment, I found it flexible and accommodating to my needs, The Pandemic has spurred innovation and creativity in the education sector with many teachers and schools developing new approaches to teaching and learning that could have positive long effects. (Brigette)

5.5.2.3 Not Affected

In summary, only 6% of the students was not affected by the transition from face-to-face learning to ERT. Not all student in South Africa has socio-economic problems, and although some are struggling, there are others that are not and were not affected at all by the swift transition from face-to-face learning to ERT and online learning. These are students with no electricity, loadshedding, network and digital technology issues.

5.6 Modes of Instructional Delivery

This section still responds to the second research question and presents the feedback from the participants regarding their views on instructional techniques. The researcher asked the academics about their preferred teaching methods and asked the students which learning method enhanced their learning experience during the pandemic period.

The academics were asked, “In your opinion, which teaching methods is the best?”, and the following subsections discusses the responses related to different teaching methods.

5.6.1 Flipped Learning

Academics across the universities portrayed a preference for the flipped learning approach because of its pedagogical nature. The flipped classroom, sometimes referred to as the student-centred approach, involves providing students with course materials prior to class, which allows them to actively participate and delve deeper during class time (Alexander et al., 2019). This method allows class time to be used for practical activities such as discussions, question-based learning,

and collaborative work to reinforce and applying the knowledge acquired outside the classroom (Aydin & Demirer, 2022). The academics explained their preference as follows:

> It is important that students learn to study by themselves and one way to encourage this is through flipped learning. Also, when flipped learning is operating successfully, it is possible to find out what the students do not understand, much better. (Prof Muranga)
>
> I think the flipped learning would help our students to have the opportunity to engage with active learning during the class time and then read material to supplement active learning at their own time. (Dr Ray)
>
> A flipped approach gives freedom on students to learn in their own time and to then engage in the classroom. (Dr Sethlare)

In a flipped classroom, students can engage in more direct contact with the instructor or their peers and receive personalised feedback during classroom activities. This is made possible by delivering the course materials online before the in-class time (Zappe et al., 2009). This provides a space for students to participate in active learning activities throughout class, such as problem-based learning and group work (Fulton, 2012). Flipped classroom instructors can provide prompt feedback to students as they engage in learning activities that need more advanced cognitive skills (Chen Hsieh et al., 2017). However, Dr Dikalo had a different notion that was explained as follows:

> They are more easily able to determine where their knowledge deficiencies lie if they do not hear the theory for the first time in class but rather focus on the application of that knowledge. However, this must be done strategically (i.e. you cannot just tell them to read the textbook; you probably need some kind of explanation video or something). It also relies on students' preparing BEFORE the class (students' own academic accountability). There is also a risk of overloading students, and careful consideration should be taken in this regard. This approach also (eventually) lightens the load of the lecturer (once the theory videos have been done; then can be reused), giving the lecturer more time to focus on engaging the class with practical application (often overlooked).

Students acquire fundamental knowledge through pre-class readings, podcasts, or films, and subsequently, their comprehension are enhanced through in-class exercises under the instructor's guidance. By adopting this approach, the classroom can dedicate additional time to addressing

students' queries, focus on complex abilities like problem-solving in practical situations, and engage in active learning activities (Yean, 2019).

The researcher asked the students to share how and which learning method enhances their learning experience. The students who said they prefer the flipped learning method explained their preference as follows:

> During the recent protest, for one course the lecturer shared slides and videos online and when we got to campus, she prioritised what required active learning, and that worked well. (Prudence)

> In my view, flipped learning teaching using face-to-face time in the best way. It is almost always impossible to 'teach' students every theoretical aspect of the course in the allocated class time. (Patricia)

> Online learning allowed for less stress and study materials to be covered more effectively. As we could focus on one or two modules per day and meaningfully engage materials. (Chanay)

All the students concurred with the academics in that flipped learning approach enables them to go through material prior to class and use class time for questions and applications (Alexander et al., 2019).

5.6.2 Face-To-Face Learning

Face-to-face learning is a pedagogical approach in which educational content and learning resources are delivered in person to students (Adebo, 2018; Mielgo-Conde et al., 2021). This facilitates real-time engagement between students and the teacher. This mode of learning offers immediate interaction, occurs during designated contact hours, and delivers timely feedback to students. The academics who preferred face-to-face learning explained their preference as follows:

> Face-to-face learning provides face-to-face interaction and asking questions and discussions can be more active and livelier than other method of teaching. It has the best assessment (no plagiarism). (Dr Sammule)

> When students are in front of you, you will be able to point each student to answer the questions that you are posing them during lecture time. You can observe the behaviour of the students if they don't understand. (Dr Molobye)
>
> Our students are not equipped nor motivated to learn on their own. They do not possess the skillset needed to be successful in a tertiary education system without the face-to-face accountability and support provided by a lecturer in class. The primary education system has not equipped the student body with necessary computer skills, critical thinking skills, nor writing/communication skills to make online learning a viable option. Thinking and motivation is stimulated in an IN-PERSON context, not via a screen. The online environment enables students to detach themselves from their education and continually shirk personal responsibility for their learning. Lectures, discussion, debates, discourse, and thinking happens best in a room with people. (Dr Dicks)

It was interesting to hear a different view from Dr Kolo: "Purely face-to-face lends itself to 'sage on a stage' teaching where students are passive learners only. They often don't read the material and just come to absorb during classes". The term 'sage on the stage' refers to the primary figure in a classroom, typically the instructor, who delivers the lecture to students using a one-way communication approach. This pedagogical approach is occasionally known as the teacher-centric model or conventional education, and there is little participation from the students (Adebo, 2018; Gonzalez et al., 2020; Matadi & Uleanya, 2022). Dr Yokong touched on the resource factors and mentioned that "in a normal environment, blended learning would be good but with the current loadshedding and digital divide, digital teaching and learning exacerbates inequities". This is a reality for South African students and was evident during the pandemic era.

Dr Supung touched on several factors and explained it as follows:

> There are few objective reasons for the disastrous T&L [teaching and learning] outcomes of forced online teaching and learning: 1) Lack of adequate network infrastructure across the country—large number of students leaving in rural areas were physically unable to participate classes. 2) Lack of class communication—personal experience shows that it is much easier to encourage students in-class discussions in the face-to-face mode. 3) Lack of support—again personal experience shows that number

> of students asking for help/assistance/consultation significantly dropped in the forced online mode, partially due to technical constraints (poor connectivity, loadshedding, etc.) and partially due to loss of learning motivation. 4) Lack of assessment control and cheating prevention—this is possible to control with the aid of specialised software, which in turn requires adequate and expensive computer equipment on student's side.

What Dr Supung said is true, and most of these factors were seen during the pandemic era. Face-to-face and online courses share numerous fundamental pedagogical elements, including interactions between students and instructors, the assistance and guidance provided by instructors (Ananga and Biney, 2021), the quality of lectures and content delivery, the course material, and the use of social networking platforms.

The researcher also asked the students to share which learning method enhanced their learning experience. The following are their responses with respect to the face-to-face learning method:

> Interaction with the instructors, allowed me to ask questions, and gain insights from experienced instructors in real time. This enhanced my understanding of complex concepts, improving problem-solving skills, and boosted my confidence in academic performance. (Phenyo)

> Face-to-face learning has facilitated collaboration and teamwork among students. Working together on group assignments or projects, helped me learn from one another's diverse perspectives, exchange ideas, and build social skills that will prove beneficial in my professional career. (Sam)

> Resources are an issue. I also concentrate better when I see the lecturer in front of me. However, it is nice to work at my own pace and to then have access to the lectures again, since most of them are recorded, so I can catch up if I need to. (Thandi)

> It is difficult to teach someone theatre acting, dance, stage design, directing, and many other disciplines in theatre and performance from online platforms as those disciplines require the embodied modes that online platforms cannot provide. (Hlompho)

> Was not facing problems like loadshedding which affect network. (Tshepo)

> You never experience connection issues with face-to-face. (Jack)

5.6.3 Blended Learning

Most of the academics preferred the blended teaching method. Blended learning is the use of traditional classroom teaching methods together with online learning for the same students studying the same content in the same course (Bliuc et al., 2007; Boelens et al., 2015; Cleveland-Innes & Wilton, 2018; Shetu et al., 2021; Siegelman, 2021; Yuen, 2014). This strategy enables students to participate in virtual activities while retaining important communication with their peers and teachers. Dr Merle explained that the integration of the flipped teaching method in the blended learning: "I think mixing face-to-face activities with online activities can help to create a flipped classroom that allows for contact time to focus on issues, rather than the general content". In addition, Dr Pringle said the following:

> Blended learning brings face-to-face and online teaching elements together so one can get the best of both worlds. As blended learning is not limited to teaching face-to-face and online but can be used in the sense of blending assessments, activities etc. one can also implement different elements too. As mentioned earlier, I like and have adopted a blended approach and then can bring in the notion of flipped classroom as a method so I will give my learners resources online via the LMS that they can engage with and understand and then when we have a face-to-face session then we do a more hands-on activity where they get to implement and apply what they have read or learned on said topic.

While online learning offers students opportunities to participate in virtual classrooms, Dr Makinta raised some concerns around managing the quality of assessments in online learning, and therefore, recommend blended learning:

> Purely online learning created difficulties for assessment quality and integrity assurance. A blended/flipped model has been implemented in my course in 2023 with good results so far. Students are required to do readings alone in one week (guided by some videos/podcasts in short length). At the end of that week, they do an online quiz to test their basic comprehension of the material. The following week they come to small classes (70 students) to discuss the material with a lecturer—these sessions are focused on problem-solving. Students have NEVER been this engaged during in-person lectures.

> They are asking questions, referring to the text, and seem to be learning a lot more than usual.

Dr Makinta also adopted the flipped approach, wherein students were given materials before class, which seemed to encourage students' engagement. Other respondents used similar approaches:

> Blended allows the student to have time to consolidate the work and the face-to-face interaction helps ensure that both facilitator and student are confident about the work covered. (Prof May)

> A blended approach, by definition, means using various ways of teaching and engagement. Learning is no longer confined to a physical classroom. Teaching is no longer just limited to a lecturer in front of you. But we can use different tools to assess different skills. We can have peer-learning and assessment, and many other opportunities that traditional, didactic teaching did not offer. (Prof Sulle)

Some of the respondents raised the idea of social skills and expressed themselves as follows:

> I know now that as much as I needed to engage with my students as humans, they also needed to engage with each other. Many of the soft skills of social awareness, communication skills, leadership and teamwork skills are much more difficult to instil if students aren't comfortable with each other. Social and peer support networks are critical, and difficult to replicate online. (Dr Makda)

> I think it is important that we get the benefit of the efficiency of online learning. However, we must never lose touch of the human real-life interaction. Another benefit is that with students who would predominantly be shy to participate in the lecture room, they are able to do so, because no one is watching them. So, a blended approach caters for these. (Dr Serapa)

Most of the academics agreed about the benefits of blended learning and mentioned the aspect of social interaction or presence, engagement, collaboration and assessments as some of the important factors to consider with blended learning and are in line with findings of Anderson (2017), Garrison and Arbaugh (2007), and Kozan and Caskurlu (2018).

The researcher also asked the students to share which learning method enhanced their learning experience. It was interesting to note the agreement between the academics and the students on

this learning method; for example, Lesedi said, “I feel that blended learning allowed me to try and understand content on my own and when I don’t understand I could still ask my lecturer face to face to explain to me”. Again, this can be linked to the inclusion of the flipped learning approach because Lesedi had access to materials online before going to the class. Refiloe agreed and explained as follows:

> I believe that blended provides the most correct balance. There are face-to-face aspects that should remain such as attending lectures and interactions that are in real time. But also having the option to conduct certain lectures online and hand in assignments online as well makes learning far more manageable.

Some students focused on the advantages and disadvantages of blended learning:

> Blended learning because you still get to interact and communicate with lecturers and peers on misunderstood topics while working at your own pace. Face-to-Face learning can be a bit draining physically especially when one has multiple lectures to attend daily which leaves little time to study as one is exhausted by the end of the day. Online learning is great, but the only thing that makes it problematic are issues such as loadshedding and unstable Wi-Fi. Furthermore, face-to-face consultations are preferred instead of having to email a lecturer. (Setso)

> Face-to-face allows more freedom to ask questions. Online allows independence. (Lefa)

> Face-to-face allows for proper engagement between lecturer and student but online does allow the student to revisit the teaching material. (Hlale)

> By blended I mean online lectures and face-to-face tutorials. The majority, if not all of my lecturers simply read slides when we attend campus lecturers, something I feel I can do on my own, and that to me is time wasted. Some are hardly able to cover all slides in the allocated lecture time. I could have taken that time plus the travel to campus time to go through slides, research more for clarity as well as ask questions online or through email to gain more understanding. I would not have to go back home again to go through the work in a way that would make me prepared for tutorials. (Boikanyo)

> I find campus tutorials effective though. I have had enough time online to prepare and have jotted down contributions and questions which when discussed will give more insight and help my classmates as well. (Betty)

Carol agreed with other students and also raised the issue of brick-and-mortar classes that were also mentioned by one of the academics.

> I think we really need to have more online classes, because many of those classes are recorded and there's no crowd to disturb you during your online class. There is very less preparation, and very little money is wasted on these classes. when a class was disturbed by a technical error, recorded power presentations are done to replace the lost lesson, that we can access anytime everywhere. Also, manual classes help more when it comes to students engaging with the lecture on the content they do not understand well. Also, they are more effective when it comes to explaining activities (assignments, research, tests/quizzes) on what is expected of them and how to actually do it. (Carol)

5.6.4 Hybrid Learning

Only a few academics across the three universities chose the hybrid learning approach as their preferred approach. Hybrid learning is a pedagogical tool where some students attend class in person, while others join the class virtually from home (Linder, 2017). Hybrid courses are distinct because their online components are intentionally created to substitute a portion of in-person class time (Linder, 2017). The academics who prefer hybrid learning made the following comments:

> It gives freedom to address their own personal students' need to choose to attend a lecturer at the venue of their choice depending on the circumstance. (Prof Cross)

> I believe that students should learn according to their individual unique strengths. (Dr Carsten)

> Both should be used as they save money for transport and learning, student become in charge of their own learning. (Dr Mmollo)

All the points the academics mentioned are some of the benefits of hybrid learning.

The researcher also asked the students to share which learning method enhanced their learning experience, and similarly to the academic's responses, only a few students opted for hybrid learning as a mode of learning that enhances their learning experience: They said the following:

> In the event that one cannot attend physical lectures the online lectures keep a student on track. (Omphile)
>
> I prefer studying online in my own pace and in person when I've covered the work. The two students share the same sentiments with the academics in terms of the benefits that hybrid learning offers. (Lehlogonolo)

5.6.5 Online Learning

Only students were given online learning as an option when asked their preferred method of instruction to avoid confusion of them being unable to distinguish between synchronous and asynchronous learning approaches. The researcher needed to be as explicit as possible when asking this question. The majority of students opted for online learning. Online learning refers to instruction delivered electronically through various multimedia and internet platforms and applications (Bates, 2015; Garrison & Arbaugh, 2007). It is used interchangeably with other terms such as web-based learning, e-learning, computer-assisted instruction, and internet-based learning (Bakia, 2010). Students expressed their appreciation of this mode of learning due to the benefits that it comes with as follows:

> It saves time for going to lectures and also convenient because I can also access the recorded lecture later. (Maria)
>
> Asynchronous learning helped in moving at a pace suitable for me and/or my intelligence. (Lebo)
>
> Online learning during Covid-19 pandemic has helped me in managing time because I was able to do my assignments at my own time, and time that is convenient to me to do more research for high-quality information. (Shirley)
>
> The use of technology allows for more personalisation and flexibility in how students learn. (Pontsho)

> With online tools and resources, I was able to access course materials anytime, anywhere, and can work at their own pace and level. (Bokamoso)
>
> Online learning has enhanced me with more interactive and collaborative learning experiences, such as through group discussions, online forums, and virtual classrooms. (Lelo)
>
> I was able to balance my studies with other commitments such as work or family responsibilities. (Kelly**)**
>
> Provided me with access to a vast number of resources such as articles, videos, and interactive tools to deepen my understanding. Online libraries, databases, and research tools also provided me with an easy access to a wide variety of information. (Zonke)
>
> I have enough time to plan my work and do my work at my own pace and time. I can sleep all day, and it helped my mental health. I was never spoken to harshly and was never stressed by lecture. Please bring it back. (Stompie)
>
> I had enough time to plan my work to my preference. I met new people which I never thought I will ever work with. (Esther)

Students highlighted factors such as flexibility, time management, cost, personalised learning, peer-to-peer learning, digital skills, skills development, balancing personal and academic life and mental health improvement.

In summary, it is evident that the affordances of digital technologies enable asynchronous and online teaching and learning methods. Tools such as LMS were used for teaching and learning during the Covid-19 period. LMS platforms allows communication and interaction between teachers and students in virtual spaces. According to Dlamini and Ndzinisa (2020) and Oliveira et al. (2016), LMS is a virtual environment that aims to simulate face-to-face learning environments with the use of information technology, and this is exactly what transpired during ERT and online learning in South African universities. Although LMSs were adopted, some students failed, others found it hard to manage, while others managed very well. This exposes the inequality issues still faced by South Africa. Having the same resources does not guarantee success for everyone. It was important to take into consideration factors such as access to technology and infrastructure as well socio-economic issues to ensure equity. Effective training of academics and students on the use of

the virtual teaching and learning tools was crucial before these platforms were implemented. However, this change was imposed on students and academics without sufficient training offered to them.

5.6.6 Teaching Methods: Academics' Perspective

Figure 5.6 shows that blended learning was chosen the most frequently as the best teaching method by academics with a substantial frequency of 44 responses (57.1% of the total responses). Face-to-face learning was the second most common choice, with a frequency of 19 responses (24.7% of responses), and flipped learning had a lower but notable frequency of 11 responses (14.3% of responses). Hybrid learning was the least selected option, with only three responses (3.9% of responses).

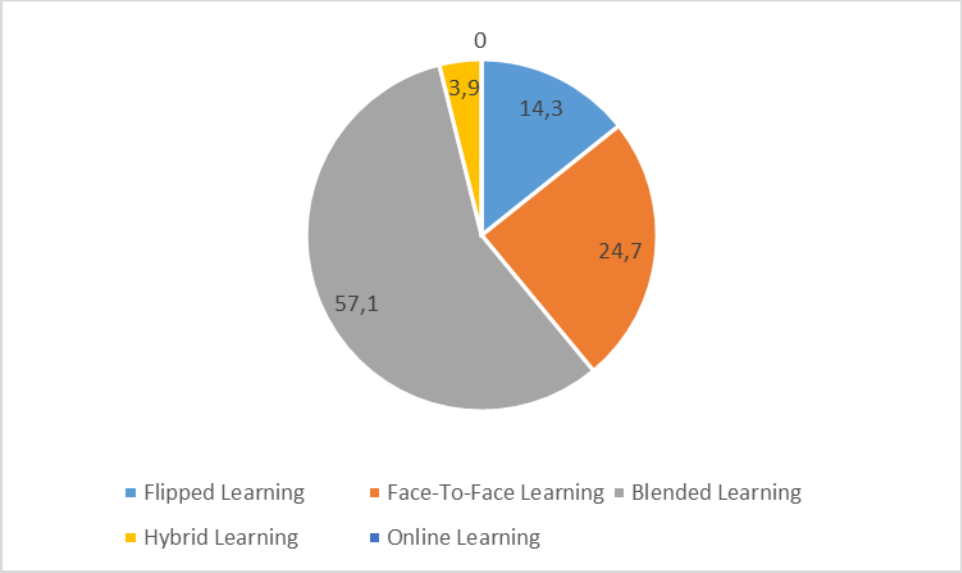


Figure 5.6 An overview of effective teaching methods preferred by academics

5.6.7 Teaching Methods: Students' Perspectives

Similarly to the academic's responses, Figure 5.7 shows that blended learning emerged as the most frequently chosen learning method by students for enhancing their learning experiences, with a frequency of 34 responses (38.6% of responses). Face-to-face learning was selected by 27 respondents (30.7% of responses), and online learning also had a significant representation with 23 responses (26.1% of responses). The flipped approach and hybrid learning have lower frequencies and were each selected by only two respondents (2.3% of responses each).

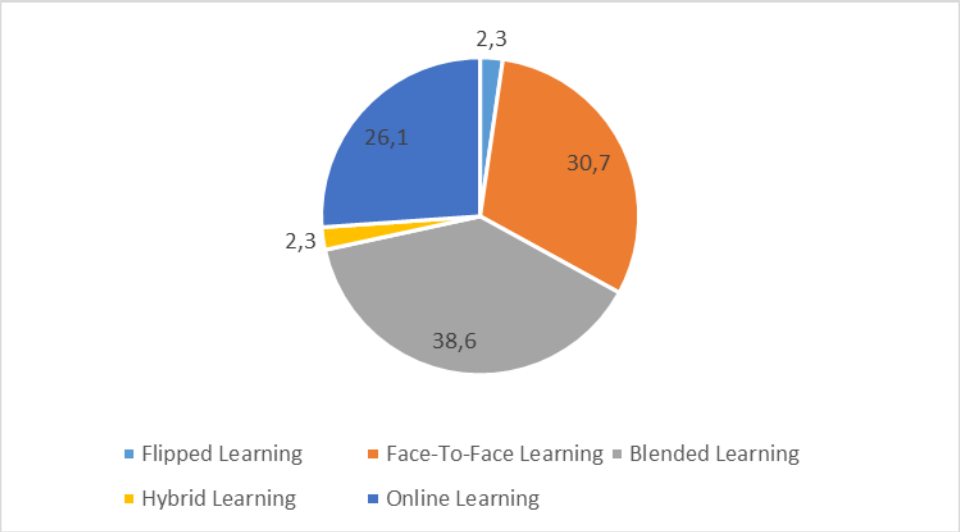


Figure 5.7 The learning methods that enhance students' learning experiences

In summary, both the academics and students showed a preference for blended learning as the best mode of instructional delivery, ranking face-to-face education as their second choice. The blended learning approach integrates conventional face-to-face instruction with online elements. Face-to-face instruction refers to traditional classroom teaching that does not include significant online components. This traditional approach involves direct communication between teachers and students in a physical classroom setting. Flipped learning is an instructional approach in which students engage with educational content outside of the classroom, enabling class time to be dedicated to interactive and collaborative learning experiences. Hybrid learning is an instructional approach that combines traditional face-to-face teaching with online learning, offering flexibility and enhanced availability of educational materials. Online learning provides the benefit of flexibility and the ability to remotely access educational resources, hence improving learning experiences, particularly in digital environments. It is important to highlight that the most effective teaching method may vary depending on the educational environment, student preferences, topic matter, and other variables. Based on these frequencies, it seems that blended learning is the most common choice. Ultimately, the effectiveness of a teaching method should be evaluated based on clearly defined educational objectives, academic standards, student needs, and the resources at hand.

5.6.8 Crosstabulation Analysis: Academics Perspective: Teaching Methods

Crosstabulation analysis, commonly referred to as contingency table analysis, involves the use of data tables to display the outcomes of both the total group of respondents and specific subgroups of survey respondents. This is primarily used to compare the outcomes of one or more variables with those of another. In this instance, the researcher compared the outcomes of institutions located in metropolitan, rural, and semi-rural areas with regards to their instructional delivery methods.

The crosstabulation analysis illustrated in Table 5.4 shows the favoured approach to teaching and learning for academics by comparing flipped learning, face-to-face learning, blended learning, and hybrid learning across the three universities. The crosstabulation presents the frequencies of these universities.

Table 5.4 Overview of effective teaching methods and their impact on student learning outcomes: Academics

		Teaching Methods				Total
		Flipped Learning	**Face-To-Face Learning**	**Blended Learning**	**Hybrid Learning**	
University	Metropolitan	10%	9%	19%	0%	39%
	Rural	0%	4%	22%	1%	27%
	Semi-rural	4%	12%	16%	3%	34%
Total		14%	25%	57%	4%	100%

According to Table 5.4, 10% of the academic participants from the metropolitan university preferred the flipped learning method, 9% preferred face-to-face learning, and 19% chose blended learning. None of the respondents preferred the hybrid approach. In total, they were 39% of the total respondents. Conversely, the rural university did not demonstrate a preference for the flipped learning method, and 4% of academics from the rural university preferred face-to-face, 22% preferred blended learning, and 1% showed a preference for hybrid. Only 4% of the academic participants from the semi-rural institution preferred the flipped learning approach, 12% preferred face-to-face instruction, 16% preferred blended learning, while 3% opted for a hybrid learning approach.

This crosstabulation offers a concise summary of the various types of universities' inclinations towards teaching methods, highlighting blended learning as the most favoured approach. These results align with the previous frequencies of the most effective teaching approaches as determined by the academics.

5.6.9 Crosstabulation Analysis: Students' Perspectives

Table 5.5 illustrates the crosstabulation analysis for the students to show their preferred learning method according to university type, namely metropolitan university, rural university, and semi-rural university. Contrary to the academics, in this case the researcher needed to ascertain which learning methods enhanced the students' learning experience. This was primarily because these approaches were imposed on students due to the pandemic and it was not their choice. Furthermore, students were provided with the opportunity to choose online learning in addition to the academic methods offered because most of them were unfamiliar with phrases like 'flipped' or 'hybrid' learning, despite them being described in the questionnaire. The researcher asked the students to choose the learning approach that enhanced their learning experiences. They had to choose between flipped, face-to-face, blended, hybrid, and online learning.

Table 5.5 Overview of effective teaching methods and their impact on student learning outcomes: Students

		Teaching Methods					Total
		Flipped Approach	**Face-To-Face Learning**	**Blended Learning**	**Hybrid Learning**	**Online Learning**	
University	Metropolitan	2%	6%	22%	1%	3%	34%
	Rural	0%	9%	15%	1%	5%	30%
	Semi-rural	0%	16%	2%	0%	18%	36%
Total		2%	31%	39%	2%	26%	100%

According to Table 5.5, 2% of the student participants from the metropolitan university found the flipped learning approach to enhance their learning experience, 6% found the face-to-face approach to enhance their learning experience, 22% found the blended learning approach to enhance their learning experience, 1% found the hybrid learning approach to enhance their learning experience, and 3% found the online learning approach to enhance their learning experience. At the rural university, none of the respondents reported enhancements in their learning experience from the flipped learning approach. However, 9% of respondents from the rural university found face-to-face learning to enhance their learning experience, 15% preferred blended learning, 1% preferred hybrid learning, and 5% indicated that online learning enhanced their learning experience. For the semi-rural university, none of the respondents found flipped learning to enhance their learning experience. Instead, 16% respondents found face-to-face learning to enhance their learning experience, 2% favoured blended learning, none found hybrid

learning beneficial, and 18% respondents found online learning to enhance their learning experience.

This crosstabulation provides a clear overview of the different universities' teaching methods that enhance student learning experiences, with blended learning emerging as the method that enhances most students' learning experiences.

5.7 Online Assessments of Students

In order to answer the second research question, academics were further asked to share their experience with assessing and grading students online. Most of the issues they highlighted were related to cheating and network problems, as can be seen in the following responses.

> A lot of unauthorised group work, copying and cheating. Student network problems right in the middle of a test, making it difficult for them to complete within time. (Dr Ruth)
>
> Having to examine students using several continuous assessments like quizzes and tests. The challenge is also that I could not verify the independence of student's work. (Dr Mpedi)
>
> Collusion was rife between students. Even when we tried to create multiple different versions of tests, students still colluded. This came out through Turnitin reports in some cases. In more shocking instances students accidentally added me to their email mailing lists saying, "hi guys, here are the test answers that I just did, hope this helps". As such, we have since shifted away from online assessments as far as possible. (Dr Phiri)
>
> It was difficult to create online assessments; It was not easy to establish if they were colluding to respond to tasks or if they were copying each other or the internet. Assessments were mainly through multiple-choice questions, which at times did not need much engagement but good guesswork. Students' average performance marks increased. (Dr Hlope)

Dr Roots gave the following interesting opinion:

> Felt it forced me to think out of the box. To design and develop my assessments in a way that enabled my students to think and apply rather than remember. I felt and still feel it doesn't help to provide students with assessments that require recall, that they can

> read a textbook or the internet and get the answer directly and 'copy' it into the online assessment tool. So rather where they must take what they read understand it, deduce, apply and articulate. I felt that this change in thinking and assessment was necessary as students now had access to the internet, to their books basically to create assessments in a way that one would design an assessment as if it were an open book test or a group project. Additionally, we needed to do some further reading and research on online assessments. So, what I found and tried out is to take on a continuous assessment approach. So rather than having a massive exam with two assignments in between I give my students multiple small assignments. This did mean more work, but it was well worth it. I learned different assessment types and tools especially for online teaching for example creating a discussion forum and allowing students to respond there. I also required to do additional admin in terms of teaching learners how to use the LMS to submit assessments.

Other academics gave similar responses to Dr Roots:

> As part of my effort to maintain the integrity of the assessments, I removed all recall questions from my assessments, because the answer to those can be looked up. I introduced a big project component for my database systems course and leaned towards code creation for my programming course. The nature of the assessments had to change to remove forms of assessment that were more susceptible to copying/cheating. (Dr Sethlare)

> Many students lived in rural areas where there was either zero or poor network. So, these students would provide the assignments late as they could only go to an internet shop when going to town to buy food. I just accepted this situation! (Prof Kay)

Other academics mentioned the following problems they faced with online assessments:

> For my specific module, we did not assess or grade our students online as we were unable to use the proctoring system as well as considering that our assessments are open book. The risk of students cheating with unauthorised material was prevalent. (Dr Hlompho)

> I experienced total luck of class control during assessments. (Dr Molobye)

> Setting the assessments was not an easy process since I had to learn to use the Wildcard method that prevent cheating. (Dr Sithole)
>
> No major challenge, just more time required to mark online. (Dr Makinta)

In summary, these diverse experiences emphasise shared challenges such as cheating, dishonesty, connectivity constraints, and the challenge of maintaining the authenticity of assessments in online teaching and learning environments. Several academics modified their evaluation techniques to prioritise critical thinking, project-oriented assignments, or smaller, more frequent evaluations to foster active participation and minimise instances of academic cheating.

5.8 Documents Analysis

The document analysis was done to answer the third research question:

- **RQ3:** What is the impact of digital education on student performance?

University documents such as annual reports, websites and throughput reports prior, during and after the Covid-19 pandemic were reviewed for the document analysis for each type of university, namely the metropolitan, rural, and semi-rural universities. The document analysis for each of the universities are discussed in the following subsections.

5.8.1 Documents Analysis: Metropolitan University

Looking at the metropolitan university's five-year review from 2014 to 2019 (Wits, 2020c), an extensive evaluation of teaching and learning in these years uncovered numerous achievements, notably in the areas of improved student progression and graduation rates. This university's new strategy incorporated their digital suite, which consists of comprehensive online programmes and e-degrees, as well as short courses that offers 13 MOOCs, with over 83 000 registered learners from all over the world. Their plan aims to facilitate access to higher education. This university made substantial investments in new infrastructure and technology, such as limitless high-speed Wi-Fi connections, intelligent classrooms, state-of-the-art libraries and information hubs, simulation laboratories, and e-zones. This resulted in significant improvements made to online resources, student support, and professional development for academics. Their Vice Chancellor said the following:

> The rate at which students are progressing has gradually been rising. In 2019, our institution achieved the highest number of graduates in its history, with a total of over 9 500 graduations. In addition, we have implemented our digital learning approach through both our MOOCs and blended learning. We envisage moving more of our degree programmes to online learning and teaching in the upcoming years. (Wits, 2020c)

This attest to why the transition from face-to-face to ERT and online learning was possible for this university during the pandemic era. Moving to virtual instructional delivery mode was part of this university's strategic plans. In 2020, the Covid-19 pandemic had a multi-layered impact on this university, affecting interactions, research activities, teaching methods, and learning processes, just like at many universities during that time. The teaching calendars and course outlines were adjusted to accommodate the smooth transition from face-to-face teaching and learning to virtual instruction mode. The global pandemic presented an opportunity for a significant reset, both in South Africa and worldwide, including at this university. According to the information in this university's annual report (Wits, 2020c), they managed to swiftly transition to ERT and online teaching within a span of three weeks, coinciding with the implementation of a nationwide lockdown, while some of rural and semi-rural universities were totally shutting down. This could be because of funding or other factors, as well as the fact that this university is an advantaged university. Staff and students embraced the affordance of the virtual teaching and learning platforms, LMS, and creative pedagogies to provide uninterrupted teaching and learning. Academics and students were provided with the skills to navigate online platforms.

The university also developed measures so that most students were able to study remotely during this pandemic era. These measures included negotiations with mobile network providers such as MTN, Vodacom, Cell C or Telkom to get zero-rating for learning sites, to assure the hosting of systems in the cloud to prevent crashes, and 30 gigabytes of data to students monthly (Wits, 2020d). During this time, the South African society's material inequality and its unequal distribution of resources, wealth, and opportunities became apparent.

Countries in the Global North that have advanced ICT infrastructure were capable of establishing support systems for university students and their staff members (Li & Lalani, 2020). On the other hand,

> The South African government neglected to make significant investments in ICT infrastructure prior to the onset of the Covid-19 pandemic. As a result, a lot of university students were left to manage on their own when President Cyril Ramaphosa implemented a stringent lockdown in March 2020. Due to the lockdown, some university students were required to evacuate their residences. In practical terms, they were required to abandon their accommodations, study areas, dining facilities, libraries, and in-person assistance from instructors and lecturers. (Hlatshwayo, 2022)

To respond to these predicaments, the university further sent appeals to high-net-worth individuals to come on board to help purchase or donate laptops for students to bridge the digital divide. The digital divide denotes the disparity between individuals with sufficient access to ICT and those with little or inadequate access to ICT (Soomro et al., 2020). One philanthropic high-net-worth individual came on board and donated laptops to the majority of students at this university. To avoid creating additional expenses for the students, this university negotiated with the South African Post Office (SAPO) to deliver the devices to the students in various areas, including rural areas. Students collected these devices from their nearest Post Office. The university's Vice Chancellor also expressed his gratitude to the exceptional service rendered by SAPO:

> All devices were delivered promptly by SAPO employees to students at various locations across the country (including many rural areas), thus enabling the students to participate in the university's online academic programme. This project is an exemplar of how public institutions can work together efficiently to achieve a common good that benefits society", he said. "We are appreciative of the SAPO and its efficient delivery of services that has positively impacted on the lives of thousands of students. (Wits, 2020e)

In 2021, the university had successfully handled the challenges posed by the Covid-19 pandemic and changes in leadership. Significant advancements were achieved in various areas, including education, research, innovation, community involvement, and outreach. The university excelled in completing the academic programme, achieved significant progress in research, teaching, and learning, and established the university's reputation in all areas relevant to addressing the worldwide pandemic. In the year 2021, the university adopted blended learning in most of their courses.

It was interesting to see how the students performed in 2019, the year prior to the pandemic, in comparison to 2020, the pandemic year, and 2021, the post-pandemic year. This comparison was done by looking at the schools within the Faculties of Humanities, Commerce, Law and Management, Health Sciences, and Science. The data was stratified into YOS 3 and YOS 4 students. However, it is important to note that not all the programmes have a fourth year.

Figure 5.8 shows that most of the students in the Faculty of Humanities performed well in 2020, with 93.89%, as opposed to 2019 (91.45%) and 2021 (90.50%). This may also mean that there were more enrolments in 2020 as opposed to other years or suggest that students performed better in 2020 than in 2019 and 2021.

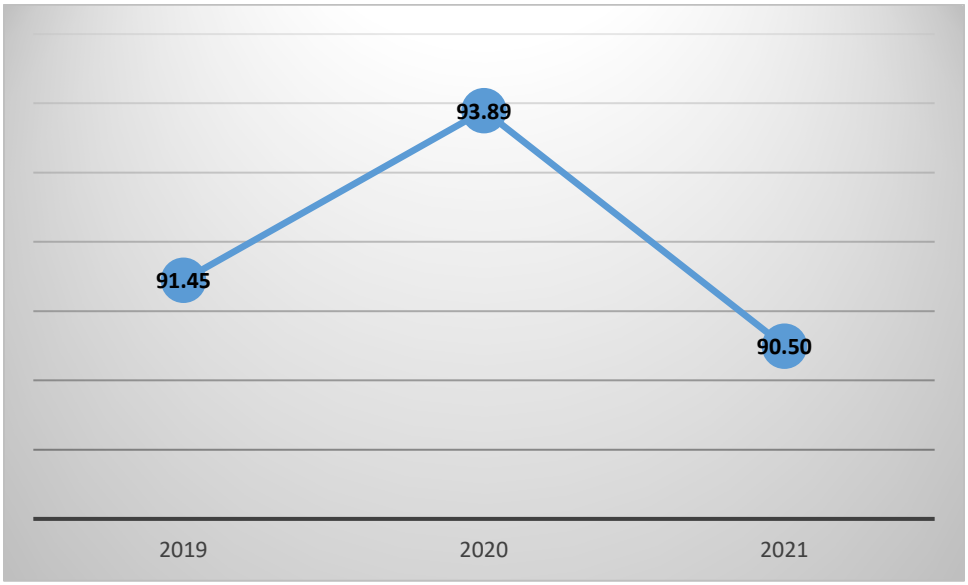


Figure 5.8 Descriptive analysis: Student performance for the Faculty of Humanities at the metropolitan university in 2019, 2020, and 2021

Looking at Figure 5.9, it appears that most of the students in the Faculty of Commerce performed well in 2019, with 66.41%, as opposed to 2020 (63.19%) and 2021 (62.23%). The pass rate percentage was determined by the total enrolment for the year divided by the total qualified students in that year, and it could suggest that students who performed better in this school struggled in 2020 because this school has courses that requires more practical's than theory.

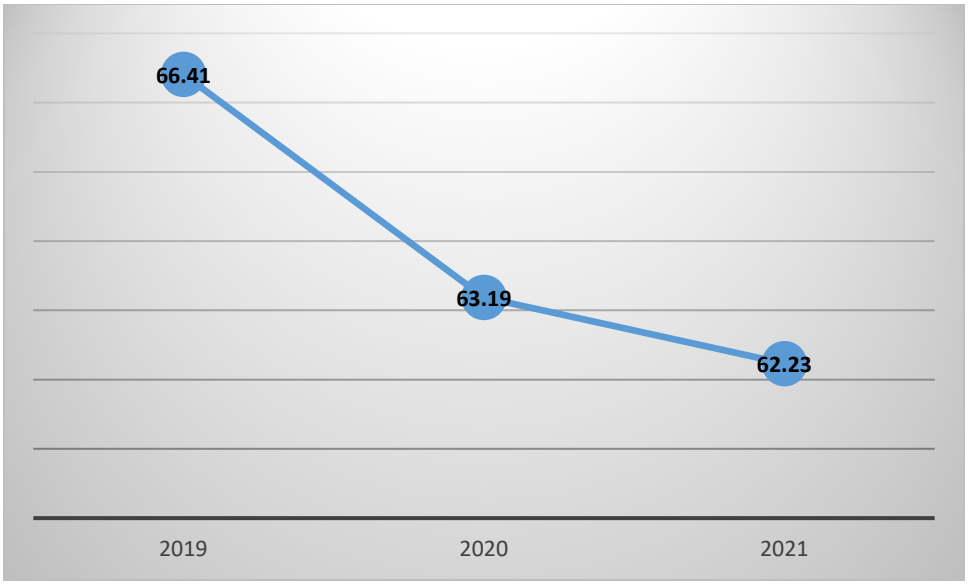


Figure 5.9 Descriptive analysis: Student performance for the Faculty of Commerce at the metropolitan university in 2019, 2020, and 2021

Figure 5.10 shows that most of the students in the Faculty of Law performed well in 2020 with 92.08%, as opposed to 2019 (73.41%) and 2021 (90.57%). This pass rate was determined by the total enrolment for the year divided by the total qualified students in that year, and the results suggest that students performed better in 2020 than in 2019 and 2021. It is worth noting that the decrease in performance in 2021 is still better than the results for in 2019.

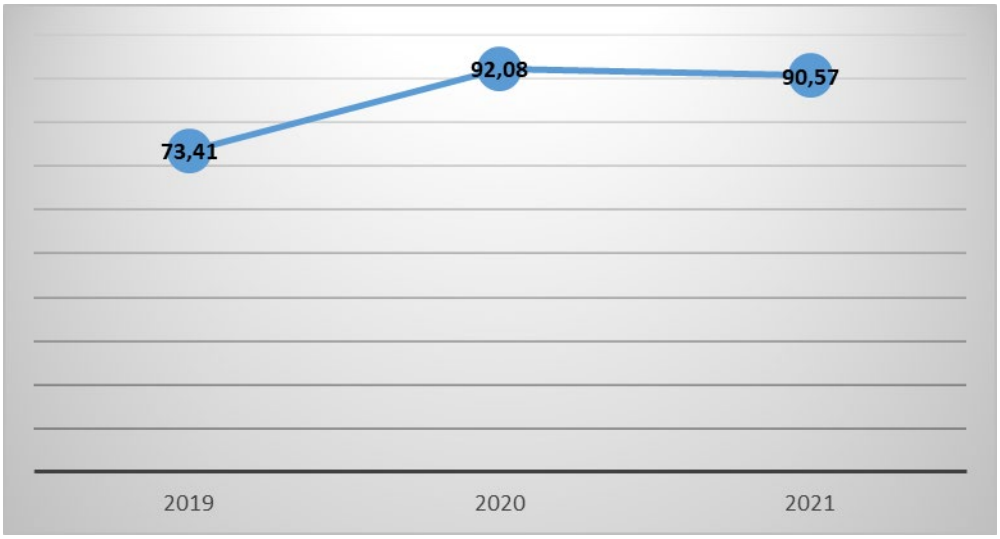


Figure 5.10 Descriptive analysis: Student performance for the Faculty of Law at the metropolitan university in 2019, 2020, and 2021

Looking at the results for the Health Sciences in Figure 5.11, it shows that the students performed better in 2020 than in 2019 and 2021, but the increase is minimum. The same applies for programme type F, which also shows an increase in 2020 from 2019 and 2021. This could also mean that there were more enrolments in 2020 as opposed to other years or that students performed better in 2020 than in 2019 and 2021.

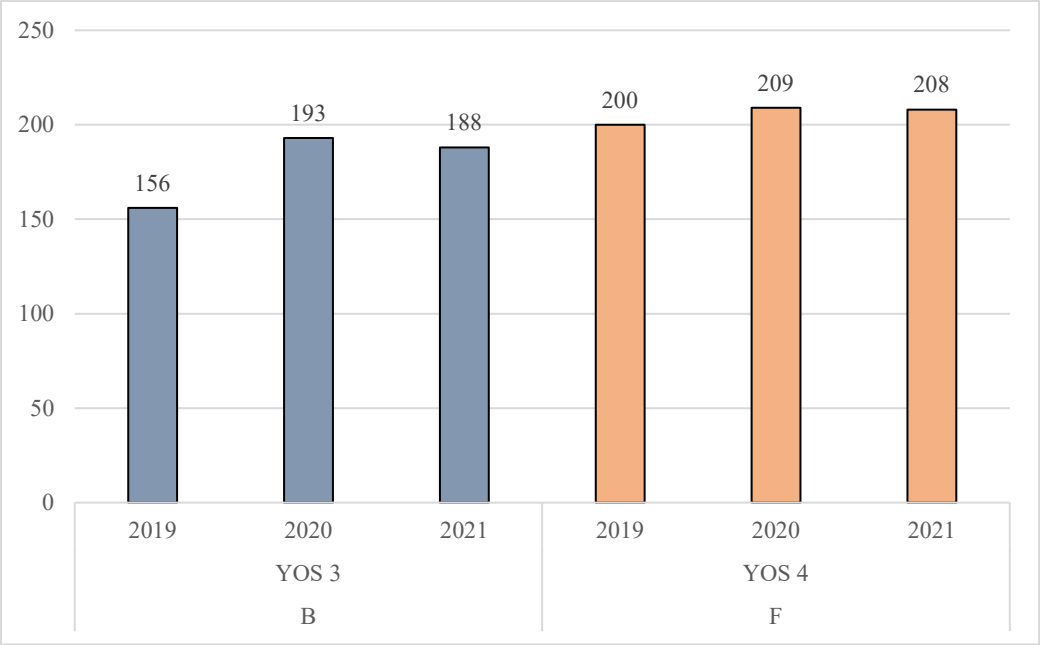


Figure 5.11 Descriptive analysis: Student performance for the Faculty of Health Sciences at the metropolitan university in 2019, 2020, and 2021

Looking at the Faculty of Science in Figure 5.12, it shows that students performed extremely well in 2020 with 79.04% as opposed to 2019 (74.07%) and 2021 (71.40%). There is a huge decrease in performance in 2021. There numbers were determined by the total enrolment for the year divided by the total qualified students in that year and suggests that students performed better in 2020 than in 2019 and 2021.

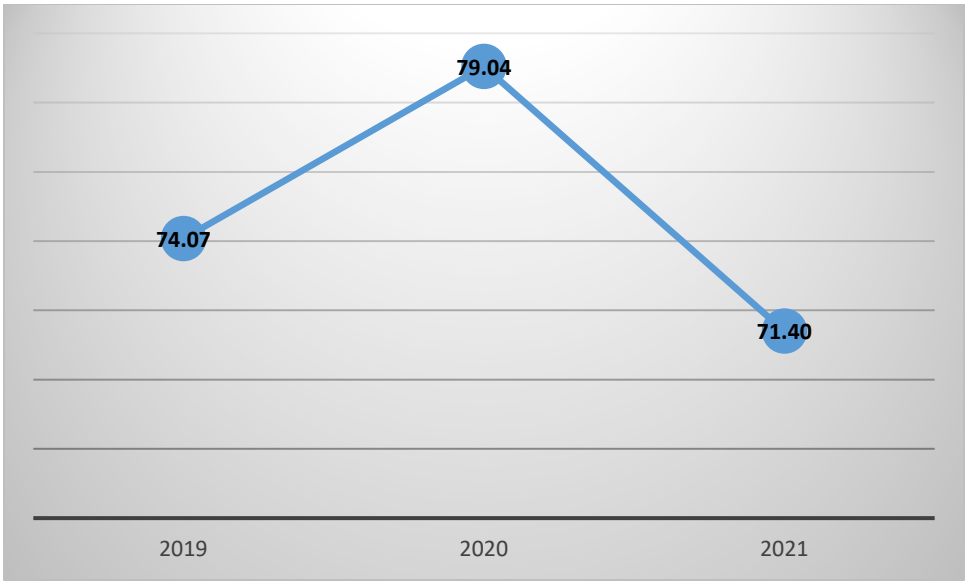


Figure 5.12 Descriptive analysis: Student performance for the Faculty of Science at the metropolitan university in 2019, 2020, and 2021

5.8.2 Documents Analysis: Semi-Rural University

Similar to other educational institutions, the students and academics at this university were required to evacuate the campuses when the Covid-19 lockdowns were imminent in 2020. The Covid-19 pandemic presented a chance for South African universities to enhance their ICT operations, notwithstanding their lack of online programme delivery capabilities (Nyawo, 2020). Consequently, the semi-rural university made the extreme choice to transition from face-to-face instruction to online education. Due to the abrupt commencement of the pandemic, each college and school within the university initiated its own mapping process to work towards reaching this goal. The university supported the students with data bundles and laptops as most students came from financially unstable families. Many academics were desperately trying to learn tools to support this new mode of teaching by conducting needs analysis to understand their students' access and abilities to study online and developing procedures and guidelines for the implementation of online teaching and learning.

The semi-rural university presented a 2019 report detailing how they managed during the pandemic period across all their colleges. The accomplishments and positive trajectories recorded in the report remain a testament to the dedication and professionalism of the university (UKZN, 2019). The Covid-19 pandemic necessitated unwavering will and dedication from all members of

the university community to maintain operations and uphold its mission. The Vice Chancellor thanked all the staff members and students for their resilience during the trying times:

> On behalf of the Council, I would like to convey my heartfelt appreciation to the Executive Management team for their exceptional leadership during this challenging period. I would also want to extend my gratitude to all staff members, regardless of their position, for their extraordinary efforts in maintaining the institution's fundamental activities of teaching, learning, and research. We commend our students who demonstrated resilience in their academics despite facing various challenges. (UKZN, 2019)

The transition from face-to-face content to virtual platforms posed challenges for students and academics to ensure equitable access to learning and information across all colleges in this university. Despite all these challenges, the academics and students made it work. This university with its dedicated staff embarked on ways to transition from face-to-face to online teaching and learning, identified the impact as a result of this transition, and provided support to those in need. Academics and students were provided with the relevant training, resources and support. Dr Singh mentioned

> It is somewhat strange to teach practical concepts through a virtual environment, where, due to the number of participants, screen sharing, video and microphones had to be controlled. The assistance of a technical support person at each session helped the facilitator to focus on the content delivered, and address 'academic' related queries. (Singh et al., n.d.)

This university also highlighted the access and inequality dynamics that were exposed by this abrupt transition. A one-size-fits-all approach did not work during the pandemic period because those with access and know-how were ahead of those that lacked access. According to Dr Singh,

> A transition to 'online learning' in the South African context has however once again illustrated the stark contrasts. Those who have access and the necessary know-how have more of an advantage. As academics in South Africa, we have come to experience how issues of access to a computer, network, internet, electricity and a conducive space, can facilitate or hinder online learning. We have witnessed this at the various levels of

> education—the 'success to the successful' archetype is of relevance, and inequalities once again come to the fore. (Singh et al., n.d.)

Whitelaw et al. (2023) also alluded to the income inequalities, saying "Additional variables may contribute to variations in performance based on income level. For example, lower-income top performers may have had greater challenges with online learning compared to their higher-income counterparts". Chisadza et al. (2021) conducted a study at the University of Pretoria and examined the impact of face-to-face and online learning on the academic performance of economics students. They analysed data from survey responses and compares the average assessment grades before and after the lockdown period. They found a positive correlation between students' academic performance and access to high-quality Wi-Fi, as opposed to relying on mobile internet data.

This semi-rural university conducted a study with the aim of investigating how their students navigated the transition from face-to-face to virtual learning and this is what the students mentioned. The study is titled "our students' take on studying during a pandemic" (IN DEPTH, 2022).[1] This is what third and fourth students across the Colleges of Agriculture, Engineering and Science; Health Sciences; Humanities; and Law and Management Studies had to say:

> While online learning comes with challenges, mainly because of unstable internet connections, power disruptions, and a lack of access to data and laptops, for me, it was smooth sailing from the onset. I don't confront these issues due to my parents' financial support. However, I have to say that online learning has an enormous emotional, psychological and physical toll that adversely affects one's mental health. It is like walking through a minefield with no metal detector. It is both lonely and easy because with automated, virtual systems, you don't have to wake up at 5:30 am every morning to get ready and travel to class. Class is brought to your home, and this enables people to be flexible with their time. However, I find it lonely because I'm isolated from my peers. I don't have a friend or a study buddy on campus or online which can make the experience a lot harder. (Malusi)

[1] https://ww3.ukzn.ac.za/wp-content/uploads/2023/12/in-depth-2022.pdf

While Malusi appreciated this mode of learning, he also appreciated the financial support received from her parents and noted the pros and cons that comes with this instructional mode of delivery. Bongekile noted the importance of support from lecturers, friends and family. She mentioned the changes to the course outline, where instead of field trips, they were provided with videos of what they would have seen on those trips. Adjustments had to be made to the course outlines. She said the following:

> The pandemic brought a lot of changes which I had to adapt to in a short period of time. Studying at the campus library worked well for me as I was motivated by other students at the library whereas at home, it's easy to leave things for later as I have to complete my house chores in between my study sessions. That results in a pile of work to finish before going to bed. Loadshedding comes with a slow connection and it's even worse if it happens during a lecture, especially if it is not recorded. However, I can always send an email to the lecturer if I need clarity on something. My degree includes field trips and unfortunately, we couldn't continue with them, but the lecturers' shared videos of what we would have seen. While I feel that online learning has increased my workload, my family and friends have been supportive, making things easier. I am also lucky to have lecturers who do whatever it takes to give us the best training regardless of the situation. (Bongekile)

Qhawe shared his experience during and after the Covid-19 pandemic, which was interesting. He alluded to the importance of time management and that he did extremely well:

> At first when online learning was introduced during the first semester of 2020 it was easy, and I passed because I had the same energy and determination that I had on campus. The second semester was not as easy, as we were given tests every week and at the same time we had to attend online Zoom classes. Time management was a big issue for me as I was not familiar with online classes, but I managed to pass the semester with an overall mark of 70%. The first semester of 2021 was easy for me since I knew how to manage my time. I even got three distinctions during the semester and managed to be part of the Enactus UKZN team.

Onelisiwe mentioned the issue of access and inequality of resources. This is a reality for most South African students. Onelisiwe was at a verge of giving up due to challenges beyond his control:

> At the beginning of the Covid-19 pandemic it was not easy to adjust. I live with my grandma who doesn't have a smart phone and in January and February I had not received my NSFAS payment so I couldn't buy myself a new smart phone. When registration opened NSFAS didn't confirm my funding. Had I been on campus with access to Wi-Fi, I would have been able to use my computer to attend classes that were online and sort out my NSFAS crisis. Getting a permit to come to campus was also a process, but I was finally able to be on campus. I applied for a Student Representative Council SRC bursary, registered and did my best to catch up. Zoom recorded classes expire so following documents posted on e-learning was frustrating because a lot was explained in the recordings—which I had missed. I was very stressed and thought of taking a gap year, but eventually I pulled through. (Onelisiwe)

Access to resources in South Africa is a real problem and an inhibitor for many students. Many students in urban areas were able to swiftly continue with online learning but others struggled. Onelisiwe student had to apply to return to the campus because even the resources he had were not enough due to lack of infrastructure. Students from rural areas confront problems such as limited network coverage, unpredictable electrical supply, and lack of academic support at home (Dlamini & Ndzinisa, 2020; Nyawo, 2020).

Due to difficulties of obtaining detailed information on student performance from this university, only annual reports were reviewed to help conclude how students performed in these years. This was determined by the students who graduated in that year, and the numbers could mean that students enrolments were less, which means there were a smaller number of graduates, or vice versa rather than students performed better or worse.

Figure 5.13 shows that for the College of Agriculture, Engineering and Science there seemed to be a higher number of graduates in 2021 than in 2020 and 2019. This could mean that students performed better in 2021 than in the other years or that more students enrolled in 2021 than in the other years.

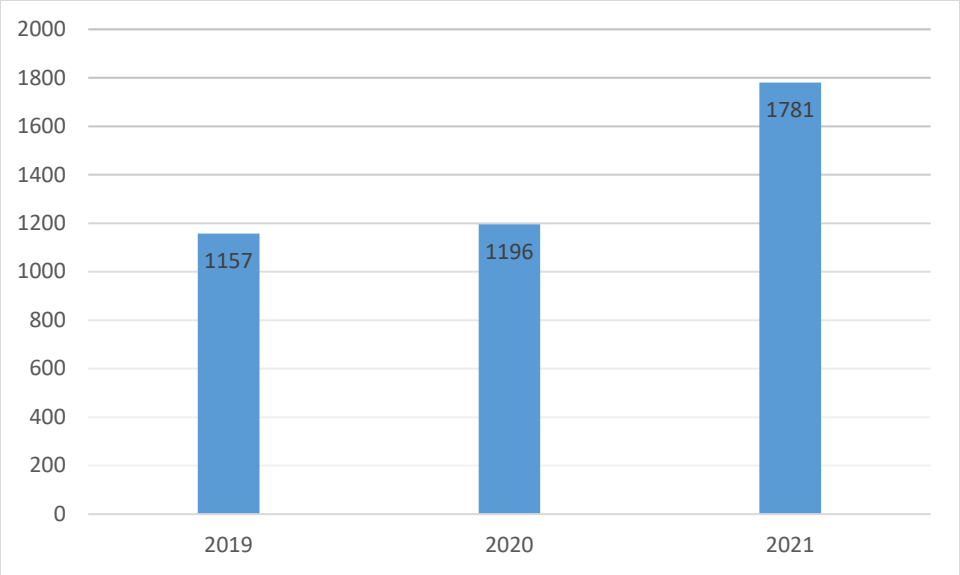


Figure 5.13 Graduation rates for the College of Agriculture, Engineering and Science at the semi-rural university in 2019, 2020, and 2021

Figure 5.14 shows that for the College of Health Sciences there were more graduates in 2021 than in 2020 and 2019. This could mean that students performed better in 2021 than in the other years or that the university had more students enrolled in 2021 than in 2019 and 2020.

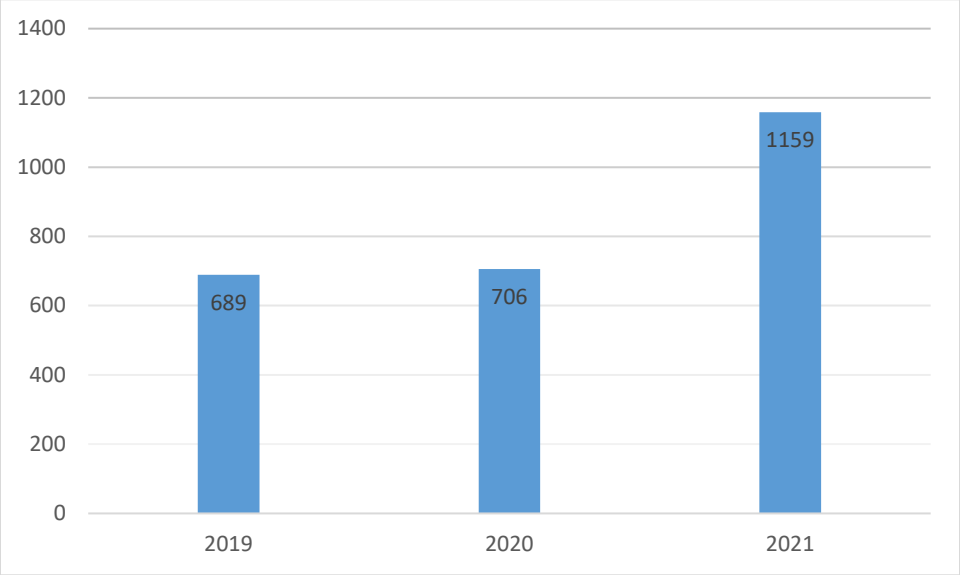


Figure 5.14 Graduation rates for the College of Health Sciences at the semi-rural university in 2019, 2020, and 2021

Looking at the College of Humanities, Figure 5.15 shows that there were more graduates in 2021 than in 2020 and 2019. This could mean that students performed better in 2021 than in the other years or that the university had bigger enrolment numbers in 2021 than in the other years.

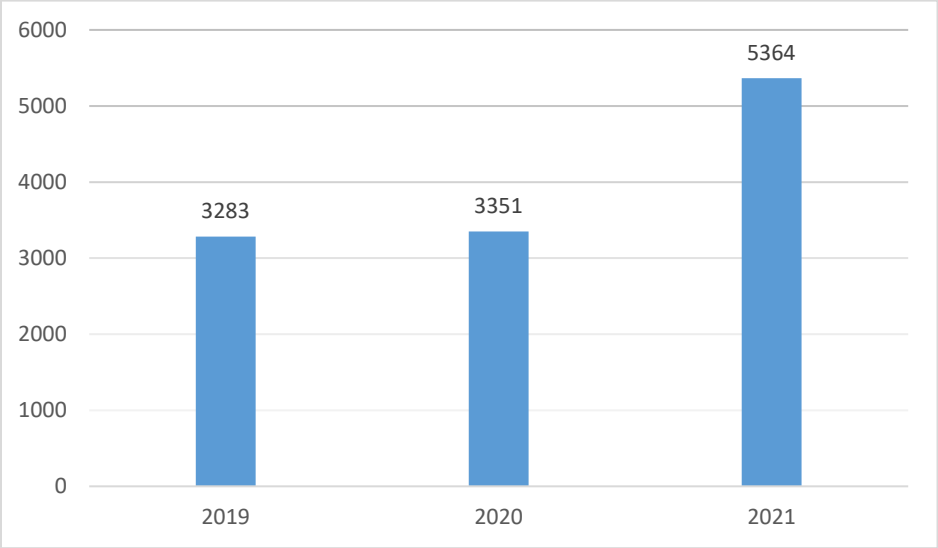


Figure 5.15 Graduation rates for the College of Humanities at the semi-rural university in 2019, 2020, and 2021

Figure 5.16 shows that for the College of Law and Management Studies, there were more graduates in 2021 than in 2020 and 2019. This could mean that students performed better in 2021 than in 2019 and 2020 or that the university had more students enrolled in 2021 than in 2019 and 2020.

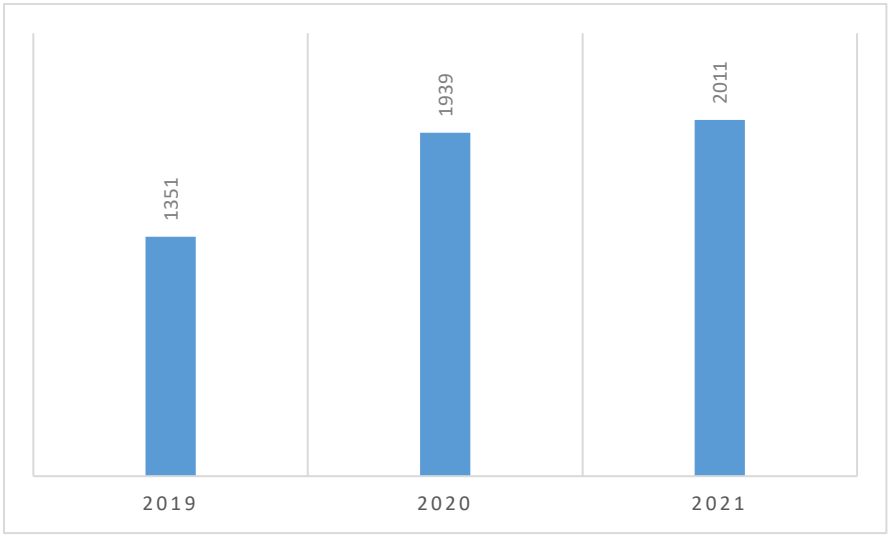


Figure 5.16 Graduation rates for the College of Law and Management Studies at the semi-rural university in 2019, 2020, and 2021

5.8.3 Annual Report Analysis: Rural University

Like all the other educational institutions, this university was not immune to the effects of the Covid-19 pandemic. All campuses of this university were closed to both students and staff when the national lockdown came into effect on 27 March 2020 (van Schalkwyk, 2020). The University Senate decided on a set of measures to implement to mitigate the spread of the Covid-19 virus inside the university community, including the immediate suspension of all academic activities on campus and the evacuation of all students. This university immediately set up a crisis committee to advise the Executive Management Committee (UNIVEN, 2020a).

Academic activities were suspended to ensure the safety of the students, and a total readjustment to the academic year due to the Covid-19 pandemic had to be considered (UNIVEN, 2020a). The transition from face-to-face to virtual teaching and learning affected most students due to lack of resources. The university directed the Covid-19 relief grant received from the DHET to purchase devices and data for the students to mitigate the digital gap (DHET, 2020; Hedding et al. 2020; Maqhina, 2020). Each student was provided with 30 gigabytes of data during the pandemic period. The use of LMS was also approved as an interim measure to ensure continuity of teaching and learning. Training to use the LMS was conducted for both students and academics. Once all this was done, the university moved to online learning in the second semester in 2020 (UNIVEN, 2020b). When the lockdown restrictions were eased, students were permitted to return to the university via a staggered approach; for example, only final year students in programmes requiring clinical training were permitted to return to campuses, starting with Medicine and followed by the phasing-in of other permitted programmes, such as Dentistry, Nursing and Veterinary Science (van Schalkwyk, 2020). This approach was necessary because of the rural location of the institution and the Senate's recognition of the challenges faced by many students who lack uninterrupted access to energy and connectivity and who have unfavourable learning conditions in their homes. In line with this, "one study reported that 46% of students faced challenges in completing assignments or participating in online learning due to a lack of access to computer equipment or data" (Jordaan & Mennega, 2021). Another report stated that "all universities reported that access to devices and internet connectivity were the main stumbling blocks in the delivery of online learning" (Universities South Africa, 2020).

In 2021, which was the second year of the Covid-19 pandemic, the university continued with blended learning approach, and realised a more mature online, blended and multi-modal teaching and learning approach, which was first introduced at the start of the pandemic in 2020 (UNIVEN, 2020b; van Schalkwyk, 2020). For the first time, all assessments in 2021 were done online after the Senate approved the introduction of a final online, integrated assessment of modules in lieu of physical examination at the end of each semester. As in the rest of the sector, the introduction of both continuous and summative online assessments saw a marked increase in student success. According to the annual reports, the student success from the Faculties of Environmental, Health Sciences, Law and Management Sciences, and Mathematics and Natural Science at this university increased from 81% in 2019 and 2020 to 88% in 2021 (see Figure 5.17).

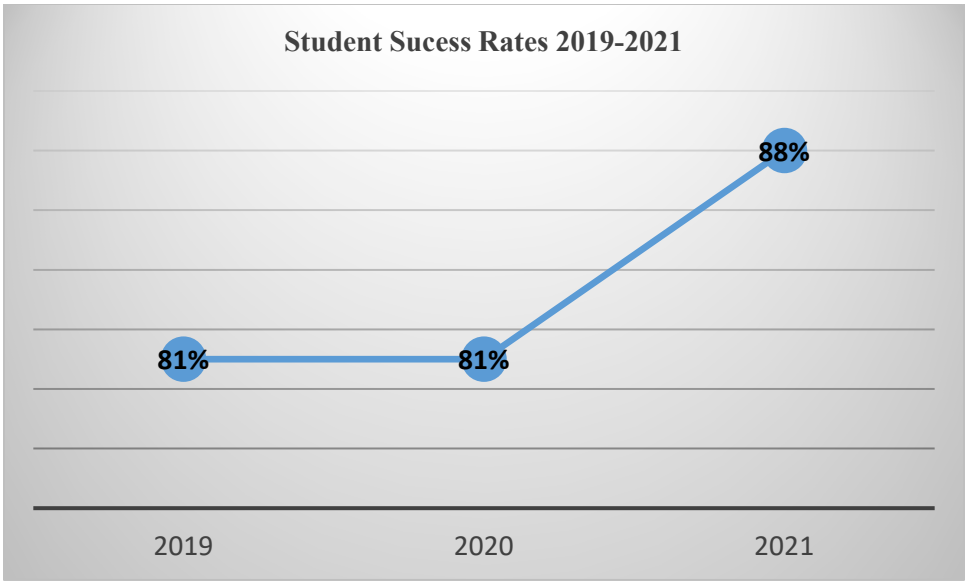


Figure 5.17 Student success rate at the rural university in 2019, 2020, and 2021 ((UNIVEN, 2021)

It is interesting to observe the graduation rate of undergraduates between the years, 2019 - 2021, at this university because it looks like the number of graduates increased in 2021 (see Figure 5.18).

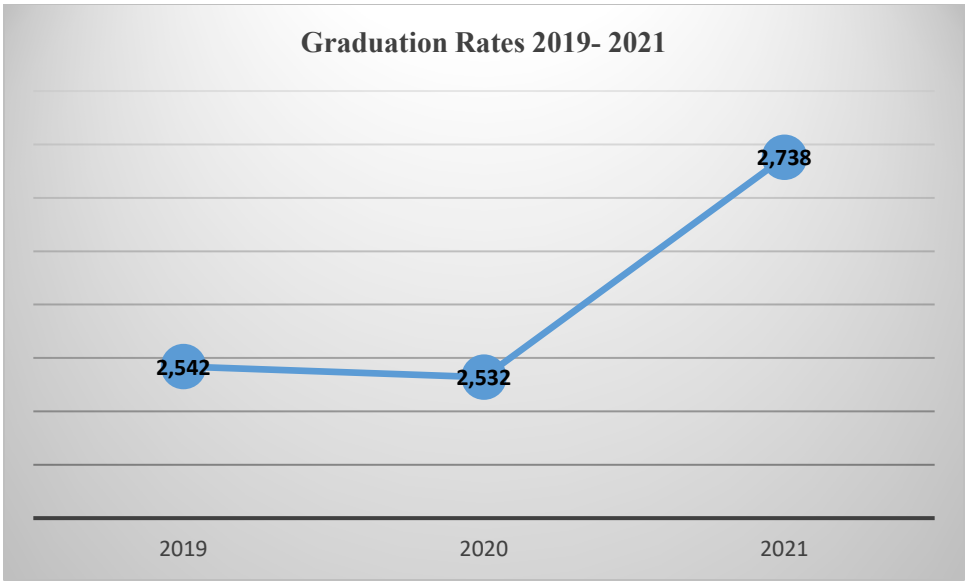


Figure 5.18 Graduation rates at the Rural University in 2019, 2020, and 2021 (UNIVEN, 2021)

5.8.4 Summary of Document Analysis for the Metropolitan, Rural, and Semi-Rural Universities

The findings from these universities vary from school to school and faculty to faculty. However, the metropolitan university results showed that on average students performed better in 2020 than in 2019 and 2021. It is worth noting that only one school in the five faculties showed different results: In the Faculty of Commerce, which falls under the School of Accounting, students performed better in 2019 than in 2020 and 2021, which can be attributed to many factors. In semi-rural universities, the findings showed minimum improvement in 2020 and high numbers of graduates in 2021. This could mean that there were more enrolments in 2021 compared to other years. It is worth noting that in general, there was also a significant improvement in the number of graduates in 2020 compared to 2019. These results are in line with the findings of Whitelaw et al. (2023). Whitelaw et al. (2023) suggested that income inequalities may influence variations in academic performance. One of the respondents from this university mentioned that she would not have managed if she did not receive financial support from her family. Supporting this notion, Chisadza et al. (2021) examined the effects of face-to-face versus online learning on economics students' performance at the University of Pretoria, South Africa. They used survey data to compare assessment grades before and after the lockdown and found that students' academic performance is positively correlated with full access to high-quality Wi-Fi, rather than mobile

internet data. This was proven because students in rural areas who were provided with data still struggled with network connectivity.

It appears that the Covid-19 pandemic affected the rural university more that the metropolitan and semi-rural universities, based on student performance data. The student success rate in the rural university dropped in 2020, which could be attributed to factors such as readjustments to the academic year and students' evacuation from the residences to their respective homes. It is worth noting that most of the students in this universities come from rural areas with a total lack of infrastructure, including no mobile networks or electricity. In 2021, which is the year students returned to campus, there seemed to be a reasonable improvement in the student performance and graduation rates. It is also evident that this university faced inequality issues because although the university provided resources, the student still struggled with other issues.

5.8.5 Impact of Digital Education on Student Performance

Determining the impact of digital technology on student performance is subjective given that during the pandemic era most universities had to compensate for the time that was lost during the lockdown by revising the course outlines and making assessments a bit easier to accommodate the students. This was confirmed by Whitelaw et al. (2023). They analysed data from the 2020 and 2021 academic years using difference-in-difference models and found that the performance gains observed in 2020 were reversed in 2021 as academic performance declined compared to pre-pandemic trends. They further discovered an increasing disparity in academic accomplishment among students from various socio-economic backgrounds, indicating that disparities in family circumstances had a more pronounced impact on student performance in 2021, even though campus housing had reopened that year (Whitelaw et al., 2023). This outcome is consistent even after because the rates of students leaving school in 2021 are significantly lower in comparison to prior years. The findings indicated that the increases witnessed in 2020 were not indicative of genuine learning progress and confirm the assumption that a decrease in the amount of material taught, greater leniency in grading, a shift in the curriculum, altered assessment methods, and a reduction in the workload contributed to the enhanced performance during the 2020 academic year (Whitelaw et al., 2023).

Aucejo et al. (2020) conducted a study to examine the impact of the pandemic on university students at one of the largest public institutions in the United States. They used a survey

specifically designed to determine the hypothetical consequences that would have occurred if the pandemic had not taken place. As an illustration, the authors inquired students' present grade point averages (GPA) in a post-Covid-19 era, as well as their anticipated GPA if Covid-19 did not exist. They thus made a subjective assessment of the impact of Covid-19 on academic performance. They discovered that students from lower-income backgrounds were 55% more likely to postpone their graduation because of the Covid-19 pandemic than those from higher-income backgrounds.

Rodr´ıguez-Planas (2022) examined the impact of the Covid-19 pandemic on university student academic achievement, including credits earned and dropped and GPA. Using panel data from the same college, the author predicted significant GPA increases in the Spring 2020 compared to previous semesters. Rodr´ıguez-Planas suggested that a flexible grading policy at the institution in their study may have contributed to the observed performance improvements. According to Rodr´ıguez-Planas, unequal treatment based on pupils' income level is implausible as it was not observed. While modifications in marking and cheating may improve overall performance, other variables may cause disparities in performance by income position. They suggested that lower-income top performers may have had more challenges with online learning than their higher-income colleagues. Conversely, the author indicated that financial aid considerations may have favoured low-income students near the bottom of the performance distribution as excellent performance is typically necessary for sustained aid.

Chisadza et al. (2021) examined the impact of face-to-face and online learning on the academic performance of economics students at the University of Pretoria. They analysed data from survey responses and compared the average assessment grades before and after the lockdown period. The research indicated that students' academic achievement positively correlated with reliable Wi-Fi connectivity, as opposed to relying on mobile internet data.

These findings were also confirmed by the academics who responded to the current study's survey:

> I was unable to do much practical work, except in the Experimental Archaeology Class (third year) where students did the experiments at home, and we conducted WhatsApp conversations about them. (Prof Mpho)
>
> Hands-on labs were restricted. Illustrations were done on Ulwazi and students had to try it on their own. (Dr Banda)

> It was not possible to send students out to schools for Teaching Practice. Some ineffective online assessment was devised. (Dr Makda)
>
> I allowed the student to take the assessment as homework. (Prof Dlamini)

The students who responded to the survey of the current study were also asked how their performance was impacted, and they responded as follows:

> I think my performance was affected positively. The online tests were open book, so one could refer back to notes, instead of relying on memory. (Lerato**)**
>
> Practical was not conducted during the pandemic. (Dimpho)
>
> I can say that when I compare previous years and during the time of the Covid, there was a change in my school performance I think the reason is because I had a good access to internet which helped me to research more information for my studies. Hence it positively affected me. (Lesedi)
>
> When you compare my performance during the time of the Covid and previous years was good, this is because I was able to do my work at my own pace and that I had time to google more information. Hence it was a positive benefit. (Bokamoso)

In summary, the academics confirmed that the workload for students was reduced, while others permitted students to complete practical assignments at home, resulting in a calmer and less stressed environment, which had a favourable impact on their academic performance. Additionally, several students reported improved performance compared to previous years and attributed it to their ability to reference the recordings and having more time for their work and study. Both at local and global level, substantial evidence indicated significant decreases in learning due to the closure of schools because of the Covid-19 pandemic(Ardington, 2021; Aucejo et al., 2020). Despite expectations of a decrease in learning and inadequate educational experiences at universities Salmi (2020), data from South African universities suggested that academic performance showed improvement in 2020. This could be due to various factors, including relaxed marking standards, alterations in the curriculum, modified assessment methods, increased instances of cheating, students using more effective online learning strategies, and the ability to learn at one's own speed.

5.9 The Factors that Contribute to the Success of Digital Technology Enabled Education

This section responds to the fourth research question:

- **RQ4:** Which factors contribute to successful digital technology enabled education?

To meet this research objective, the researcher analysed the important factors contributing to the success of digital technology enabled education in HEIs by analysing the results of the reliability of the items within the constructs for both the academics and students' datasets to see whether the items measured what they intended to measure (Green & Salkind, 2011). The researcher conducted convergent validity tests to assesses whether different measures that were supposed to assess the same construct were indeed related and to test the relationship between the constructs as shown in the conceptual model for this study (Rojahn et al., 2003). The researcher employed EFA to examine the factor loadings to determine their correlation and to see whether the underlying observed items were the contributing factors and whether the identified items existed and were practical (Bandalos & Finney, 2018). The researcher further analysed the responses to the open-ended questions from the participants. The data were collected from academics and students and are presented as such. This section presents the analysis of Cronbach's alpha coefficient, convergent validity, EFA and the responses to the open-ended questions.

5.9.1 Social Presence

5.9.1.1 Cronbach's Alpha Coefficient

The analysis showed that social presence with high reliability consisted of nine items (SCLP1–SCPL9) from the academics' dataset, demonstrating a robust internal consistency with a Cronbach's alpha coefficient of 0.933, and nine items (SSCLP1–SSCLP9) from the students' dataset, demonstrating a high reliability with a Cronbach's alpha coefficient of 0.828. This also demonstrates high internal consistency, which is higher than the acceptable internal consistency of 0.7 for both the academics' and students' datasets.

5.9.1.2 Convergent Validity

The convergent validity showed that social presence correlates with other constructs in the academics' dataset. The results showed a strong and positive correlation between social presence and cognitive presence ($r = 0.786$), suggesting that the more social presence there is in learning,

the more cognitive presence there is, and vice versa. The social presence correlation showed moderate correlation with learner presence (r = 0.448), indicating a positive relationship that means social presence is positively related to learner presence but not as strongly as with cognitive presence. There was a moderate positive correlation between academic skills (r = 0.459) and social presence, meaning that higher social presence is associated with better academic skills. Similarly, there was a moderate positive correlation between technology (r = 0.459) and social presence, which means that increased social presence correlates with better use or perception of technology. There was a strong positive correlation between environment (r = 0.716) and social presence, which indicates that as social presence increases, the learning environment is perceived more positively. There was a weaker positive correlation between social presence and infrastructure (r = 0.349), which means that although there is a relationship, it is not as strong as with the other factors.

The analysis for the convergent validity showed how social presence correlated with other constructs in the students' dataset. The results showed a moderate positive relationship between social presence and student skills (r = 0.449), suggesting the importance of student skills in achieving student autonomy in learning. A moderate to strong positive relationship between social presence and technology (r = 0.488) suggested that as social presence increases, technology use or its effectiveness is positively perceived. A moderate positive relationship between social presence with the environment (r = 0.442) suggested that as social presence increases, the learning environment is perceived more positively. A moderate positive correlation between social presence and cognitive presence (r = 0.440) showed that higher social presence is associated with higher cognitive presence. A moderate positive relationship between social presence and learner presence (r = 0.440) indicated a positive relationship, which means that social presence is positively related to learner presence. A very weak positive correlation between infrastructure (r = 0.167) and social presence, which is not statistically significant, suggested that social presence does not have a meaningful relationship with infrastructure in the students' dataset.

5.9.1.3 Exploratory Factor Analysis

The factors analysis and the loadings indicated a strong relationship between the items and the constructs for both the academics' and students' datasets. The underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality. The following

items were found and confirmed to be the items that measured social presence: Open communication between the students; collaborative activities between students; students feeling secure to communicate; students and facilitator/lecturer communication; group cohesion; mutual trust among the students; and structures, systems, and opportunities that support social interaction in online learning.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that both the academics' and the students' models fit well with the data.

5.9.1.4 Academics' and Students' Perceptions

Social presence is about open communication, collaboration between students, and mutual trust among students (Arbaugh et al., 2008; Garrison, 2017; Garrison & Arbaugh, 2007; Kreijns et al., 2014; Matadi & Uleanya, 2022). To further understand the respondents' perceptions about social presence, they were asked, "How does social presence enhance the learning and teaching process in online learning?" The students responded as follows to the question:

> That social presence helps people relax and promotes a better environment for learning. (Puseletso)
>
> Makes people connect and communicate effectively which is a big requirement for online learning, so if people have social presence productivity will be greater than for those who don't. (Lehlaku)

The academics responded as follows to the same question:

> Students are able to share ideas and ways of solving problems. (Dr Phiri)
>
> It gives confidence to the students and enables them to contribute as part of the teaching and learning process. (Prof Bakes)

This analysis correlates with the findings of Garrison et al. (1999, p. 94), who mentioned that social presence refers to the capability of participants in a learning community to "project themselves

socially and emotionally, as real people, through the medium of communication being used". Individuals become themselves and are also free to express their emotions. These mediums of communication can be social affordance platforms that enhance the participants' social presence (Arbaugh et al., 2008). The participants' social presence can be assessed from a range of dimensions, such as affective, interactive, and cohesive (Arbaugh et al., 2008), and has been identified to impact their satisfaction, perceived learning, online social interactions, and learning outcomes (Kreijns et al., 2014; Kreijns & Kirschner, 2018; Weidlich & Bastiaens, 2019).

5.9.2 Cognitive Presence

5.9.2.1 Cronbach's Alpha Coefficient

The results showed high reliability for cognitive presence consisting of six items (COGP1–COGP6) from the academics' dataset, demonstrating a good internal consistency with a Cronbach's alpha coefficient of 0.876, and seven items (SCOGP1–SCOGP7) from the students' dataset, demonstrating a good internal consistency with a Cronbach's alpha coefficient of 0.828, which is higher than the acceptable internal consistency of 0.7.

5.9.2.2 Convergent Validity

The findings for the convergent validity showed how cognitive presence correlated with the other constructs in the academics' dataset. The results showed a strong and positive correlation between cognitive presence and social presence ($r = 0.786$), suggesting a strong and statistically significant relationship between how students feel when interacting with others and how they feel about the design of the learning activities and assessments (Arbaugh et al., 2008; Garrison & Arbaugh, 2007; Kreijns et al., 2014). This shows that the more social presence there is, the more cognitive presence there is. A moderate positive relationship between cognitive presence and academic skills ($r = 0.600$) suggested a strong link between students' academic skills and their cognitive presence. Improved academic skills are associated with deeper engagement in thinking. A strong relationship between the use of technology ($r = 0.600$) and cognitive presence implied that the effective use of technology enhances the design of the learning activities and assessments. A very strong correlation between cognitive presence and environment ($r = 0.826$) showed that a supportive learning environment is closely linked to better cognitive presence. This analysis also implied that a positive learning environment greatly promotes deep thinking.

The findings for the convergent validity analysis showed how cognitive presence correlates with other constructs in the students' dataset. The results showed a strong and positive correlation between cognitive presence and technology presence (r = 0.540), suggesting a strong positive relationship between how students use technology and their cognitive presence, and therefore, when students use technology effectively, they tend to engage more deeply with the content. A weak and positive correlation between cognitive presence and environment (r = 0.192), though statistically significant, indicated that a slightly better learning environment might be associated with some increase in cognitive presence, but the relationship was not very strong. A moderate positive relationship between students' skills (r = 0.431) and cognitive presence showed that improved student skills are associated with better engagement and understanding of the content. A moderate positive relationship between social presence (r = 0.440) and cognitive presence showed a strong relationship between how students feel when interacting with others and how they feel about the design of the learning activities and assessments (Arbaugh et al., 2008; Garrison & Arbaugh, 2007; Kreijns et al., 2014). A weak positive relationship with learner presence was not statistically significant, suggesting that the connection between learner presence (r = 0.185) and cognitive engagement was not strong.

5.9.2.3 Exploratory Factor Analysis

Factor analysis was conducted, and the loadings indicated a strong relationship between the items and the constructs for both the academics' and students' datasets. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality and that they are items that measure cognitive presence: Students being able to explore, integrate and apply knowledge; high level thinking tasks and application type of activities; activities that promote critical thinking and problem-solving skills among students; and peer review discussions.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These analyses indicated that both the academics' and students' models fit well with the data.

5.9.2.4 Academics' and Students' Perceptions

Cognitive presence is about the design of learning activities and assessments as well as the facilitation of courses. It refers to the extent to which learners and academics constructs meaning through sustained communication (Arbaugh et al., 2008; Garrison & Arbaugh, 2007; Kreijns et al., 2014). To further understand the respondents' perceptions of the cognitive presence, they were asked, "In your opinion, what can be done to enable/stimulate students to explore, integrate and apply the knowledge in an online environment?" The students replied as follows to this question:

> Putting students in smaller groups sort of forces everyone to integrate. (Peter)
>
> Making the sessions interactive, where students are able to engage with the content and learn in a fun way. (Grace)
>
> Academics should allow students to drive the discussions. (John)

Dr Botha responded to a similar question and agreed with Peter, saying, "providing them with questions and giving them the chance of using breakout rooms for discussions. That way, students begin to learn by depending on peers". Dr Marks responded and recommended the implementation of strategies to test reading on a weekly basis and an opportunity to receive feedback on basic application and integration skills in order to assess students on integration and application.

In 2020, there was not much time to thoroughly plan the transition from face-to-face teaching and learning to ERT, and thus, students were connected to the same courses according to the normal face-to-face setting, which according to the respondents, did not always work. During that period, there was a lack of student engagement, interaction and collaboration, and material or content about the courses was posted on the LMS and students were expected to engage with the material. According to Garrison (2017), Garrison et al. (1999), and Kozan and Caskurlu (2018), cognitive presence is about the co-learning approach and inquiry process and about academics and learners leveraging technological affordances and social affordances to enjoy teaching and learning in the digital age. Technological affordance refers to the design features of a technology tool that allow for the completion of a learning task in an easy way that satisfies the user (Xue et al., 2023). In other words, a usable design contains information specifying affordances that enable users to accomplish learning activities without technological challenges. Social affordances are the features of technology tools that facilitate social interactions among its users (Weidlich & Bastiaens, 2019).

5.9.3 Learner Presence

5.9.3.1 Cronbach's Alpha Coefficient

The results showed good reliability for learner presence, consisting of two items (LNRP1–LNRP2), for the academics' dataset that demonstrated a satisfying internal consistency with a Cronbach's alpha coefficient of 0.756, and two items (SLNRP1–SLNRP2) for students' dataset demonstrating a questionable Cronbach's alpha coefficient of 0.668, which is slightly lower than the acceptable internal consistency of 0.7.

5.9.3.2 Convergent Validity

The findings for the convergent validity analysis showed how learner presence correlated with the other constructs in the academics' dataset. The results showed a moderate positive relationship between learner presence and social presence ($r = 0.448$), suggesting that as students feel more present and engaged in the learning environment, they also tend to feel more connected to their peers. A moderate to strong positive relationship between learner presence and cognitive presence ($r = 0.594$) suggested that when students feel more present and engaged, they are also more likely to be deeply involved in thinking and learning activities. There was a moderate positive relationship between learner presence and the environment ($r = 0.557$) that suggested that a stronger sense of being present in the learning setting is associated with a more positive perception of the overall learning environment. A moderate positive correlation between learner presence and academic skills ($r = 0.447$) suggested that academics with a high level of pedagogical skills enhance students' engagement, which leads to better academic performance. A moderate positive correlation between learner presence and technology ($r = 0.447$) suggested that an increased engagement and presence in the learning environment are associated with a more effective use of technology. A weak positive correlation between learner presence and infrastructure ($r = 0.306$) suggested that although there is a connection, it is not as strong as between the other constructs. A higher sense of learner presence is somewhat associated with better infrastructure, but the relationship is not as pronounced.

The findings for the convergent validity analysis showed how learner presence correlates with other constructs in the students' dataset. The results showed a moderate positive relationship between learner presence and social presence ($r = 0.448$), suggesting that as students feel more

present and engaged in the learning environment, they also tend to feel more connected to their peers. A moderate to strong positive relationship between learner presence and cognitive presence (r = 0.594) suggested that when students feel more present and engaged, they are also more likely to be deeply involved in thinking and learning activities. There was a moderate positive relationship between learner presence and the environment (r = 0.557), suggesting that a stronger sense of being present in the learning setting is associated with a more positive perception of the overall learning environment. A moderate positive correlation between learner presence and academic skills (r = 0.447) suggested that academics with high-level pedagogical skills enhance students' engagement, which leads to better academic performance. A moderate positive correlation between learner presence and technology (r = 0.447) suggested that an increased engagement and presence in the learning environment are associated with more effective use of technology. A weak positive correlation between learner presence and infrastructure (r = 0.306) suggested that although there was a connection, it was less strong compared to the other constructs. A higher sense of learner presence was somewhat associated with better infrastructure, but the relationship was not as pronounced.

5.9.3.3 Exploratory Factor Analysis

Factor analysis was conducted, and the loadings indicated a strong relationship between the items and the constructs for both the academics' and the students' datasets. The underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality. The following items were identified as items that measures learner presence: Self-efficacy and environment. Self-efficacy in this context refers to an individual's belief in their capacity to execute behaviours necessary to produce specific performance attainments (Semwal et al., 2019; Shea & Bidjerano, 2010). Learning environments refer to the environments that support social and cognitive development spaces where students feel they can be successful and are motivated to learn.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables also showed a good fit with 20.0% of non-

redundant residuals having absolute values greater than 0.05. These findings indicate that both the academics' and the students' models fit well with the data.

5.9.3.4 Academics' and Students' Perceptions

Learner presence in the context of this study and the literature refers to students' autonomy to be successful in an online class. To further understand the respondents' perceptions about learner presence, they were asked, "What other learner presence enhance student learning experience?" Lindo suggested open communication between the lecturers and students, where lecturers consistently check in to see if students understand and to clarify if necessary. Lehlaku suggested live interaction and participation, and Lehlogonolo suggested self-discipline for students. Dr Bret agreed with Lehloholonolo and mentioned time management and discipline. Dr Govendor also mentioned self-motivation and time management, and Dr Phiri mentioned "a conductive learning space".

According to the responses to the open-ended questions, while the academics and students acknowledged that the self-efficacy and conducive learning environments are contributing factors to learner presence, they pointed out that time management, self-motivation and self-discipline are some of the factors that could be taken into consideration (Fadda, 2019; Ontong & Mbonambi, 2021; Shim & Lee, 2020). Learner presence was added as construct to the existing CoI elements by Shea and Bidjerano (2010). The authors proved that there is a strong correlation between the constructs in the CoI framework and self-efficacy, which is attributed to the learner presence. Learner presence is about the student's role and participation in learning and is a collaboration between learners and lecturers (Anderson, 2017; Kovanović et al., 2015).

5.9.4 Academics Skills

5.9.4.1 Cronbach's Alpha Coefficient

The results showed a high reliability consisting of three items (ACAD1–ACAD3) for academic skills for the academics' dataset, demonstrating a strong internal consistency with a Cronbach's alpha coefficient of 0.901, which is higher than the acceptable internal consistency of 0.7.

5.9.4.2 Convergent Validity

The findings for the convergent validity analysis showed how academic skills correlate with the other constructs in the academics' dataset. The findings indicated a moderate positive relationship between academic skills and cognitive presence (r = 0.600), suggesting that higher levels of academic skills are closely associated with greater cognitive engagement. The perfect positive correlation between academic skills and technology **(**r = 1.000) indicated that academic skills and technology are directly and perfectly aligned in this study, or it could point to an issue with data redundancy. A strong positive correlation between academic presence and environment (r = 0.632) indicated that better academic skills are associated with a more supportive or effective learning environment. A moderate positive correlation between academic skills and cognitive presence (r = 0.459) suggested that higher academic skills are moderately associated with enhanced cognitive interactions in the learning process. A moderate positive correlation between academic skills and learner presence (r = 0.447) indicated that greater academic skills are somewhat associated with a stronger presence or participation of the learner in the learning environment. A weak positive correlation between academic skills and infrastructure (r = 0.297) suggested a lower, though statistically significant, association between academic skills and the quality and adequacy of the infrastructure. This implies that while there is some relationship, it is relatively weaker compared relationships with the other constructs.

5.9.4.3 Exploratory Factor Analysis

Factor analysis was conducted and the loadings indicated a strong relationship between the items and the constructs for the academics' dataset. The underlying observed items, namely technical skills, digital skills, and computer literacy, were confirmed as key contributing factors, demonstrating their validity and practicality.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for the academics' dataset. The model for the academics' data variables showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that the model fit well with the data.

5.9.4.4 Academics' Perceptions

Academic skills in the context of this study and the literature encompass the capacity to recognise and employ various methods of acquiring knowledge, comprehend the diverse ways in which knowledge is conveyed and assessed, and empathise with the viewpoints of individuals operating in other systems of knowledge (Kreijns & Kirschner, 2018). According to Arbaugh et al. (2008), Garrison and Arbaugh (2007), and Kreijns et al. (2014), one of the responsibilities of academics is to design learning activities and assessments, and these requires some level of skill.

To further understand the respondents' perceptions of academic's skills, they were asked, "What other skills and factors do you think are important for academics to have to enhance online learning?" The respondents answered as follows:

> Excellence in curriculum design. (Dr Metsi)
>
> Online assessment skills. (Dr Router)
>
> Content knowledge, methods of teaching and assessing within an online environment is key. (Dr Grace)
>
> Online assessments. It was not easy to establish if they were colluding to respond to tasks or if they were copying each other or the internet. Assessments were mainly through multiple-choice questions, which at times did not need much engagement but good guesswork. Students' average performance marks increased. (Dr Hlope)

In the researcher's view, which supports the view of the respondents, academics should have technical skills, digital skills, computer literacy, curriculum and instructional design skills, and online assessment skills. During the Covid-19 pandemic, most academics struggled with digitising their content because of a lack of these skills (Ferri et al., 2020; Mackenzie, 2019; Udeogalanya, 2022).

5.9.5 Student Skills

5.9.5.1 Cronbach's Alpha Coefficient

The findings confirmed a high reliability consisting of three items (SSKLS1–SSKLS3) of student skills for the students' dataset, demonstrating a good internal consistency with a Cronbach's alpha coefficient of 0.759, which is higher than the acceptable internal consistency of 0.7.

5.9.5.2 Convergent Validity

The findings for the convergent validity analysis showed how student skills correlate with other constructs in the students' dataset. The findings indicated a strong positive correlation between student skills and social presence (r = 0.449), suggesting that students with higher skills tend to have greater social engagement or presence in their learning environment. This was observed during the transition from face-to-face to ERT. Students with digital skills found it easier to navigate than those who lacked the skills. A strong positive correlation between student skills and cognitive presence (r = 0.431) suggested that students who have better skills are more likely to exhibit deeper cognitive engagement or understanding in their learning activities. A positive correlation between student skills and learner presence (r = 0.413) suggested that students with better skills tend to be more actively involved, collaborate easily, and interact with ease in the learning process. A strong positive correlation between student skills and technology (r = 0.455) implied that students with better skills use technology effectively in their learning. A strong positive correlation between student skills and environment (r = 0.481) suggested that students with better skills are likely to perceive or interact with a more supportive and conducive learning environment. A weak positive correlation between student skills and infrastructure (r = 0.219) suggested a lower level of association between student skills and the quality or adequacy of infrastructure. Although this correlation was statistically significant at the 0.05 level, the strength of the relationship was relatively weak, meaning that while there was some association, it was not as pronounced as with the other constructs.

5.9.5.3 Exploratory Factor Analysis

Factor analysis was conducted, and the loadings indicated a strong relationship between the items and the constructs for the students' dataset. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality: Technical skills, digital skills, and computer literacy.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50. The model for the students' variables showed a good fit, with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. These findings indicated that the models fit well with the data.

5.9.5.4 Students' Perceptions

Student skills in the context of this study and literature encompass a broad range of abilities that contribute to students' academic success and overall personal development. These skills include critical thinking, problem-solving, time management, communication, computer literacy, digital skills, and technical skills. Digital literacy refers to the ability to effectively use technology, technical skills refer to understanding basic computer hardware and software with the ability to perform computer operations, such as using a keyboard and mouse, and digital skills refers to the ability to use technology, critically evaluate information, organise data and media sources, and collaborate and participate in online environments. All these encompass the skills a student requires to thrive in an online environment. According to Conley (2012), student skills also involve emotional intelligence, adaptability, and collaboration, which are crucial for working in team settings and responding to various challenges.

To further understand the respondents' perceptions of student skills, the students were asked, "What other skills and factors do you think are important for students to have to enhance online learning?" They responded as follows:

> Time management. (Pontso)
>
> The ability to navigate through new learning platforms. (Pitso)
>
> Critical thinking, online learning often requires students to learn independently and analyse information on their own. (Senzo)
>
> Listening and communication skills. (Doreen)

The ability to navigate systems with ease is crucial. According to Spante et al. (2018), students should be able to search for and generate content, solve problems, innovate, and effectively use technology. During the pandemic era, students were required to possess the skills to proficiently navigate online platforms. They needed to know how to access the uploaded materials, voice-over PowerPoint presentations, and video files and how to participate in live online sessions via Zoom, Teams, or Google Meet. According to Hallal et al. (2020), all these tasks necessitate a certain level of digital skill and competency.

5.9.6 Technology

5.9.6.1 Cronbach's Alpha Coefficient

The findings confirmed a high reliability consisting of four items (TECH1–TECH4) for technology for the academics' dataset, demonstrating a good internal consistency with a Cronbach's alpha coefficient of 0.839, which showed good internal consistency of 0.7, and four items (STECH1–TECH4) for technology for the students' dataset, also demonstrating good internal consistency with a Cronbach's alpha coefficient of 0.765, showing good internal consistency of 0.7.

5.9.6.2 Convergent Validity

The findings for the convergent validity analysis showed how technology correlated with other constructs in the academics' dataset. The findings indicated a strong positive correlation between technology and cognitive presence (r = 0.600), suggesting that increased use or effectiveness of technology is associated with higher levels of cognitive engagement or presence in learning activities. A perfect positive correlation between technology and academic skills (r = 1.000) indicated that the measure of technology and academic skills are perfectly aligned or identical in this study. This might suggest that the two variables were measured the same way or could point to an issue with data redundancy. A strong positive correlation between technology and environment (r = 0.632) indicated that the effective use of technology is associated with a more supportive or effective learning environment. A moderate positive correlation between technology and social presence (r = 0.459) suggested that the increased use of technology is somewhat associated with higher levels of social interaction or presence in the learning environment. A moderate positive correlation between technology and learner presence (r = 0.447) implied that the effective use of technology is moderately associated with increased learner engagement or presence in the educational setting. A weak positive correlation between technology and infrastructure (r = 0.297) suggested a lower, though statistically significant, association between technology and the adequacy of infrastructure. This suggested that while there was some relationship between technology use and infrastructure, it was relatively weak compared to the relationship with the other constructs.

The findings for the convergent validity analysis showed how technology correlated with the other constructs in the students' dataset. The findings indicated a strong positive correlation between technology and cognitive presence (r = 0.540), suggesting that the effective use of technology is closely associated with higher levels of cognitive engagement or presence in learning activities. In other words, as technology use improves, cognitive presence tends to increase. A strong positive correlation between technology and social presence (r = 0.488) suggested that better or more effective technology use is associated with enhanced social interaction, collaboration and presence within the learning environment. A positive correlation between technology and learner presence (r = 0.363), while not as strong as with cognitive and social presence, still suggested a significant association, meaning that technology use contributes to increased learner engagement and presence, though the effect is moderate. A strong positive correlation between technology and student skills (r = 0.455) suggested that the effective use of technology is associated with better student skills or abilities. A strong positive correlation between technology and environment (r = 0.548) implied that effective technology use contributes to a more supportive or effective learning environment. A moderate positive correlation between technology and infrastructure (r = 0.315) indicated a moderate association between technology use and the adequacy of infrastructure. This suggested that while technology and infrastructure were related, the relationship was not as strong as with the other constructs, but it remained statistically significant.

5.9.6.3 Exploratory Factor Analysis

Factor analysis was conducted, and the loadings indicated a strong relationship between the items and the constructs for both academics' and students' datasets. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality: Intelligent tutoring systems; applications that enable online learning; applications that enable effective collaborations between student and teachers; and digital learning platforms or LMSs.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicated that both the academics' and the students' models fit well with the data.

5.9.6.4 Academics' and Students' Perceptions

Technology in the context of this study refers to the tools, systems, and devices created through scientific knowledge and innovation to solve problems, enhance productivity, and improve daily life. It includes everything from simple tools and machines to complex digital systems such as computers, smartphones, and the internet (Mishra & Koehler, 2006). In education, technology plays a crucial role in facilitating learning through digital platforms, online resources, and interactive applications. It also enables collaboration, communication, and access to a vast array of information, making learning more efficient and engaging. The rapid evolution of technology continues to transform industries, economies, and societies, highlighting its essential role in modern life (Mishra & Koehler, 2006). Technology has the potential to greatly enhance learning; however, to completely reap the advantages of technology in the education system and offer genuine learning opportunities, educators must effectively use technology (U.S. Department of Education, 2017).

To further understand the respondents' perceptions about technology, they were asked "What other technology factors are important for online learning?" The academics responded as follows:

> Awareness and readiness to adopt or use technology. (Dr Ruth)
>
> Technology platforms should be very easy to navigate and integrated with other platforms students are required to use. (Dr Mashigo)
>
> AI and plagiarism considerations. (Dr Clive)
>
> Ability to select suitable digital technology for one's teaching context. (Dr Sam)
>
> Enough data and reliable connection so that we can put on our cameras. (Prof Dladla)

Students were asked the same question and responded as follows:

> A good LMS is crucial to student online learning, I remember we would have moments where Sakai would crash during a test, at some point lecturers thought we were making excuses. (Lerato)
>
> Reliable internet connection, is crucial for online learning as it allows students to access online course materials, engage in discussions with peers and instructors, and submit assignments. (Phuma)

Technology in the context of this study refers tools, systems, and devices created to enhance productivity and to better the daily lives of people, and it includes teaching and learning. The respondents also mentioned that these tools ought to work effectively for people to realise their benefits, but they do contend with the notion that the use of technology tools enhance teaching and learning. In addition to this, Fogarty (2020) mentioned that without the technological tools that make remote education possible, higher education would have had to surrender in the face of the pandemic.

5.9.7 Infrastructure

5.9.7.1 Cronbach's Alpha Coefficient

The findings confirmed a good reliability consisting of four items (INFR1–INFR4) for infrastructure from the academics' dataset, demonstrating a high internal consistency with a Cronbach's alpha coefficient of 0.922, and four items (SINFR1–SINFR4) from students' dataset, demonstrating good internal consistency with a Cronbach's alpha coefficient of 0.789, which is higher than the acceptable internal consistency of 0.7.

5.9.7.2 Convergent Validity

The findings for the convergent validity analysis showed how infrastructure correlated with the other constructs in the academics' dataset. The findings indicated a moderate positive correlation between infrastructure and social presence ($r = 0.349$). This suggests that improvements in infrastructure are somewhat associated with higher levels of social interaction and presence in the learning environment. Better infrastructure facilitates more effective communication and interaction among participants. A moderate positive correlation between infrastructure and cognitive presence ($r = 0.450$) suggested that better infrastructure is moderately associated with increased cognitive presence in learning activities. This implies that improved infrastructure supports deeper cognitive processing. A moderate positive correlation between infrastructure and learner presence ($r = 0.306$) suggested that infrastructure has a positive effect on the presence or engagement of learners. A moderate positive correlation between infrastructure and academic skills ($r = 0.297$) suggested that improvements in infrastructure are associated with better academic skills, though the relationship is relatively weak. This suggests that while infrastructure plays a role in supporting academic skills, its impact is less pronounced compared to other constructs. A

similar moderate positive correlation between infrastructure and technology (r = 0.297) suggested that better infrastructure is somewhat associated with more effective use of technology. Improved infrastructure may facilitate better technological integration and usage in the learning environment. A moderate positive correlation between infrastructure and environment **(**r = 0.490) suggested that better infrastructure is associated with a more supportive or effective learning environment. This means that improved infrastructure contributes significantly to creating a conducive learning environment.

The findings for the convergent validity analysis showed how infrastructure correlated with the other constructs in the students' dataset. The findings indicated a moderate positive correlation between infrastructure and learner presence (r = 0.363), suggesting that better infrastructure is associated with increased learner presence or engagement in the learning environment. Improved infrastructure, such as better facilities or resources, supports students' active involvement in their learning activities. The correlation between infrastructure and student skills (r = 0.219) is positive but weak, suggesting that while there is some association between infrastructure and student skills, the impact is relatively moderate. Better infrastructure may support student skills development to a certain extent, but its influence is not very strong. There was a moderate positive correlation between infrastructure and technology (r = 0.315), suggesting that improved infrastructure is moderately associated with the effective use of technology in the learning environment. Better infrastructure can facilitate better technological integration, though the relationship is not very strong. A moderate positive correlation between infrastructure and environment (r = 0.417) suggested that better infrastructure is associated with a more effective and supportive learning environment. This means that infrastructure contributes to creating a better overall learning environment. A weak positive correlation between infrastructure and social presence (r = 0.167), although not statistically significant, suggested that the association between infrastructure and social presence is minimal. Better infrastructure may have a slight effect on social interaction but does not have a strong or significant impact. The correlation between infrastructure and cognitive presence (r = -0.023) was very weak and negative and was not statistically significant, suggesting that there is little to no association between infrastructure and cognitive presence. In this context, better infrastructure does not appear to have a meaningful impact on cognitive engagement.

5.9.7.3 Exploratory Factor Analysis

Factor analysis was conducted, and the loadings indicated a strong relationship between the items and the constructs for both the academics' and the students' datasets. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality: Network infrastructures, reliable network bandwidth, data or digital bandwidth, reliable electricity, and connectivity.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that both the academics' and the students' models fit well with the data.

5.9.7.4 Academics' and Students' Perceptions

Infrastructure in the context of education encompasses the buildings, technology, and resources required to support teaching and learning, such as classrooms, internet connectivity, digital devices, and LMSs. Effective infrastructure is crucial for ensuring that services and processes run smoothly, to enable growth and development, and for the efficient functioning of an organisation or community (Aschauer, 1989).

Preparing students to be successful in the future requires a robust and flexible learning infrastructure capable of supporting new types of engagement and of providing ubiquitous access to the technology tools that allow students to create, design, and explore. The essential components of infrastructure capable of supporting transformational learning experiences include the following:

- Consistent access to high-speed internet in and out of the university;
- Access to huge internet resources to facilitate communication and collaboration among learners and educators;
- High-quality digital learning content and tools for creating interesting and relevant learning experiences; and

- Responsible use policies that contain standards to protect people and guarantee infrastructure is used for learning.

To further understand the respondents' perceptions about infrastructure, they were asked to respond to the following open-ended question: "What other infrastructural factors should be considered for online learning?" The academics responded as follows:

> Reliable electricity. (Prof Lee)
>
> Devices—laptops, desktops, smartphones, tablets with access to the internet and the necessary loaded applications. (Dr Bruce)
>
> Availability of tablets or laptops to students. (Dr Bett)

The students were asked the same question and responded as follows:

> Technical support is necessary to help students troubleshoot technical issues and ensure that their devices are in good working condition. Schools should provide students with access to technical support services, either through an on campus help desk or a remote support service. (Mpho)
>
> Access to technology, students need access to technology such as computers, laptops, tablets, and smartphones to participate in online learning. It's important for schools to ensure that students have access to the necessary devices and that they are in good working condition. (Pontsho)
>
> Reliable network connection. (Bright)

Looking at these comments, most respondents suggested network and electricity, which equates to access. It is important to note that technology tools require access to connectivity features like electricity, internet, mobile coverage, a broadband connection, and access to hardware such as computers and tablets. The extent to which these technologies are readily available in an area will heavily influence the feasibility of successfully implementing the use of these technology tools (Rodriguez-Segura, 2020). Unfortunately, significant global disparities in infrastructure continue to limit the effectiveness of technological interventions in disadvantaged countries. The data analysis revealed that students from rural areas frequently reported issues with inadequate

electricity and network connectivity problems. This was also noted by Dlamini (2023). In these cases, policymakers, researchers, and partnerships with private institutions might be the solution.

5.9.8 Environment

5.9.8.1 Cronbach's Alpha Coefficient

The findings confirmed a good reliability consisting of three items (ENVR1–ENVR3) for environment from the academics' dataset, demonstrating a high internal consistency with a Cronbach's alpha coefficient of 0.859, and two items (SENVR1–SENVR2) for the students' dataset, demonstrating a lower level of reliability, with a Cronbach's alpha coefficient of 0.520, which is lower than the acceptable internal consistency of 0.7.

5.9.8.2 Convergent Validity

The findings for the convergent validity analysis showed how environment correlated with the other constructs in the academics' dataset. The findings indicated a strong positive correlation between environment and social presence ($r = 0.716$), suggesting that improvements in the learning environment are strongly associated with higher levels of social presence. This implies that a good learning environment fosters social interactions among students and a supportive learning experience. A strong positive correlation between environment and cognitive presence ($r = 0.826$) suggested that a well-structured environment could be critically important for enhancing cognitive abilities. A moderate to strong positive correlation between the environment and learner presence ($r = 0.557$) suggested that a positive environment is likely to contribute significantly to the active, social presence and engagement of learners. A strong positive relationship between the environment and academic skills ($r = 0.632$) suggested that improvements in the learning environment are likely to result in better academic performance. A strong positive correlation between the environment and technology ($r = 0.632$) suggested that a well-developed environment supports the effective use and integration of technology. A moderate correlation between environment and infrastructure ($r = 0.490$) suggested that a better environment is related to improvements in infrastructure, although this relationship is slightly weaker compared to the relationships between other constructs, such as cognitive presence or technology.

The findings for the convergent validity analysis showed how environment correlated with the other constructs in the students' dataset. The findings indicated a moderate to strong positive

relationship between environment and social presence (r = 0.442), suggesting that as the environment improves, social presence also increases. A weaker, though still positive, correlation between environment and cognitive presence (r = 0.192) suggested that a better environment might contribute to improved cognitive presence, but the relationship is less strong than the relationships to the other variables. A moderate to strong positive correlation between environment and learner presence **(**r = 0.453) suggested that a better environment is likely associated with enhanced learner presence. A moderate to strong relationship between environment and student skills (r = 0.481) suggested a better environment contributes significantly to the development of student skills. A strong correlation between environment and technology (r = 0.548) suggested that improvements in the environment are strongly associated with better technological support or usage. A moderate positive correlation between environment and infrastructure (r = 0.417) suggested that a better environment is associated with improved infrastructure.

5.9.8.3 Exploratory Factor Analysis

Factor analysis was conducted, and the loadings indicated a strong relationship between the items and the constructs for both the academics' and the students' dataset. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality: The student has a conducive and safe environment; and an environment that cultivates interpersonal relationships between facilitator and students.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that both the academics' and the students' models fit well with the data.

5.9.8.4 Academics' and Students' Perceptions

Environment in the context of this study refers to the setting in which teaching and learning take place. This encompasses creating a safe and conducive space for students, as well as fostering an environment that supports positive interpersonal relationships between facilitators and students. To further understand the respondents' perceptions of the environment factors, the respondents

were asked, “What other factors should be considered for online learning environment?” The academics responded as follows:

> Creating an environment conducive to learning is crucial. One of the challenges we encountered was that many students had to share their living space with other family members and did not have a suitable area for studying. They had to wait until everyone was asleep before they could engage in their school activities. (Dr Khoza)
>
> Personal learning space, desk and chair and conducive learning space. (Prof Pitso)
>
> Institutions to remember that other students (the majority in my case) come from rural areas. (Dr Angy)

The students were asked the same question and responded as follows:

> Student must have adequate resources for internet connection. (Lihle)
>
> Allow discussions similar to face-to-face learning. (Brenda)
>
> Engagement - the online platform should be designed to promote engagement and interaction among students, through features such as discussion forums, group projects, and interactive learning activities. (Lihle)
>
> Data and network. (Grace)
>
> User-friendly interfaces, the online platform should be easy to use and navigate, with clear instructions and guidance for students. (Thato)
>
> User-friendly interface: The online platform should be easy to use and navigate, with clear instructions and guidance for students. (Hlompho)

A conducive and supportive environment is crucial for any situation. During the Covid-19 pandemic, there was not a sufficient needs analysis regarding where students went when they evacuated from residences. As a result, some students struggled because of the lack of appropriate learning spaces. In South Africa, some students come from unsettled areas and live in shacks where everything is cramped together. During the pandemic, these students were still expected to continue learning despite these challenging conditions.

5.9.9 Exploratory Factor Analysis

The following subsections present in detail the factor analysis results for both the academics' and the students' datasets. The subsections discuss how the exploratory factor analysis was conducted and how the researcher derived the constructs with items deemed fit for the model and contributing to the digital technology enabled learning. The researcher presents how data were prepared; the EFA requirements, which include the setting of the minimum factor loading criteria, the communality of the scale; and the correlation matrix through Bartlett's test of sphericity and the KMO measure of sampling adequacy. Finally, the prior and post communalities as well as the final constructs and items are presented.

5.9.9.1 Exploratory Factor Analysis: Academics' Dataset

5.9.9.1.1 Data Preparation: Academics' Dataset

This section shows how the academics' dataset was prepared and how the sample size, normal distribution, linearity, outliers and correlation among factors were examined. The initial process, shown in Table 5.6, resulted in a KMO of 0.798, which is greater than 7 and equivalent to middling.

Table 5.6 KMO and Bartlett's test: Academics

KMO measure of sampling adequacy		**0.798**
Bartlett's test of sphericity	Approx. chi-square	2212.553
	df	465
	Sig.	<0.001

Table 5.6 shows that the Bartlett's test of sphericity was significant, which means that all the variables correlated with each other (Matsunaga, 2010; Suhr, 2006; Zeynivandnezhad et al., 2019). An EFA was performed using a principal component analysis and varimax rotation. The minimum factor loading criteria was set to 0.50. An important step was weighing the overall significance of the correlation matrix through Bartlett's test of sphericity, which provided a measure of the statistical probability that the correlation matrix has significant correlations among some of its components. The first time the results were ran, they were significant: x^2 (n = 465) = 2212.553 (p < 0.0001). This indicated its suitability for factor analysis. The KMO measure of sampling adequacy that indicates the appropriateness of the data for factor analysis was 0.798. In this regard,

data with this measure of sampling adequacy values are considered appropriate for the factor analysis.

5.9.9.1.2 Communalities: Academics' Dataset

Table 5.7 shows the communalities to indicate how the amount of variance in each dimension was assessed to ensure acceptable levels of explanation. The results show that all communalities were over 0.50.

Table 5.7 Initial communalities: Academics' dataset

	Initial	Extraction
SCLP1	1,000	0.698
SCLP2	1,000	0.674
SCLP3	1,000	0.820
SCLP4	1,000	0.779
SCLP5	1,000	0.832
SCLP6	1,000	0.779
SCLP7	1,000	0.658
SCLP8	1,000	0.705
SCLP9	1,000	0.783
COGP1	1,000	0.755
COGP2	1,000	0.810
COGP3	1,000	0.833
COGP4	1,000	0.655
COGP5	1,000	0.691
COGP6	1,000	0.539
LNRP1	1,000	0.685
LNRP2	1,000	0.756
ACAD1	1,000	0.824
ACAD2	1,000	0.856
ACAD3	1,000	0.801
TECH1	1,000	0.834
TECH2	1,000	0.770
TECH3	1,000	0.804
TECH4	1,000	0.757
INFR1	1,000	0.734
INFR2	1,000	0.790
INFR3	1,000	0.889
INFR4	1,000	0.882

	Initial	Extraction
ENVR1	1,000	0.770
ENVR2	1,000	0.732
ENVR3	1,000	0.804
Extraction method: Principal component analysis		

5.9.9.1.3 Evaluating the Validity of a Scale, Test or Instrument: Academics' Dataset

In line with Bandalos and Finney (2018), after careful consideration, when some items were not loading together and others loaded nothing, the researcher eliminated some variables one by one and rerun the analysis every time with the hope that as they were removed, others would align or that the removal of one variable would eliminate problems with others. The items SCLP2, COGP5, ACAD2 and ENVR1 were removed because they loaded onto factors other than their underlying factors. The researcher then reanalysed the remaining variables. The second time the results were ran, were significant: x^2 $(n = 351) = 1825.968$ $(p < 0.0001)$. The results of the new analysis confirmed the dimensional structure defined in Table 5.8 where the KMO measure of sampling adequacy was updated to 0.842, which is equivalent to 0.8 meritorious.

Table 5.8 Revised KMO and Bartlett's test: Academics' dataset

KMO measure of sampling adequacy		0.842
Bartlett's test of sphericity	Approx. chi-square	1825.968
	df	351
	Sig.	<0.001

5.9.9.1.4 Number of Factors: Academics' Dataset

The factor solution derived from the new analysis yielded five factors for the scale, as shown in the scree plot in Figure 5.19, which accounted for 74.880% of the variation in the data, as shown in Table 5.9. The new analysis of the communalities, which are also above 0.50, is shown in Table 5.10.

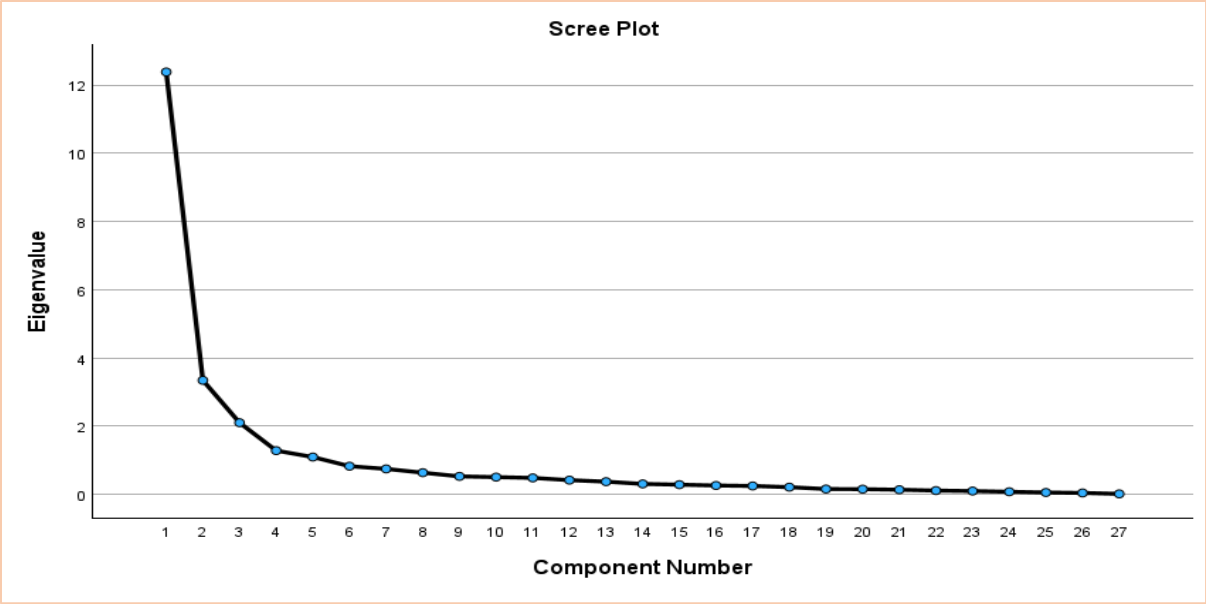


Figure 5.19 Final scree plot: Academics' dataset

Table 5.9 Total variance explained: Academics' dataset

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.380	45.853	45.853	12.380	45.853	45.853	8.608	31.882	31.882
2	3.346	12.393	58.246	3.346	12.393	58.246	4.614	17.089	48.971
3	2.105	7.796	66.042	2.105	7.796	66.042	3.142	11.639	60.610
4	1.287	4.766	70.808	1.287	4.766	70.808	2.373	8.789	69.399
5	1.099	4.071	74.880	1.099	4.071	74.880	1.480	5.481	74.880
Extraction method: Principal component analysis									

Table 5.10 Revised communalities: Academics' dataset

	Initial	Extraction
SCLP1	1,000	0.709
SCLP3	1,000	0.793
SCLP4	1,000	0.775
SCLP5	1,000	0.835
SCLP6	1,000	0.742
SCLP7	1,000	0.630
SCLP8	1,000	0.732
SCLP9	1,000	0.782
COGP1	1,000	0.747

	Initial	Extraction
COGP2	1,000	0.844
COGP3	1,000	0.850
COGP4	1,000	0.609
COGP6	1,000	0.475
LNRP1	1,000	0.729
LNRP2	1,000	0.779
ACAD1	1,000	0.680
ACAD3	1,000	0.697
TECH1	1,000	0.796
TECH2	1,000	0.758
TECH3	1,000	0.803
TECH4	1,000	0.748
INFR1	1,000	0.697
INFR2	1,000	0.774
INFR3	1,000	0.892
INFR4	1,000	0.891
ENVR2	1,000	0.717
ENVR3	1,000	0.731
Extraction method: Principal component analysis		

The Bartlett's test of sphericity proved to be significant, and all communalities were over the set value of 0.50. The newly identified factors for this EFA aligned with the theoretical proposition of this research.

5.9.9.1.5 Factor Loading: Academics' Dataset

Table 5.11 shows the correlations between the variables for the new factor loadings. Factor 1 item SCLP2 was removed from social presence items; Factor 2 item SCOGP5 was removed from the cognitive presence items; ACAD2 was removed from academic presence; and ENVR1 was removed from the environment factors.

Table 5.11 Final factor loading: Academics' dataset

Rotated Component Matrix[a]					
	Component				
	1	2	3	4	5
SCLP1	0.651				
SCLP3	0.850				
SCLP4	0.840				

Rotated Component Matrix[a]					
	Component				
	1	2	3	4	5
SCLP5	0.852				
SCLP6	0.825				
SCLP7	0.742				
SCLP8	0.841				
SCLP9	0.805				
COGP1	0.589				
COGP2	0.623				0.563
COGP3	0.661				0.534
COGP4	0.610				
LNRP1				0.570	0.527
LNRP2				0.810	
ACAD1		0.540		0.610	
ACAD3		0.729			
TECH1			0.758		
TECH2			0.834		
TECH3			0.820		
TECH4			0.629		
INFR1		0.809			
INFR2		0.853			
INFR3		0.904			
INFR4		0. 905			
ENVR2	0.696				
ENVR3	0.595				
Extraction method: principal component analysis Rotation method: Varimax with Kaiser normalisation					
a. Rotation converged in 9 iterations					

5.9.9.1.6 Model Fit: Academics' Dataset

The model fitness was the final step the researcher took to determine the fitness of the factor analysis. The factors were generated based on the observed correlation between the variables. The degree of correlation between the variables were reproduced. For an appropriate factor analysis solution, the difference between reproduced and observed correlation should be less than 0.05. A model for the academics' variables was a good fit with 20.0%, which is less than 50% as per the requirements of the non-redundant residuals with absolute values that are greater than 0.05. Table 5.12 shows the rotated component matrix after removing the other items. These are the final

constructs with items deemed fit for the model after the factor analysis and shows the correlation of the variables.

Table 5.12 Final factor loading of items: Academics' dataset

Factor	Rotated Component Matrix[a]
Social presence	Open communication between the students
	Collaborative activities between students
	Students feeling secure to communicate
	Student and facilitator/lecturer communication
	Collaboration between students and academics
	Group cohesion (the extent to which students are committed to the group and its goals)
	Mutual trust among the students
	Structures, systems, and opportunities that support social interaction in online learning
Cognitive presence	Students able to explore, integrate and apply the knowledge
	High-level thinking tasks/application type of activities
	Activities that promote critical thinking and problem-solving skills among students
	Peer review discussions
Learner presence	Self-efficacy
	Environment
Academic skills	Technical skills
	Computer literacy
Technology	Intelligent tutoring systems
	Applications that enable online learning
	Applications that enable effective collaborations between student and teachers
	Digital learning platforms or LMSs
Infrastructure	Network infrastructures
	Reliable network bandwidth, data bandwidth, or digital bandwidth
	Reliable electricity
	Connectivity
Environment	Environment that cultivates interpersonal relationships between facilitator and students
	Engaging and collaborative environment

5.9.9.2 Exploratory Factor Analysis: Students' Dataset

5.9.9.2.1 Data Preparation: Students' Dataset

This section shows how the students' dataset was prepared and how the sample size, normal distribution, linearity, outliers and correlation among factors were examined. The initial process,

shown in Table 5.13, shows that the KMO was 0.771, which is greater than 7 and middling. All variables correlated with each other.

Table 5.13 KMO and Bartlett's test

KMO measure of sampling adequacy		0.771
Bartlett's test of sphericity	Approx. chi-square	1611.278
	df	465
	Sig.	<0.001

The Bartlett's test of sphericity was significant, which means that all the variables have correlation among each other. An EFA was performed using principal component analysis and varimax rotation. The minimum factor loading criteria was set to 0.50.

A crucial step included weighing the overall significance of the correlation matrix through Bartlett's test of sphericity, which provided the measure of the statistical probability that the correlation matrix had significant correlations among some of its components. The first time the results were ran, were significant: x^2 $(n = 378) = 1381.050$ $(p < 0.0001)$. This indicated its suitability for factor analysis. The KMO measure of sampling adequacy, which indicates the appropriateness of the data for factor analysis, was 0.765. In this regard, data with this measure of sampling adequacy values were considered appropriate for the factor analysis. The factor solution derived from this analysis yielded eight factors for the scale, which accounted for 69.355% of the variation in the data.

5.9.9.2.2 Communalities: Students' Dataset

Table 5.14 shows the communalities, portraying how the variance in each dimension was assessed to ensure acceptable levels of explanation. The results show that all communalities were over 0.50.

Table 5.14 Initial communalities: Students' dataset

	Initial	Extraction
SSCLP1	1,000	0.729
SSCLP2	1,000	0.764
SSCLP3	1,000	0.762
SSCLP4	1,000	0.737
SSCLP5	1,000	0.753
SSCLP6	1,000	0.719
SSCLP7	1,000	0.721

	Initial	Extraction
SSCLP8	1,000	0.664
SSCLP9	1,000	0.721
SCOGP1	1,000	0.715
SCOGP2	1,000	0.739
SCOGP3	1,000	0.746
SCOGP4	1,000	0.686
SCOGP5	1,000	0.659
SCOGP6	1,000	0.733
SCOGP7	1,000	0.699
SLRNP1	1,000	0.604
SLRNP2	1,000	0.759
SSKLS1	1,000	0.712
SSKLS2	1,000	0.694
SSKLS3	1,000	0.698
STECH1	1,000	0.689
STECH2	1,000	0.718
STECH3	1,000	0.755
STECH4	1,000	0.618
SINFR1	1,000	0.692
SINFR2	1,000	0.840
SINFR3	1,000	0.746
SINFR4	1,000	0.837
SENVR1	1,000	0.616
SENVR2	1,000	0.618
Extraction method: Principal component analysis		

5.9.9.2.3 Evaluating the Validity of a Scale, Test or Instrument: Students' Dataset

After the first analysis, the items SSCLP1 to SSCLP3, SCOGP5–SCOGP7 and SENVR2 were removed because they loaded onto factors other than their underlying factors. Similar to the academics' dataset, the researcher repeated the EFA without the items that were removed and reanalysed it. The second time the results were ran, they were significant: x^2 (n = 231) = 952.667 ($p < 0.0001$). The results of the new analysis confirmed the dimensional structure defined in Table 5.15. The KMO measure of sampling adequacy was now updated to 0.781, equivalent to 0.7 and middling.

Table 5.15 Revised KMO and Bartlett's test

KMO measure of sampling adequacy		0.781
Bartlett's test of sphericity	Approx. chi-square	952.667
	df	231
	Sig.	<0.001

5.9.9.2.4 Number of Factors: Students' Dataset

The factor solution derived from new analysis yielded six factors for the scale, as shown in the scree plot in Figure 5.20, which accounted for 69.664% of the variation in the data shown in Table 5.16. The new analysis of the communalities was also above 0.50 and is shown in Table 5.17.

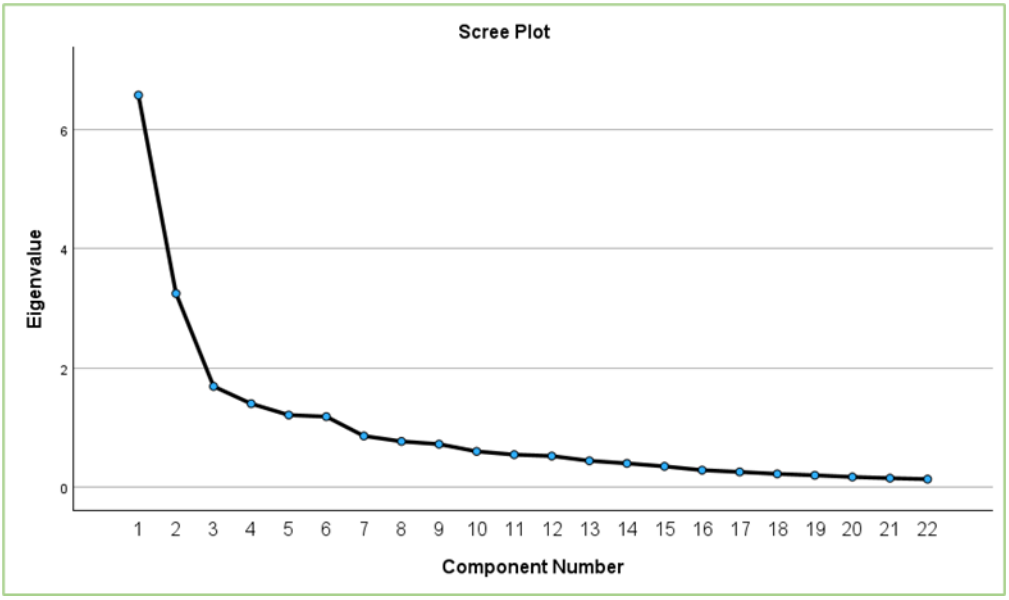


Figure 5.20 Scree plot: Students' dataset

Table 5.16 Revised total variance: Students' dataset

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.579	29.902	29.902	6.579	29.902	29.902	3.165	14.385	14.385
2	3.252	14.780	44.682	3.252	14.780	44.682	3.011	13.687	28.072
3	1.693	7.698	52.380	1.693	7.698	52.380	2.898	13.174	41.246
4	1.403	6.379	58.758	1.403	6.379	58.758	2.683	12.197	53.444
5	1.213	5.513	64.272	1.213	5.513	64.272	2.101	9.549	62.992
6	1.186	5.392	69.664	1.186	5.392	69.664	1.468	6.672	69.664
Extraction method: Principal component analysis									

Table 5.17 Revised communalities: Students' dataset

	Initial	Extraction
SSCLP4	1,000	0.753
SSCLP7	1,000	0.751
SSCLP8	1,000	0.601
SSCLP9	1,000	0.679
SCOGP1	1,000	0.708
SCOGP2	1,000	0.706
SCOGP3	1,000	0.798
SCOGP4	1,000	0.681
SLRNP1	1,000	0.807
SLRNP2	1,000	0.667
SSKLS1	1,000	0.658
SSKLS2	1,000	0.736
SSKLS3	1,000	0.646
STECH1	1,000	0.572
STECH2	1,000	0.634
STECH3	1,000	0.666
STECH4	1,000	0.657
SINFR1	1,000	0.706
SINFR2	1,000	0.840
SINFR3	1,000	0.745
SINFR4	1,000	0.802
SENVR2	1,000	0.514
Extraction method: Principal component analysis		

The Bartlett's test of sphericity proved to be significant, and all communalities were over the set value of 0.50.

5.9.9.2.5 Factor Loading: Students' Dataset

Table 5.18 shows the new factor loadings to illustrate the correlations between the variables. The newly identified factors of this EFA aligned with the theoretical proposition of this research. Factor 1 includes items SSCLP4, SSCLP7, SSCLP8, to SSCLP9, referring to social presence. Factor 2 gathered items from SCOGP1 to SCOGP4, referring to cognitive presence. Factor 3 gathered items from SSKLS1 to SSKLS3, referring to student skills. Factor 4 gathered items from STECH1 to STECH4, referring to technology. Factor 5 gathered items from SINFR1 to SINFR3, referring to infrastructure. Factor 6, SENVR, remained with one item.

Table 5.18 Final factor loadings: Students' dataset

Rotated Component Matrix[a]						
	Component					
	1	2	3	4	5	6
SSCLP4			0.796			
SSCLP7			0.764			
SSCLP8			0.738			
SSCLP9			0.731			
SCOGP1		0.745				
SCOGP2		0.788				
SCOGP3		0.865				
SCOGP4		0.689				
SLRNP1						0.851
SLRNP2						0.607
SSKLS1					0.765	
SSKLS2					0.777	
SSKLS3					0.660	
STECH1				0.703		
STECH2				0.711		
STECH3				0.773		
STECH4				0.557		
SINFR1	0.787					
SINFR2	0.910					
SINFR3	0.828					
SINFR4	0.870					
SENVR2				0.502		
Extraction method: Principal component analysis Rotation method: Varimax with Kaiser normalisation						
a. Rotation converged in 6 iterations						

5.9.9.2.6 Model Fit: Students' Dataset

The researcher conducted the model fitness as the final step to determine the fitness of the factor analysis. The factors were generated based on the observed correlation between the variables. The degree of correlation between the variables were reproduced. A model for the students' variables was a good fit with 35.0%, which is less than 50% as per the requirements of the non-redundant residuals, with absolute values that are greater than 0.05. Table 5.19 are the constructs with items deemed fit for the model.

Table 5.19 Final factor loading of items: Students' dataset

Factors	Rotated Component Matrix[a]
Social presence	Students feeling secure to communicate
	Collaboration between students and academics
	Mutual trust among the students
	Structures, systems, and opportunities that support social interactions in online learning
Cognitive presence	Students able to explore, integrate and apply the knowledge
	High-level thinking tasks/application type of activities
	Activities that promote critical thinking and problem-solving skills among students
	Student-led discussions
Learner presence	Self-efficacy
	Environment
Student skills	Digital skills
	Computer literacy
Technology	Intelligent tutoring systems
	Applications that enable online learning
	Applications that enable effective collaborations between student and teachers
	Digital learning platforms or LMSs
Infrastructure	Network infrastructures
	Reliable network bandwidth, data bandwidth, or digital bandwidth
	Reliable electricity
	Connectivity
Environment	Environment that cultivates interpersonal relationships between facilitator and students

5.10 RQ5*:* What Framework Can Be Implemented to Ensure the Successful Integration of Digital Technology Enabled Education at HEIs?

Based on the EFA and the final identified constructs, a comprehensive framework to ensure the success of digital technology enabled education for South African universities was developed. This framework should address the key factors identified in the analysis by ensuring that each aspect is adequately supported to create an effective, engaging and inclusive online learning environment. This conceptual framework is discussed in more detail in Section 6.2.5 and presented in Figure 6.5.

5.11 Concluding Remarks

This chapter discussed the findings of data analysis according to the themes and subthemes. These findings were presented in terms of the EFA and the descriptive, thematic, and content analysis. The next chapter presents the interpretation of these findings based on the context of this research.

CHAPTER 6: INTERPRETATION OF FINDINGS AND RECOMMENDATIONS

6.1 Chapter Overview

The preceding chapter provided the data analysis of the findings. This chapter provides an interpretation of the findings. Literature was used to either corroborate or question the findings, situating them inside the framework of prior studies to furnish universities with a framework for providing efficacious equitable digital technology education for students. The objective of the study was to ensure no students are put at a disadvantage because of lack of resources. Furthermore, the results provide valuable advice to South African universities regarding the management of ERT and online learning. Universities might enhance their ability to handle future emergencies without relying on ERT by drawing lessons from the recent pandemic. A framework that emphasises context is presented to provide guidance to South African universities on critical aspects for achieving success in ERT and digital education.

6.2 Interpretation of the Findings

This section offers an analysis of the results obtained from the study. The findings are provided according to each theme. A theme is equivalent to the research objective. The analysis, recommendations and conclusions were derived from the three sampled unit cases.

6.2.1 Interpretation of Findings for the First Theme

The first theme was to assess the efficacy of digital technology enabled education in HEIs. With this objective, the study sought to analyse and understand the efficacy of digital technology enabled education. This was accomplished by analysing the quantitative and qualitative responses from the participating academics and students. Both the academics and students explained to the researcher f how they navigated the courses with practical or laboratory work during the Covid-19 pandemic and how they managed to conduct their practical and laboratory work and assessments throughout the pandemic era. The respondents were also asked how the lockdown, which resulted in ERT, affected their teaching and learning. This enabled the researcher to assess the efficacy of digital technology enabled education in HEIs. The themes in the following subsections discuss the efficacy of digital technology enabled education and the impact of ERT.

6.2.1.1 The Efficacy of Digital Technology Enabled Education

Digital technologies are an effective instrument that can enable education in multiple ways, including facilitating the creation of instructional materials by instructors and offering novel methods for people to learn and collaborate. The use of these instruments was evident during the swift shift from the face-to-face instructional delivery mode to ERT during the Covid-19 pandemic. Technology was the saviour of the education sector. The literature mentioned that technology holds the promise to significantly improve the educational process because it has the capacity to enhance the bonds between teachers and students, revolutionise learning methods and collaboration, and tailor learning experiences to individual needs (Roy, 2019; U.S. Department of Education, 2017).

The findings revealed that digital technology indeed enabled education, which correlates with the sentiments of Fogarty (2020) and Haleem et al. (2022). The authors mentioned that it was evident during the pandemic that digital technologies were the saviours and will continue rescue education during critical times. However, it appeared that while some academics leveraged the affordances of virtual teaching tools, others experienced great difficulties.

Prof Pillay responded to the question on how they managed to conduct practical work by saying that he had to devise the means for students to carry on with their activities by leveraging virtual teaching tools. On the other hand, Prof Mothoa divided his class into small groups and made sure they all adhered to the Covid-19 preventive measures, and Dr Muller stopped his academic practicals until lockdown was lifted, which probably affected the course outlines or activities.

Some of these experiences confirms the affordances of virtual online and learning platforms such as Moodle, MS Teams, WhatsApp and Google Classrooms (Khoza & Mpungose, 2020; Ma et al., 2021; Xue et al., 2023). These virtual online and learning platforms offer many benefits such as flexibility, reduced cost, more free time, increased collaboration, personalised education, enhanced time management skills, and immediate feedback (Fadda, 2019; Francom et al., 2021; Hallal et al., 2020).

6.2.1.2 The Impact of Emergency Remote Teaching

Rural communities have limited opportunities, and therefore, addressing inequality of resources in the same manner for everyone will not effectively reduce the gap between them. Students were

equipped with tools such as data and gadgets to facilitate their online learning; nonetheless, there were still students who encountered difficulties. Uniform national policies and behaviours have been shown to be insensitive to these variances and can unintentionally exacerbate inequality (Visagie & Turok, 2021).

The findings revealed that the sudden implementation of virtual teaching and online learning exacerbated the existing inequalities in South Africa, particularly affecting low-income students who had difficulties accessing computing resources and ongoing courses due to limited internet connectivity and power outages. In noting the efforts by the universities to ensure all students had the data and digital tools they needed during the pandemic era, the researcher's opinion is that the blanket approach that was applied by the universities to mitigate the digital gap did not do justice to all students as they still experienced technological and network problems. Although education continued during the pandemic, the respondents revealed that the universities were not ready for the swift transition from face-to-face learning to ERT and online learning.

The findings correlate with the literature that the Covid-19 pandemic highlighted the economic disparities in South Africa (World Bank, 2018). Some students' homes were not conducive for learning and they often struggled with completing learning online, while other students continued with ease. The environment factor was brought up by Lerato when responding to the question related to environment as a contributing factor to the success of virtual instruction delivery. Her environment was not conducive to this mode of instructional delivery, which aligns with the statement by Evans and Petrie (2020) that some students who had to move back home experienced psychological and emotional suffering, rendering them unable to constructively engage with coursework. Lerato further mentioned that her grades were greatly affected.

These findings also correlated with the findings of Ndzinisa and Dlamini (2022), who highlighted problems with infrastructure. They specifically indicated that obstacles such as limited adoption of ICTs, lack of internet connectivity, and unreliable electricity hindered the shift towards digitalisation. In agreement with the findings, the literature further revealed the need for educational, technical/technological, social, environmental, access, and infrastructure affordances (Kirschner & Wopereis, 2003; Weidlich & Bastiaens, 2019; Xue et al., 2023).

6.2.1.3 Digital Literacy

The findings revealed that students who lacked access in general were at a significant disadvantage. Access could mean lack of resources or lack of digital literacy. When the respondents were asked how they managed their academics during the pandemic, Pontso said that she sadly did not manage and struggled with the transition from face-to-face to online learning due to resources, while Rophiwa was thrilled with the experience and enjoyed the benefits. Hallal et al. (2020) also identified difficulties using online learning platforms for teaching and learning, including issues related to internet and device accessibility, as well as the availability of technical expertise. It is one thing to have a device, and another thing to know how to use it. Students with limited digital tools were expected to use public spaces like libraries, cafes, and restaurants to access internet as a survival strategy, but this was not possible during the lockdown period. This support the statement by Udeogalanya (2022) that while some students were unable to access digital material due to the quarantine indoors during the pandemic, teaching and learning continued and those who had access to resources continued with learning.

The Covid-19 pandemic made digital literacy compulsory for academics and students. Digital literacy skills are crucial for academic, career, and interpersonal success. As academics become more technologically literate, they use these skills in the classroom, which benefits students. Digital literacy was mentioned by both the students and academics, Sarah responded to the question on how ERT affected her learning and said that she had to adjust to online learning and improve her digital skills. Dr Legong found it hard and mentioned that she had to quickly adapt to a new method of teaching that she had never been exposed to before. It was very challenging in the beginning for her and the students.

The findings indicated that academics and students lacked the necessary preparation for the rigorous demands of online education. A significant portion of them were unfamiliar with the digital literacy tools. Both instructors and students were compelled to acquire proficiency in computer usage and digital literacy tools to endure the pandemic. In some instances, academics and students were compelled to acquire resources in order to cope with the rigorous demands of teaching and learning (Udeogalanya, 2022). Academics were not sufficiently trained to deliver instructions and assess students online because of lack of digital literacy and online teaching skills and competencies. They had to be equipped with the skills and competencies to effectively teach

online. As per the literature, pedagogical, content, design, technological, management and institutional, social and communication skills were required for academics to run online courses (Hodges et al., 2020; Kovanović et al., 2018; Weidlich & Bastiaens, 2019). Although it is evident that digital technology enhances teaching and learning, the literature revealed that this can only be achieved if it includes factors that contribute to the success of virtual teaching and learning (Fadda, 2019).

Supporting these findings, Hodges et al. (2020) found that effective online learning is achieved by meticulous instructional design and preparation that uses a systematic paradigm for design and development. The design process and the meticulous evaluation of various design choices significantly affect the quality of the teaching. This means that applying or replicating face-to-face pedagogical skills in online teaching and learning will do injustice to students. According to Hodges et al. (2020), the approach taken during the pandemic period lacked the meticulous design process. Digital literacy skills were critical for both students and academics, and these skills included the ability to use the internet for tasks such as finding, evaluating, assessing, distributing, and generating content (Widana, 2020).

6.2.2 Interpretation of Findings for the Second Theme

The second theme was to explore how digitalisation enhances academics' and students' experience in higher education. With this objective, the researcher sought to investigate and understand how both the academics and the students were affected by the transition from face-to-face learning to ERT and online learning. This was accomplished by analysing the quantitative and qualitative responses from the academics and students. The responses from both academics and students enabled the researcher to assess the need for digitalisation in HEIs. The themes that are discussed in the following subsections are digitalisation, teaching methods, and technology enabled assessments of students.

6.2.2.1 Digitalisation

The findings revealed that the majority of the academics who completed the online survey were negatively affected by the transition from face-to-face learning to ERT and online learning. As seen in Figure 6.1, about 31% of academics indicated that digitalisation had negatively affected their teaching experience. Academics were expected to transition to online learning platforms,

interactive apps, virtual classrooms, or educational software to engage students in new ways (Hallal et al., 2020; Spante et al., 2018). Dr Setlhare mentioned that it is not the best way to teach because technology is always an issue and not all students have adequate resources such as a stable internet connection or proper laptops. Dr Mpunguse also raised a concern and said that conducting live classes became challenging due to frequent occurrences of loadshedding and poor internet connectivity in many rural households across South Africa. These findings show that challenges include technological access problems, such as unreliable internet connections and insufficient gadgets among students. These findings correlate with that of Dlamini and Ndzinisa (2020), who stated that there are infrastructural and network problems in South African. Bates (2015) also mentioned that the digitalisation of education involves the consideration of processes, organisational and pedagogical approaches, and technological, network and infrastructure issues. Therefore, without all these resources, it becomes impossible to digitise education.

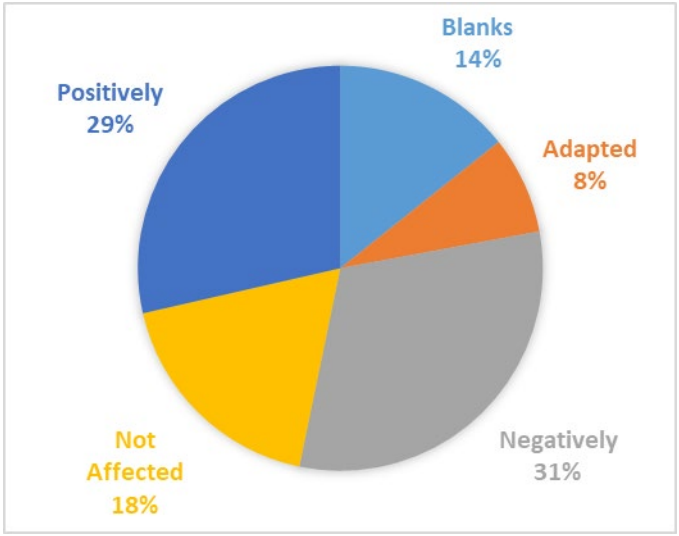


Figure 6.1 Overview on how digitalisation affected the teaching experience

The findings revealed 50% of students were positively affected by the move from face-to-face learning to ERT and 44% were negatively affected (see Figure 6.2). Brigette, responding to the open-ended question on how her academics were affected, mentioned that her performance was excellent because she found the remote learning environment flexible and accommodating to her needs.

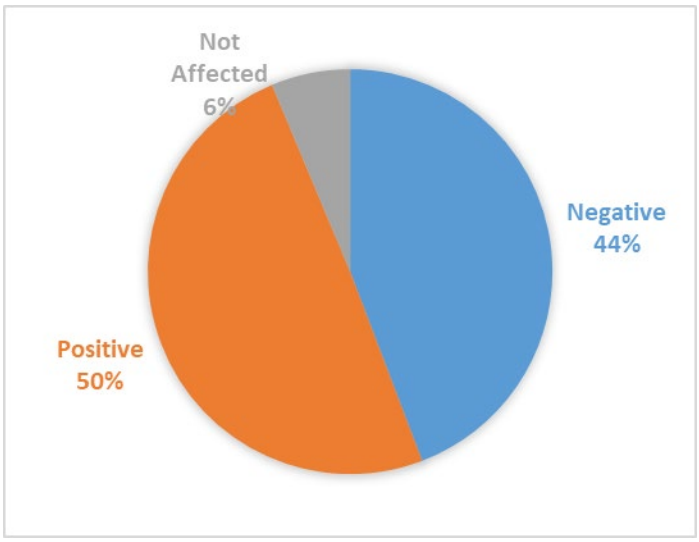


Figure 6.2 Overview on how digitalisation affected student performance

The findings revealed that as much as some students were positively affected, some were negatively affected, and only a small proportion (6%) was not affected, which can be attributed to geographical background. The findings revealed that there are practical concerns regarding physical learning environments that are conducive to various modes of learning. These findings correlate with that of Evans and Petrie (2020) that some students' home or living spaces were not conducive for learning, rendering them unable to constructively engage with coursework, while others had conducive environments. Lesedi mentioned that digitalisation negatively affected her performance and that it was harder to concentrate at home. Some students were among the most disadvantaged groups with limited learning skills and ongoing issues. Some academically capable learners from low-income backgrounds cannot access or afford online learning.

The finding revealed that 50% of students experienced positive effects from the digitalisation of teaching and learning, whereas only 29% of academics reported similar benefits. This discrepancy may be attributed to age differences as a significant majority of students (73%) were aged between 18 and 25 years, whereas 22% of academics were in the age bracket of 46 to 55 years and another 20% were above 55 years old.

In addition to these findings, Dr Clog highlighted the need for training prior to the digitalisation process, citing challenges in navigating online learning environments. This observation is consistent with Ngcamu's (2019) statement that many academic staff members lacked sufficient

digital skills, including the knowledge and competencies required for effective online teaching and learning.

6.2.2.2 Teaching Methods

The findings revealed that 57.1% of academics preferred the blended learning approach to other learning approaches (Figure 6.3). Responding to the open-ended question asking why they preferred the blended learning method, Dr Pringle mentioned that this method brings face-to-face and online teaching elements together so everyone can get the best of both worlds. He mentioned that blended learning is not limited to teaching face-to-face and online but can be used for blended assessments and activities and that different elements can be implemented. Dr Pringle mentioned that he prefers and adopted the blended learning approach and mentioned the flipped classroom as a method to give his learners resources online via the LMS that they can engage with and understand and then when they meet face to face, they can focus on practical activities. This supports the findings of Anderson et al. (2001), Aydin and Demirer (2022), and Hodges et al. (2020).

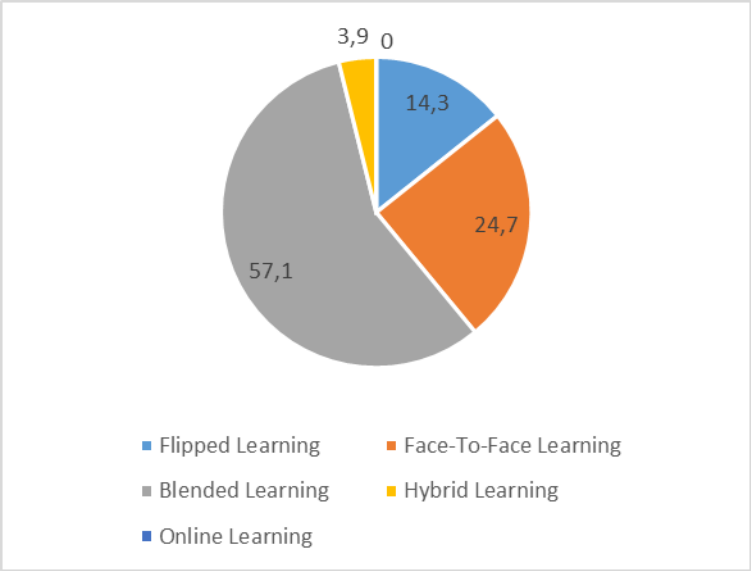


Figure 6.3 Overview on the preferred teaching methods: Academics' perspectives

The findings revealed that 38.6% of students preferred the blended learning approach to the other learning approaches (see Figure 6.4). Lesedi's response indicated that this mode of learning allowed her to be independent and prepared before attending classes and to consult when she needed. Refiloe also shared the sentiment that blended learning provides balance and flexibility.

The students highlighted factors such as flexibility, time management, cost, personalised learning, peer-to-peer learning, digital skills, skills development, balancing personal and academic life, and mental health improvements. These highlighted factors are corroborated by Francom et al. (2021), Hallal et al. (2020), and Xue et al. (2023).

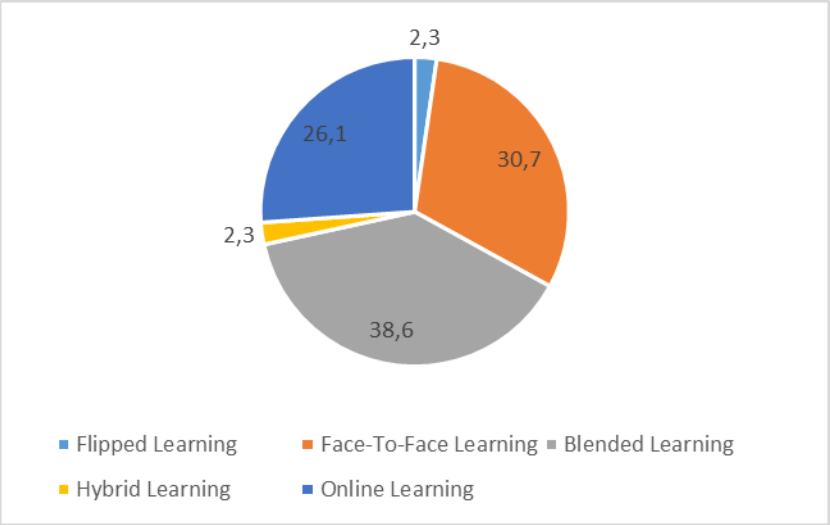


Figure 6.4 Overview on the preferred teaching methods: Students' perspective

A crosstabulation analysis was also done across the three universities to compare their preferences for teaching methods, and the findings revealed that the blended learning method was the preferred method across all the universities for academics (57%) and students (39%). However, it is worth noting that as much as blended learning was selected as the learning approach that enhanced students' experiences, the semi-rural university had the lowest number of students who preferred blended learning. They seemed to prefer the face-to-face learning approach, which could be attributed to resources.

These findings correlate with that of Garrison and Kanuka (2004) that blended learning fosters a CoI that consists of cognitive presence, social presence, and teaching presence, which enhances meaningful learning experiences. Mpungose (2020) and Pascu and Petcovici (2021) also aligns with Dr Pringle's sentiments that this approach integrates traditional teaching with online activities to create a dynamic learning environment that supports both synchronous and asynchronous learning.

6.2.2.3 Technology Enabled Assessments

The findings revealed the difficulties academics experienced with online assessments in terms of assessing the comprehension of students on the concepts or the authenticity of the students' work and the integrity of the assessments. Academics were asked to share their experience with assessing and grading students online, and Dr Hlope's response showed the difficulties of creating and managing the online assessments. He mentioned that it was not easy to determine the authenticity of the responses from the students as they were either colluding to respond to tasks or copying each other or the internet. Dr Ruth's response also showed that students engaged in unauthorised group work, copying, and cheating and that network problems arising in the middle of assessments made it difficult for them to complete assessments in time. These findings correlate with those of Ashton and Thomas (2019), Dermo (2019), Jordan (2013), and Mackenzie (2019). These authors highlighted some of the challenges brought by the technology enabled assessments around academic integrity, security, plagiarism, infrastructure and technical problems. The problems were also attributed to South Africa's lack of ICT infrastructures as previously highlighted by the World Bank (2019). Universities could invest in relevant infrastructures for online learning and applications to manage technology enabled assessments. The authors also recommended strategies such as randomising the question selection and question content (Abbas et al., 2023; Harry, 2023; Muhammad Tahir et al., 2024). Perhaps it is time to revisit how students are assessed (Ashton & Thomas, 2019; Dermo, 2019; Jordan, 2013; Mackenzie, 2019).

The findings revealed that the replication of face-to-face assessment methods proved not to be effective for virtual instructional delivery and that the approach must be totally different. This was also conveyed in Dr Root's response when she said that she was forced to think outside of the box and redesign her assessment method to enable her students to think and apply rather than remember. She required students to apply their knowledge instead of copying from the internet. With her assessments, students were forced to deduce, apply and articulate. Dr Sethlare's response also portrayed ways of maintaining assessment integrity, and he mentioned that as part of his effort to maintain the integrity of the assessments, he removed all recall questions from assessments and introduced project components (Ashton & Thomas, 2019; Dermo, 2019; Mackenzie, 2019). The researcher was intrigued by these views and concur that perhaps academics should outsmart the students and the systems they use to cheat. These findings contradict that of Jordan (2013), who mentioned that "we should use computers to do what they do best, relieving human markers of

some of the drudgery of marking and freeing up time for them to assess what they and only they can assess with authenticity".

In addition, the findings revealed infrastructural and technical issues. This was showed in Prof Kay's response where he mentioned that some students lived in rural areas where there was either no or poor network, and students would submit assignments late as they could only go to an internet shop when going to town to buy food because they lived far from areas with full network coverage.

Lastly, the findings revealed a lack of technical support during online assessments. This finding correlated with that of Mackenzie (2019), with which the researcher also concurs, that technology enabled assessments require tutor moderation or support services to monitor the performance of the assessment as well as to provide support for all queries from the students.

6.2.3 Interpretation of Findings for the Third Theme

The third theme was to explore the impact of digital technology enabled education on student performance. With this objective, the researcher sought to investigate and understand how the students' performance was affected during the pandemic period. This was accomplished by analysing the three universities' documents, website information, annual reports, and magazine publications, and the literature review. This enabled the researcher to assess the impact of digital technology education on student performance and to ascertain whether South African universities are ready for digital education. The following themes are discussed in the following subsections: Digital technology education affordance for student performance, and the impact of digital technology enabled education on student performance

6.2.3.1 Digital Technology Education Affordance for Student Performance

The findings showed that student's performance was affected by the pandemic, although the results varied from school to school within the faculties. On average, students performed better in 2020 than in 2019 and 2021 in these universities. However, the School of Accounting under the Faculty of Commerce at the metropolitan university performed better in 2019 than in 2020 and 2021, which could be attributed to the fact that these are practical courses and could imply that the students required a lecturer explaining the concepts to them face-to-face to clarify the concepts as they are taught, or it could mean that both the academics and students were not yet equipped with online teaching and learning tools for practical subjects like accounting.

During this period, universities had to revise their course outlines to accommodate the students. Bongekile, from the semi-rural university magazine publication IN DEPTH (2022), mentioned that the course outline was revised; for example, field trips were replaced by videos. Adjustments were made to course outlines, some practical portions of courses were cancelled, and academics might have been more lenient with students given the problems they had during the pandemic year. These findings correlate with those of Whitelaw et al. (2023), who stated that the improved performance witnessed in 2020 was not indicative of genuine learning progress. These findings also confirm the predictions that a decrease in the amount of material taught, greater leniency in grading, and a reduction in the workload were the probable reasons for the enhanced performance during the 2020 academic year. During this period, academic calendars and course outlines were revised to accommodate the transition from face-to-face learning to ERT and online learning.

6.2.3.2 Impact of Digital Technology Enabled Education on Student Performance

The findings revealed inequality among the universities. This was revealed through the finding that some universities managed to swiftly move from face-to-face learning to online instructional delivery while others struggled. The findings showed that it took the semi-rural and rural universities much longer to transition to online learning than it took the metropolitan university. The two universities were left behind. One document in the semi-rural university document review mentioned that a one-size-fits-all approach did not work during the pandemic period because those with access and know-how were ahead of those that lacked access. This document revealed "the transition to 'online learning' in the South African context illustrated the stark contrasts. Those who have access and the necessary know-how had more of an advantage" (Singh et al., n.d.). The documents indicated that academics in South Africa had come to experience how issues of access to a computers, network, internet, electricity and a conducive space can facilitate or hinder online learning. Both academics and students were affected.

Onelisiwe mentioned in the magazine publication by the semi-rural university that it was not easy for her to adjust. Lihle lives with her grandma and had no digital device. She mentioned that she received her NSFAS money late and had no means to continue with learning. Access to resources in South Africa is an inhibitor for many of the students. Onelisiwe further mentioned that she had to apply to return to the campus because even the resources she was given were redundant because of lack of infrastructure. These findings correlate with the findings in the report by the Universities

South Africa (2020) that universities reported that "access to devices and internet connectivity were the main stumbling blocks in the delivery of online learning". Correlating with these findings, Jordaan and Mennega (2021) mentioned that "about 46% of students faced challenges participating in online learning due to lack of access to computer equipment or data". In addition, Dlamini and Ndzinisa (2020) and Nyawo (2020) mentioned that students from rural areas confront problems such as limited network coverage, unpredictable electrical supply, and lack of academic support at home. In the semi-rural publication, Malusi mentioned while online learning comes with challenges, for her it was easy because of the financial support she received from her parents. These findings correlate with the findings of Chisadza et al. (2021) that with online learning, students' academic performance depends on the availability of high-quality Wi-Fi, as opposed to relying on mobile internet data. Unfortunately, some families in South Africa cannot afford high-quality Wi-Fi.

6.2.4 Interpretation of Findings for the Fourth Theme

The fourth theme was to analyse the factors contributing to the success of digital technology enabled education. With this objective, the researcher sought to interpret the findings of the identified important factors contributing to the success of digital technology enabled education in HEIs. The researcher interprets the findings of the Cronbach's alpha coefficients that showed the reliability of items in the constructs for both the academics' and the students' datasets to determine whether the items measured what they intended to measure (Green & Salkind, 2011). The researcher also presents the findings for the convergent validity that was meant to assess whether different measures that are supposed to assess the same construct are indeed related as well as test the relationship between the constructs shown in the conceptual model for this study (Rojahn et al., 2003). The researcher further interprets the findings of the factor analysis, as guided by Bandalos and Finney (2018), to see whether the underlying observed items were indeed the contributing factors and whether the identified items existed and are practical in the South African context. Lastly, the researcher interprets the findings of the open-ended questions from the respondents. The themes discussed in the following subsections are social, cognitive, learner presence, academic skills, student skills, technology, infrastructure, and environment.

6.2.4.1 Social Presence

According to Garrison et al. (1999), social presence is "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 a way of protecting their individual personalities".

6.2.4.1.1 Cronbach's Alpha Coefficient

The findings of the Cronbach's alpha coefficient showed high internal consistency for the social presence items, which was higher than the acceptable internal consistency of 0.7 for both the academics' and the students' datasets, suggesting that the items measured what they intended to measure and that there was reliability of items in the constructs for both the academics' and the students' datasets.

6.2.4.1.2 Convergent Validity

The findings of the convergent validity indicated that social presence has the strongest positive correlations with cognitive presence. This correlates with the findings of Anderson (2017) that social presence opens doors to make cognitive presence and the accomplishment of educational outcomes successful and possible.

Social presence demonstrated the strongest positive correlations with learning environment in the academics' dataset. This did not come as a surprise because students' learning environment contributes immensely to the learning outcomes, which was proven during the pandemic era when some students struggled with the learning environments and had to apply to return to the university residences. Environments that cultivate interpersonal relationships between a facilitator and students are important. These findings confirmed a positive relationship with other constructs to indicate that social presence instil open communication, collaboration between students, and mutual trust among students (Arbaugh et al., 2008; Garrison, 2017; Garrison & Arbaugh, 2007; Kreijns et al., 2014; Matadi & Uleanya, 2022).

The correlation was significant at the 0.01 level (2-tailed) for the academics' dataset and significant at the 0.01 level (2-tailed) and the 0.05 level (2-tailed) for the students' dataset. The findings correlate with those of Castellanos-Reyes et al. (2020) that social presence, which is how freely people interact with others, is strongly related to how deeply students think about the material and how they experience their learning environment. The strength of these relationships was

statistically significant, meaning there's a very low chance that these results happened by random chance. In essence, feeling connected with others in a learning environment tends to improve the learning experience and lead to deeper thinking about the material.

6.2.4.1.3 Exploratory Factor Analysis

The findings of the factor analysis and the loadings indicated a strong relationship between the items and the constructs for both the academics' and the students' datasets. The underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality. The following items were found and confirmed to be the items that measured social presence: Open communication between students; collaborative activities between students; students feeling secure to communicate; student and facilitator/lecturer communication; group cohesion; mutual trust among the students; and structures, systems, and opportunities that support social interaction in online learning. These findings correlate with those of Garrison et al. (1999). The authors refer to social presence as the extent to which participants in a learning community are free in any learning environment, whether online or face-to-face. This is when individuals become themselves and are free to express their emotions (Kreijns et al., 2014; Kreijns & Kirschner, 2018; Weidlich & Bastiaens, 2019).

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that both academics' and the students' models fit well with the data.

6.2.4.1.4 Findings from the Responses to the Open-ended Question

The findings related to the responses to the open-ended questions confirmed that social presence is about open communication between learners, students trusting their counterparts, and group cohesion. Responding to the open-ended question on how social presence enhances the learning process in online learning, Puseletso said that social presence helps people relax and promotes a better environment for learning. Lehlaku mentioned that social presence "makes people connected

and communicate effectively which is a big requirement for online learning, so if people have social presence productivity will be greater than for those who don't".

In the view of the researcher and in line with observations from the data and the literature, social presence builds trust between educators and students. This correlates with Garrison (2020) statement that the basic assumption of the CoI and the guiding principle is to create a template for a collaborative learning community. This has also been corroborated by other authors (Anderson, 2017; Anderson & Dron, 2011; Garrison et al., 1999; Peacock & Cowan, 2016). Garrison (2020) highlighted something important and often overlooked, namely that online collaboration can be effectively achieved by dividing students into smaller groups of about 20 students. Looking back to the Covid-19 pandemic era, the focus was on moving all students to online learning, and not much thought was given to how the online classes could be structured. According to Hodges et al. (2020), the transition from face-to-face learning to ERT lacked meticulous design and planning, and perhaps this could be a takeaway for the future: It was important to take into consideration the factors that could enable digital education.

6.2.4.2 Cognitive Presence

Cognitive presence is the extent to which learners can construct and confirm meaning through sustained reflection and discourse (Garrison et al., 1999). It is about the design of the learning activities and assessments as well as the facilitation of the course (Arbaugh et al., 2008; Garrison & Arbaugh, 2007; Kreijns et al., 2014).

6.2.4.2.1 Cronbach's Alpha Coefficient

The Cronbach's alpha coefficient showed high internal consistency for cognitive presence items, which is higher than the acceptable internal consistency of 0.7, for both the academics' and the students' datasets, suggesting that the items measured what they intended to measure and that there was reliability of items in the constructs for both the academics' and the students' dataset.

6.2.4.2.2 Convergent Validity

The findings of the convergent validity suggested that cognitive presence has the strongest positive correlations with social presence, academic skills, technology, and the learning environment. Cognitive presence is strongly influenced by social presence, academic skills, student skills,

technology and the learning environment. It was also moderately influenced by learner presence and infrastructure for the academics' dataset. It is worth noting that cognitive presence showed significant correlation with all constructs from both datasets and less or no significance (0.23) with the infrastructure for the students' dataset. On average, the correlations were statistically significant, meaning that the relationships were unlikely to be due to chance. The correlation was significant at the 0.01 level (2-tailed) for the academics' dataset, and significant at the 0.01 level (2-tailed) and the 0.05 level (2-tailed) for the students' dataset, showing strong reliability. This means that when students are more engaged in learning, they tend to feel more connected to others, perform better academically, use technology more effectively, and experience a better learning environment (Anderson & Dron, 2011; Arbaugh et al., 2008; Caskurlu et al., 2021; Castellanos-Reyes et al., 2020; Kreijns et al., 2014).

6.2.4.2.3 Exploratory Factor Analysis

The findings of the factor analysis and the loadings indicated a strong relationship between the items and constructs for both the academics' and the students' datasets. The underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality. The following items were found and confirmed to be items measuring the cognitive presence: Students able to explore, integrate and apply knowledge; high level thinking tasks and application type of activities; activities that promote critical thinking and problem-solving skills among students; and peer review discussions.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for academics' variables also showed a good fit, with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that both the academics' and the students' models fit well with the data.

The findings confirmed that cognitive presence is about the co-learning approach and inquiry process, and when a student says, "I can do this naturally", learning becomes natural for them. The student reaches this natural state when the environment permits, technology exists, learner presence exists, and the relevant infrastructure is in place. According to Anderson and Dron (2011), Arbaugh et al. (2008), Caskurlu et al. (2021), Castellanos-Reyes et al. (2020), and Kreijns

et al. (2014), cognitive presence is the degree to which students can create and validate meaning through extended reflection and conversation.

In addition, when responding to the open-ended question about what can be done to enable and stimulate students to explore, integrate and apply the knowledge in an online environment, Peter said that students can be put in smaller groups to force everyone to integrate. This corroborates Garrison (2020)'s advice to create small and maintained online classes. Grace concurred with Peter's notion and mentioned "making the sessions interactive, where students are able to engage with the content and learn in a fun way". Jonh also "recommended that academics should allow students to drive the discussions".

These findings from the respondents' statements align with those from the convergent validity analysis that indicated that cognitive presence has the strongest positive correlations with social presence, academic skills, technology, and the learning environment. Cognitive presence is significantly influenced by social presence, academic skills, student skills, technology, and the learning environment. Additionally, it is moderately influenced by learner presence and insignificantly influenced by infrastructure.

This finding is consistent with the social constructivist approach, which serves as the theoretical foundation for flipped classrooms in various studies (Mehring & Leis, 2018; Moreno-Guerrero et al., 2020). In flipped classrooms, teachers assume the role of guides, offering students opportunities to engage in active learning and hands-on activities. These statements were corroborated by Alexander et al. (2019) as they mentioned that a student-centred approach is one of the methods where students have opportunities to engage with the learning content prior to class, which results in realising personally meaningful and educational worthwhile learning outcomes.

In the researcher's view, there is a need for a paradigm shift in the pedagogical approaches wherein academics must be equipped with instructional design and students must be equipped with digital pedagogical tools and the effective use of these technologies. Once this has been achieved, the social constructivist approach can be realised. Students will receive the material online and engage with and use the face-to-face classes for points of clarity, to collaborate, and to engage with other learners. According to Anderson and Dron (2011), Caskurlu et al. (2021), and Garrison et al. (1999), cognitive presence is about co-learning approaches and inquiry processes.

6.2.4.3 Learner Presence

Learner presence is about students' role and participation in learning, and is collaboration between learners and lecturers (Anderson, 2017; Kovanović et al., 2015).

6.2.4.3.1 Cronbach's Alpha Coefficient

Cronbach's alpha coefficient showed good reliability for the learner presence items from the academics' dataset, which is slightly higher than the acceptable internal consistency of 0.7, and showed a slightly lower reliability than the acceptable internal consistency of 0.7 for the students' dataset, demonstrating questionable Cronbach's alpha coefficient (Shea & Bidjerano, 2010).

6.2.4.3.2 Convergent Validity

The convergent validity suggested that learner presence is moderately positively related to other constructs, indicating that when students feel more present, they generally experience better social interactions, engage more deeply in cognitive activities, perceive a better learning environment, and perform better academically. They also leverage technological affordances and social affordances when they are fully engaged in learning. The infrastructure construct, which refers to the infrastructural support systems and resources available, showed a weaker though positive connection with learner presence compared to the other constructs. While better infrastructure might slightly enhance how present students feel, this relationship is not as strong as for the other factors. The correlation is statistically significant at the 0.01 level (2-tailed) for the academics' dataset, and significant at the 0.01 level (2-tailed) and the 0.05 level (2-tailed) for the students' data, showing strong reliability, meaning the observed relationships are highly reliable and unlikely to be due to random chance.

6.2.4.3.3 Exploratory Factor Analysis

The findings of the factor analysis and the loadings indicated a strong relationship between the items and the constructs for both the academics' and the students' datasets. The underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality. The following items were found and confirmed to be the items measuring learner presence: Self-efficacy, and environment. Self-efficacy in this context refers to an individual's belief in their capacity to execute behaviours necessary to produce specific performance

attainments (Semwal et al., 2019; Shea & Bidjerano, 2010). The learning environment refers to the learning environment that supports social and cognitive development spaces where students feel they can be successful and are motivated to learn.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicated that both the academics' and the students' models fit well with the data.

Learner presence in the context of this study and the literature refers to students' autonomy to be successful in an online class. These findings were confirmed by the students responding to the open-ended question: "What other learner presence enhance student learning experience?" Lindo suggested open communication between the lecturers and students, where lecturers consistently check in to see if the students understand or need clarification. Dr Phiri suggested "a conductive learning space". These findings align with the convergent validity that suggested that learner presence is moderately positively related to other constructs, indicating that when students feel more present, they generally experience better social interactions, engage more deeply in cognitive activities, perceive a better learning environment, and perform better academically.

These findings correlate with the findings of Shea and Bidjerano (2010). The authors confirmed the existing correlation between constructs within the CoI framework and self-efficacy. The authors further stated that while teaching presence and social presence are important factors in their own right, the extent to which students believe that they achieve significant learning depends partly on their sense of efficacy. They further suggested that self-efficacy is just one component of the larger construct of online learner self-regulation (learning presence) and that these constructs contribute to successful online learning. This was also supported by Anderson (2017), who stated that a new presence must be added to the framework, namely learner presence. The author agreed about the concern raised about the existing CoI model and mentioned that while it helps construct and define an effective teaching model, it does not take in consideration the fact that the effectiveness of teaching is equally dependent on the learners.

The flexibility of e-learning requires strong self-discipline and time management skills from students to stay motivated and on track with coursework, which may be challenging for some learners (Ferri et al., 2020; Mpungose, 2020; Paechter & Maier, 2010). This correlates with the findings of the current study that there is a positive relationship between the elements of the CoI framework and the elements of learner presence.

6.2.4.4 Academics Skills

Academic skills in the context of this study and the literature refers to the skills that the academics ought to have to effectively deliver online instructions. This refers to digital, technical and computer literacy skills.

6.2.4.4.1 Cronbach's Alpha Coefficient

Cronbach's alpha coefficient showed high internal consistency for academic's skills items, which is higher than the acceptable internal consistency of 0.7, suggesting that the items measured what they intended to measure and that there is reliability of items within the constructs for both the academics' and the students' datasets.

6.2.4.4.2 Convergent Validity

The findings of the convergent validity suggested that academic skills are strongly correlated with cognitive presence, technology, and environment and moderately correlated with social presence, learner presence, and infrastructure. The findings show a perfect correlation with technology, which may require further investigation to ensure it accurately reflects the relationship rather than a data anomaly. Overall, the correlation is statistically significant at the 0.01 level (2-tailed), meaning the observed relationships are highly reliable and unlikely to be due to random chance.

6.2.4.4.3 Exploratory Factor Analysis

The findings of the factor analysis and the loadings indicated a strong relationship between the items and the constructs for the academics' dataset. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality: Technical skills, digital skills, and computer literacy.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for the academic datasets. The model for academics' variables showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that the academics' models fit well with the data.

Although the technical skills, digital skills, and computer literacy were confirmed as key skills, demonstrating their validity and practicality, the respondents suggested additional academic skills and factors when responding to the following question: "What other skills and factors do you think are important for academics to have to enhance online learning?" Dr Metsi suggested "excellence in curriculum design", and Dr Router suggested "online assessment skills". During the Covid-19 pandemic, most academics struggled with digitising their content due to a lack of these skills. This study showed a moderate link between cognitive presence and academic skills, meaning better academic skills yield better student academic performance because students deeply engage in the learning process. It is about the design of the learning activities and assessments as well as the facilitation of the course. One of the responsibilities of academics is to design learning activities and assessments, and these requires some level of skill (Arbaugh et al., 2008; Garrison & Arbaugh, 2007; Kreijns et al., 2014).

During the pandemic era, most students were compelled to use digital literacy skills with which they were previously unfamiliar. They were woefully ill-equipped to face the challenges that lay before them. In order to facilitate deep learning, it is imperative for academics to equip students with the necessary supplementary digital competencies (Udeogalanya, 2022). However, to be efficacious, academics must first acquire these abilities themselves before they can impart them to the students. The absence of sufficient comprehensive training in digital literacy and the unpreparedness of HEIs for unexpected disruptions, such as the Covid-19 pandemic, have significantly hindered the process of teaching and learning.

6.2.4.5 Student Skills

Student skills in the context of this study and literature refer to the skills that students ought to have to effectively learn online. The following are the skills that this study perceived as important: Technical skills, which refers to understanding basic computer hardware and software with the ability to perform computer operations, such as using keyboard and mouse; digital skills, which is the ability to use technology, find and organise data and media sources, and communicate,

collaborate and participate in online environments; and computer literacy, which refers to the ability to be able to use basic computer applications.

6.2.4.5.1 Cronbach's Alpha Coefficient

Cronbach's alpha coefficient showed high internal consistency for the student skills items, which is higher than the acceptable internal consistency of 0.7, suggesting that the items measured what they intended to measure and that the items in the constructs for the students' dataset were reliable.

6.2.4.5.2 Convergent Validity

The findings of the convergent validity revealed that student skills are strongly associated with social presence, cognitive presence, learner presence, technology, and environment. The weak correlation with infrastructure suggests that while there is some link between student skills and infrastructure, though not as strong or impactful as with the other constructs. This could imply that factors related to social, cognitive, and environmental aspects of learning are more closely related to student skills than infrastructure-related factors. Overall, the correlation was statistically significant at the 0.01 level (2-tailed) and at the 0.05 level (2-tailed), showing strong reliability, meaning the observed relationships are highly reliable and unlikely to be due to random chance.

6.2.4.5.3 Exploratory Factor Analysis

The findings of the factor analysis and the loadings indicated a strong relationship between the items and the constructs for the students' dataset. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality: Technical skills, digital skills, and computer literacy.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for the datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. These findings indicate that the student models fit well with the data.

The findings are in line with the convergent validity that revealed that student skills are strongly associated with social presence, cognitive presence, learner presence, technology, and environment factors. The factor analysis findings demonstrated the validity and practicality of the items. The respondents added items when responding to the following open-ended question: "What

other skills and factors do you think are important for students to have to enhance online learning?" Pontsho suggested "time management", and Pitso suggested "the ability to navigate through new learning platforms". These findings correlate with the findings of Hallal et al. (2020) and Spante et al. (2018) that it is important to have systems that students can navigate with ease.

In the view of the researcher, and in agreement with the respondents' statements above, students ought to acquire digital and computer literacy skills as well as time management skills as they enter university. They must be digitally inclined to navigate any online course. According to Corbett and Spinello, (2020), a connectivism approach recognises how quickly learning and leadership are changing in the digital age; how important it is to build networks; how connected, distributed, and networked knowledge is for learning and leadership; how influence is spread out; and how the roles of teachers, learners, and leaders are changing. To achieve digital literacy in HEIs, instructors and learners must cultivate a diverse set of abilities.

6.2.4.6 Technology

Technology has the potential to enhance communication and collaboration in educational institutions. Collaboration among students and between students and teachers can occur with digital technology tools.

6.2.4.6.1 Cronbach's Alpha Coefficient

The findings of Cronbach's alpha coefficient showed high internal consistency for the technology items, which was higher than the acceptable internal consistency of 0.7 for the students' dataset, suggesting that the items measured what they intended to measure and that the items in the constructs for both the academics' and the students' datasets were reliable.

6.2.4.6.2 Convergent Validity

The findings of the convergent validity revealed that technology has a strong positive correlation with cognitive presence, academic skills, and environment, suggesting that effective use of technology significantly enhances cognitive engagement. The findings demonstrated a perfect correlation between technology and academic skills, suggesting that the effective use of technology contributes to academic skills. The findings also demonstrated that technology has moderate positive correlations with social presence, learner presence and infrastructure, implying

that technology plays a crucial role in facilitating social interaction, collaboration and learner engagement as well as good infrastructure. Overall, the correlation was statistically significant at the 0.01 level (2-tailed) for the academics' dataset and at the 0.01 level (2-tailed) and the 0.05 level (2-tailed) for the students' dataset, showing strong reliability, meaning the observed relationships are highly reliable and unlikely to be due to random chance.

6.2.4.6.3 Exploratory Factor Analysis

The findings of the factor analysis and the loadings indicated a strong relationship between the items and the constructs for both the academics' and the students' datasets. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality: Intelligent tutoring systems, applications that enable online learning, applications that enable effective collaborations between student and teachers, and digital learning platforms or LMSs.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academic's variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that both the academics' and the students' models fit well with the data.

In addition, the respondents were asked to add other factors they deemed crucial. Ruth said, "A good LMS is crucial to student online learning, I remember we would have moments where Sakai would crash during a test, at some point lecturers thought we were making excuses". Dr Mashigo said, "Technology platforms should be very easy to navigate and integrated with other platforms students are required to use".

In the researchers' view, and in alignment with the findings, the literature, and the respondents' responses, technology has the potential to significantly enhance communication and collaboration in educational institutions. This involves the use of technology tools that facilitate virtual instructional delivery, such as effective LMSs, communication platforms, videos, and multimedia. While these tools offer substantial benefits, respondents emphasised that to fully maximise their potential, they must work effectively. This echoes Fogarty's (2020) claim that without the

technological tools that enable remote education, higher education would have faced insurmountable challenges during the pandemic.

6.2.4.7 Infrastructure

Infrastructure in the context of this study refers to the buildings, technology, and resources required to support teaching and learning, such as classrooms, internet connectivity, digital devices, and LMSs. Effective infrastructure is crucial for ensuring services and processes run smoothly to enable growth, development, and the efficient functioning of an organisation or community (Aschauer, 1989). Preparing students to be successful for the future requires a robust and flexible learning infrastructure capable of supporting new types of engagement and providing ubiquitous access to the technology tools that allow students to create, design, and explore.

6.2.4.7.1 Cronbach's Alpha Coefficient

Cronbach's alpha coefficient showed high internal consistency for the infrastructure items, which was higher than the acceptable internal consistency of 0.7 for the students' dataset, suggesting that the items measured what they intended to measure and that the items within the constructs for both the academics' and the students' dataset are reliable.

6.2.4.7.2 Convergent Validity

The findings are in line with the convergent validity that revealed that while infrastructure has a notable impact on various aspects of the learning experience, including technology use and the learning environment, its effect on social and cognitive presence is minimal. The findings highlight that infrastructure improvements contribute more effectively to creating a supportive environment and supporting technology and learner presence than to enhancing social interaction or cognitive engagement. Overall, the correlation is statistically significant at the 0.01 level (2-tailed) for the academics' dataset, and at the 0.01 level (2-tailed) and the 0.05 level (2-tailed) for the students' dataset, showing strong reliability, meaning the observed relationships are highly reliable and unlikely to be due to random chance.

6.2.4.7.3 Exploratory Factor Analysis

The findings of the factor analysis and the loadings indicated a strong relationship between the items and the constructs for both the academics' and the students' datasets. The following

underlying observed items were confirmed as key contributing factors, demonstrating their validity and practicality: Network infrastructures; reliable network, data, or digital bandwidth; reliable electricity; and connectivity.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for the academics' variables showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicated that both the academics' and the students' models fit well with the data.

These findings were confirmed by the academics responding to the question of which other infrastructural factors should be considered for online learning. Prof Lee mentioned "reliable electricity" and Dr Bruce mentioned "devices—laptops, desktops, smartphones, tablets with access to the internet and the necessary loaded applications". The students were asked the same question and Mpho said "technical support", Pontsho mentioned "access to technology", and Bright said "reliable network connection".

These findings are in alignment with the underlying observed items explored (network infrastructures; reliable network, data, and digital bandwidth; reliable electricity; and connectivity). To achieve equity in terms of the affordances of digital technology tools, there must be equal access to the relevant infrastructure. According to Rodriguez-Segura, (2020), the extent to which the affordances of digital technologies are readily available in an area will heavily influence the feasibility of successfully implementing these technology tools, and vice versa. The researcher draws from experience as she comes from a rural area, and when she leaves suburban areas and approaches her home area, she loses telephone network coverage because of insufficient network coverage; learning online in that area would be impossible. These finding correlate with the statement by Dlamini and Ndzinisa (2020) that South Africa's background is still characterised by areas with limited connectivity, unreliable electricity. Infrastructural factors contribute to the success of digital technology education.

6.2.4.8 Environment

Environment in the context of this study refers to the environment in which teaching and learning occurs. This refers to a conducive and safe environment as well as an environment that cultivates interpersonal relationships between facilitator and students. During the pandemic, most students were forced to evacuate their residences and expected to learn from home. This did not work for some students because their homes were not conducive to learning.

6.2.4.8.1 Cronbach's Alpha Coefficient

Cronbach's alpha coefficient showed high internal consistency for the environment items, which was higher than the acceptable internal consistency of 0.7 for the academics' and the students' datasets, suggesting that the items measured what they intended to measure and that there the items within the constructs were reliable.

6.2.4.8.2 Convergent Validity

The findings of the convergent validity revealed that the environment construct has strong positive correlations with other constructs, particularly cognitive presence. These strong relationships suggest that the environment plays a crucial role in enhancing cognitive engagement. Additionally, the findings showed a significant positive correlation with learner presence, academic skills, technology, and infrastructure, implying that improvements in the environment can have widespread benefits across various aspects of learning and educational infrastructure. The findings also implied that a well-developed environment increases the effective use and integration of technology. The strength of these correlations indicates that the environment is a key factor influencing these elements. Overall, the correlation was statistically significant at the 0.01 level (2-tailed) for the academics' dataset and at the 0.01 level (2-tailed) and the 0.05 level (2-tailed) for the students' dataset, showing strong reliability, meaning the observed relationships are highly reliable and unlikely to be due to random chance.

6.2.4.8.3 Exploratory Factor Analysis

The findings of the factor analysis and the loadings indicated a strong relationship between the items and the constructs for both the academics' and the students' datasets. The following underlying observed items were confirmed as key contributing factors, demonstrating their validity

and practicality: The student has a conducive and safe environment; and an environment that cultivates interpersonal relationships between facilitator and students.

Bartlett's test of sphericity was significant, and all communalities exceeded the threshold of 0.50 for both datasets. The model for the students' variables showed a good fit with 35.0% of non-redundant residuals having absolute values greater than 0.05, which is below the 50% requirement. Similarly, the model for academic's variables also showed a good fit with 20.0% of non-redundant residuals having absolute values greater than 0.05. These findings indicate that both the academics' and the students' models fit well with the data.

Responding to the question about what other factors should be considered for the student online learning environment, Dr Khoza suggested "creating an environment conducive to learning is crucial", and Prof Pitso mentioned "personal learning space, desk, chair and conducive learning space". Lihle mentioned that a "student must have adequate resources for internet connection" and Brenda said to "allow discussions similar to face-to-face learning".

The findings confirmed that the underlying observed items were valid and practical and significantly correlated with various factors, particularly technology and student skills. This suggests that enhancing the environment might lead to improvements across these different elements. In line with these findings, the researcher believes that learning environments in the poor condition yields poor academic performance.

6.2.5 Interpretation of Findings for the Fifth Theme

The fifth theme responds to the question of what framework can be implemented to ensure successful integration of digital technology enabled education at South African universities. The interpretation of the findings for the fourth research question informed the determination of the factors contributing to the success of digital technology enabled education and the conceptualisation of the digital technology enabled education framework portrayed in Figure 6.5. The findings confirmed that a positive correlation exists between the elements of the latest CoI, namely social presence, cognitive presence, teaching presence, and learner presence (Anderson, 2017; Shea & Bidjerano, 2010), and that academic skills, student skills, technology, infrastructure, and environment are also factors that contribute to the success of digital technology enabled education in the context of South African HEIs. These theories then assisted in the adaptation of

the CoI and the development of the conceptual framework as demonstrated by the relationship diagrams (See figures 3.5 and 3.6).

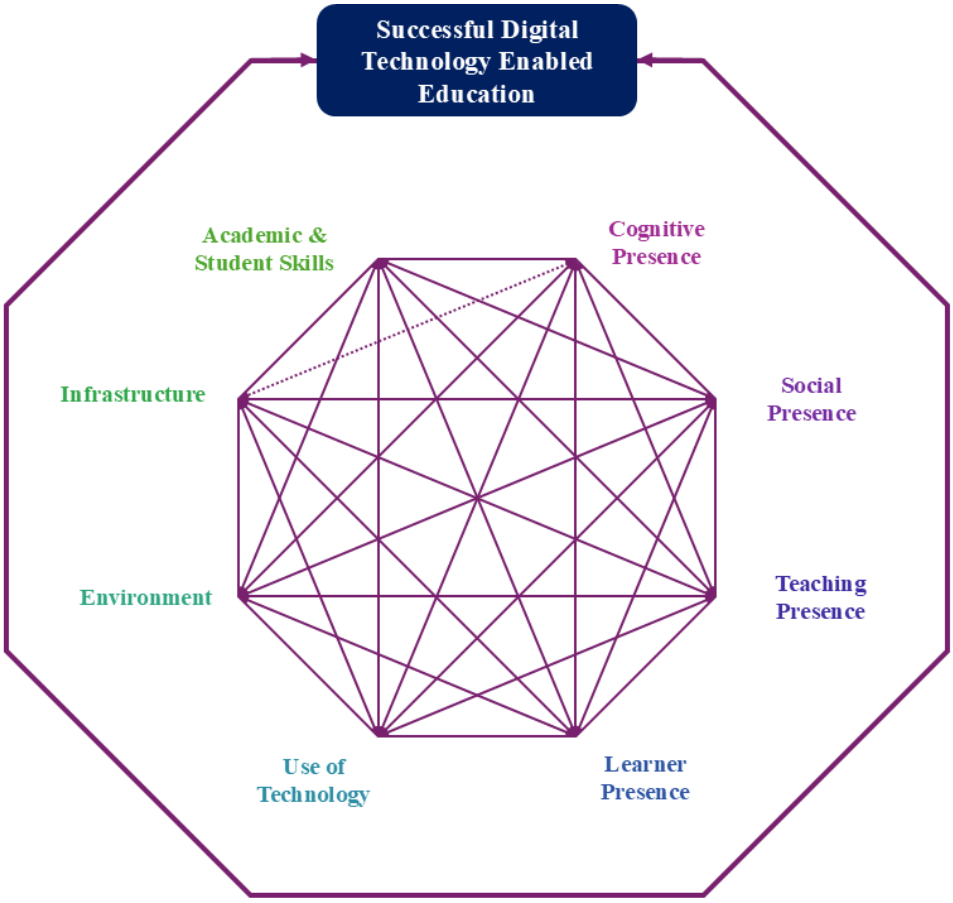


Figure 6.5 Conceptual framework: Digital technology enabled education

6.3 Recommendations of the Study

As the threats posed by Covid-19 diminished, many universities reverted to traditional classroom-only practices. However, it is crucial to retain the lessons learned in 2020 for the future. The possibility of future pandemics necessitates remote teaching, both in emergency situations and planned contexts, and therefore, online instructional delivery becomes an integral part of academics' skill set. Universities must not find themselves unprepared for ERT, and thus, ongoing planning and practice for such situations are imperative. South Africa is inclined to disruptions in education, and consequently, ERT will remain relevant in the future for South African HEIs (Cilliers, 2018; Knoetze & Du Toit, 2022).

South African universities were not prepared for the extent of the Covid-19 pandemic. Academics and students lacked the necessary preparation for the rigorous demands of online education. A significant portion of them were unfamiliar with digital literacy tools. Both academics and students were compelled to acquire proficiency in computer usage and digital literacy tools to endure the pandemic. None of the respondents from the sampled universities mentioned that when the pandemic started, they were swiftly trained, but rather, they mentioned that they switched to online environments. Academics and students were compelled to acquire resources to cope with the rigorous demand of teaching and learning (Udeogalanya, 2022). Some academics and students experienced a sense of being overwhelmed due to the demands of the new learning methodology, while some coped and enjoyed the benefits of online teaching and learning. Most academics and students with a fixed perspective about education and learning struggled to adapt and adjust, but those with a growth mindset adapted readily to the new learning environment. Additionally, it was observed that inadequate support mechanisms, such as a lack of professional training on how to effectively incorporate computers into teaching, had left educators ill-prepared (Udeogalanya, 2022). According to Anderson (2020) and Azzi-Huck and Shmis (2020), it is crucial to have a particular level of preparedness to effectively respond to any crisis and to be able to prepare, cope, and recover. What happened during the Covid-19 pandemic should never be witnessed again in South African HEIs. The Covid-19 problem has worsened the already well-documented disparities in opportunities and enrichment and harmed low-income learners more than their more affluent peers. In agreement with the authors cited in the literature and the findings of this study, the researcher recommends the following:

- It must be compulsory for academics and students to have computer and digital literacy skills regardless of their field of study. This will ensure preparedness for unforeseen events, such as the Covid-19 pandemic. This study advocates for greater institutional investment for academics' training to enhance their computer and digital literacy skills.
- There must be compulsory online professional training for academics for virtual instructional delivery. This should better prepare instructors to meticulously design online instructional delivery courses with pedagogical, content design, and technological, social and communication competencies. Ongoing professional development for academics is essential to keep pace with technological advancements and to integrate emerging trends such as AI, data analytics, and immersive technologies into the curriculum. Emphasising

lifelong learning and continuous education will help students and educators adapt to the evolving demands of the digital age. Educators should be trained to understand how AI tools work and how to interpret the results they provide, ensuring they can effectively use these tools to support student learning.

- Modern digital learning courses must be integrated into portable and autonomous e-learning platforms that does not require a continuous network or internet connection to operate. This will enable students and educators who lack digital connectivity to participate in the modern ICT-driven environment.
- There is a need for educational, technical/technological, social, environmental, access, and infrastructure affordances. The provision of digital technology resources, such as digital devices and ubiquitous network connectivity, are necessary to effectively enable teaching and learning for all South African students despite their backgrounds. Groottes's headline "Online to the Rescue" advocated for large-scale investment in online education to secure access, arguing that opposition to online education cannot prevail (Black, 2020). Watson and Calland (2020) supported this view, declaring that online learning must now be central to educating the young, stating, "Education ecosystems are now and forever, digital". They suggested that online education via digital technology should be central in addressing ongoing educational access and outcomes (Black, 2020; Fataar, 2021).
- There must be responsible use policies to safeguard students and ensure infrastructure support learning. Institutions should also develop clear policies and guidelines for the use of AI in assessments, outlining the responsibilities of both educators and students in maintaining academic integrity.
- Partnerships between government, private and public entities are necessary. Universities should ensure long-term financial sustainability and longevity, so it remains beacons of excellence for decades to come. This means that they need to build endowment funds, diversify their funding sources, and work with public and private sector partners.
- A similar study with the inclusion of ICT management should be considered.
- The success rate reports from rural and semi-rural areas must be analysed to compare student performance.
- A study can be conducted that uses a different research paradigm, approach, strategy, and design to study the same phenomenon at the same South African universities.

- Confirmatory analysis can be used to confirm the identified factors by this study and to test the conceptual framework.
- A study must be conducted on technology enabled assessments across metropolitan, rural and semi-rural universities. Institutions should focus on bridging the digital divide by ensuring equitable access to digital tools and resources for all students.

Table 6.1 shows the summary of the study objectives, themes, findings and recommendations.

Table 6.1 Summary of the study objectives, themes, findings and recommendations

Objectives	Themes	Theoretical Lens	Findings	Recommendations
To assess the efficacy of digital technology enabled education in HEIs	Digital technology enabled education	CoI Framework	• Inequality of resources among students • Lack of network and infrastructure.	A need for digital technologies, technological affordances, social affordances, ubiquitous network, and infrastructure
	The impact of ERT	Literature review	• Lack of access to digital technologies • Lack of professional training • Lack of conducive learning environment for students	Partnerships between government, private and public entities
	Digital literacy		• Lack of digital literacy skills	Digital literacy skills to be compulsory for both academics and students
To explore how digitalisation enhances student experience in HEIs	Digitalisation	CoI Literature review	• Unreliable network and internet connections • Lack digital resources	Offline e-learning platforms that will enable students and educators who lack digital connectivity to participate in the modern ICT-driven environment
	Modes of instructional delivery	Literature review	• Lack of sufficient training for academics and students on online teaching and learning methods	Effective and continuous training of academics and students on the use of the online teaching and learning methods tools
	Technology enabled assessments	CoI Literature review	• Lack of technology enabled assessments systems	Universities could invest in relevant systems and infrastructures for online learning and applications to manage technology enabled assessments Further research on technology enabled assessments
To explore the impact of digital education on student performance	Digital technology education affordances for student performance Impact of digital technology enabled education on student performance	Document analysis	• A decrease in the amount of material taught, greater leniency in grading, and a reduction in the workload were the probable factors behind the enhanced performance during the 2020 academic year • Lack of resources and relevant infrastructure for online teaching and learning	Provision of digital technology resources and network infrastructures to effectively enable teaching and learning for all South African students despite their backgrounds

Objectives	Themes	Theoretical Lens	Findings	Recommendations
To analyse the factors that contribute to the success of digital technology enabled education	Social, cognitive, teaching, learner presence, academic skills, students skills, infrastructure, technology, and environment	CoI Literature review	• Lack of social affordances, technological affordances, online teaching and learning competencies, network, and infrastructure	Digital technology enabled educational framework inclusive of all these factors
To develop a conceptual framework for successful integration of digital technology enabled education at HEIs. To assess the efficacy of digital technology enabled education in HEIs	Factors contributing to the success of digital technology enabled framework	CoI Framework Literature review	• Lack of relevant digital technology enabled education framework	Conceptual framework for successful integration of digital technology enabled education

6.4 Concluding Remarks

This chapter provided the interpretations of findings from Chapter 5. The interpretations were done and provided according to the themes and subthemes. The CoI framework was used as a lens, while the literature was used to qualify the interpretation of the findings. Theoretical and practical recommendations were then provided. The next chapter reflects on the research journey by evaluating and articulating the contributions and concludes the thesis.

CHAPTER 7: EVALUATION, CONTRIBUTIONS, AND CONCLUSION

7.1 Chapter Overview

The previous chapter provided interpretations of the findings, recommendations and presented the conceptual framework. The CoI framework and the literature were used as lenses to qualify the interpretation of findings. This final chapter reflects on the research journey and provides the limitations and conclusions.

7.2 The Research Problem

The shift to ERT and online learning in South Africa revealed numerous deficiencies that exacerbated the difficulties encountered by students and educators. The challenges included the following:

- Restricted access to devices for students, particularly in rural areas where many lacked essential digital tools such as laptops and tablets;
- Inadequate internet connectivity, with inconsistent and unreliable connections in rural regions obstructing effective online learning;
- Elevated costs associated with internet connections;
- Lack of digital literacy and insufficient training for educators and students because most students and educators lacked the requisite digital competencies to effectively participate in online learning environments;
- Pedagogical challenges arose as most academics lacked proficiency in online teaching methodologies, adversely affecting the quality of education provided; and
- Non-conducive learning environments were prevalent as most students lacked a quiet and dedicated space at home for studying, which hindered their capacity to concentrate and learn effectively.

The government support, corporate sector collaborations, and community engagement were essential during the initial phase of the transition from traditional teaching and learning to ERT and online education. Consequently, disparities emerged between the haves and the have-nots.

7.3 Research Aim

The aim of this study was to assess the impact of the shift to ERT and online learning on academic performance. This was measured by reviewing student performance prior to and during the pandemic period and the completion rates of undergraduate students in the selected universities during the 2020 academic year. The study goal was attained by identifying the factors for successful digital technology enabled education and developing a conceptual framework integration of digital technology and online instructional delivery.

7.3.1 The Achievement of Research Objectives

The research study had five objectives, and these were achieved as follows:

- To assess the efficacy of digital technology enabled education in HEIs:
    - To achieve this objective, the researcher analysed the efficacy of digital technology enabled education in higher learning institutions, determined the impact of ERT, and delved into the importance of digital literacy. Achieving this objective answered RQ1: What is the efficacy of digital technology enabled education in HEIs?
- To explore how digitalisation enhances student experience in HEIs:
    - To achieve this objective, the researcher analysed the digitalisation process in universities, instructional delivery modes, and online assessments of students. Achieving this objective answered RQ2: How does digitalisation enhance student performance and experiences in HEIs?
- To explore the impact of digital education on student performance:
    - To achieve this objective, the researcher explored student performance, primarily by comparing the performance of students prior to, during, and after the pandemic period, and investigated the impact of digital education on student performance. Achieving this objective answered RQ3: What is the impact of digital education on student performance?
- To analyse the factors that contribute to the success of digital technology enabled education:

- To achieve this objective, the researcher analysed the factors contributing to the success of online teaching and learning in the South African universities' context. This was done to ensure equity for all students regardless of their background and to ensure no student is left behind because of learning disruptions. Factors such as social presence, cognitive presence, teaching presence, learner presence, academics skills, students' skills, infrastructure, use of technology, and environment were analysed to achieve this objective. Achieving this objective answered RQ4: Which factors contribute to successful digital technology enabled education?

- To develop a conceptual framework for successful integration of digital technology enabled education at HEIs:
  - Following the analysis of the factors influencing the success of online teaching and learning, a conceptual framework for attaining success in technology enhanced education was created. This framework will guarantee equity for all students, irrespective of their background, and will ensure no student gets left behind during instances of learning disruptions. This objective was accomplished, and the framework is shown in Figure 6.5.

7.3.2 Primary Research Question

In relation to the research goal, the primary research question was: How can HEIs realise success in digital technology enabled education? This question was answered using the CoI framework lens, the literature, and the data collected and by considering the South African context.

7.4 The Contribution of the Study

This section provides a four-fold contribution, namely triangulation of methods, and practical, methodological, and contextual contributions.

7.4.1 Triangulation

As guided by Burns (2010) Cohen et al. (2002), and Mathison (1988), various methods were used to develop a comprehensive understanding of the phenomena. This approach was crucial and ensured the validity of the study. Triangulation was crucial in this study and enabled the researcher to reveal the complexities of the phenomena under study and provided insights into the subject

matter without generalisation. The following subsections discuss how the methods were triangulated.

7.4.1.1 Methods Triangulation

A mixed method research approach was deemed fit for the study's purposes, and therefor, a questionnaire with both closed-ended and open-ended questions was sent to the respondents (Johnson & Turner, 2003). Document analysis was done using the annual reports, websites and magazines of the selected universities (Cohen et al., 2002; Mathison, 1988). The study showed 'what' and 'how' to realise digital technology enabled education in the HEIs of South Africa.

7.4.1.2 Data Source

Stratified random sampling was used. This enabled the respondents to share the attributes and their experiences of the transition to ERT, online learning, and the digital education experience. The questionnaire was sent to academics and third- and fourth-year students at three different South African HEIs, categorised as metropolitan, rural and semi-rural. It was interesting to learn various perspective of the same phenomenon (Cohen et al., 2002).

7.4.1.3 Data Analysis

The researcher used different approaches that interpret the data and provide recommendations for this study. The data were analysed descriptively and thematically, and EFA was conducted to establish the relevant factors contributing to the success of digital technology enabled education.

7.4.1.4 Theoretical Contribution

Given that this study was premised on digital education affordances for South African universities and the CoI framework, it was essential to understand the various elements that contribute to the success of digital technology. The study used the CoI framework, the literature review, and studies from other scholars that used the CoI as a lens for the current research. These theories were used as lenses during data collection, data analysis and the interpretation of the findings to conceptualise the framework. Triangulating these theories provided rich findings and interpretations that helped contribute to a theory for digital technology enabled education fit for the South African HEIs context. The triangulation of these theories has not been used previously to explore and describe the digital technology enabled education, especially in the context of South African universities.

As a result, a conceptual framework is now added to the digital technology enabled education literature.

7.4.2 Methodological Contribution

Previous studies on digital technology education often used a positivistic approach and survey research, which did not fully address the 'how' and 'when' aspects of the phenomenon. In contrast, this study employed a pragmatist paradigm and a case study strategy to provide a deeper understanding of these aspects. The case study approach offered a detailed and subjective examination of digital technology as experienced by South African university students. This study effectively used the pragmatist perspective and a case study method to explore and explain the impact of digital technology on student performance, establishing these methods is valuable for understanding this topic in higher education contexts. In terms of the analysis, according to Bandalos and Finney (2018), EFA should be used when the variables to be analysed are either newly developed or have not previously been analysed together, or when the theoretical basis for the factor analysis model is weak. None of the identified constructs have been tested and analysed before in South African universities as factors to be considered for digital technology enabled education.

7.4.3 Practical Contribution

The practical contribution of this study is the framework that shows which factors should be considered to realise success in digital technology enabled education for South African HEIs. The framework shows which elements to consider to ensure equitable digital education for online teaching and learning. The practical importance lies in the way HEIs realise the digitalisation of teaching and learning, the realisation of the impact of digital technology enabled education in HEIs, and the affordances of digital technology for student performance because ultimately, all these affect student performances. The practical knowledge gap identified and discussed in section 3.4.9 has been addressed through the conceptualised framework (Figure 6.5).

7.4.4 Contextual Contribution

The affordance of digital technology is sensitive to the context in which it happens. Therefore, South African HEIs present unique contexts for digital technology affordances for student performance. The context of South African government, HEIs, businesses, and economic and

socio-economic backgrounds are distinct from the rest of the world. This thesis acknowledges that what happens and how it happens in other countries do not necessarily work in the same manner in a developing country like South Africa. South African universities are unique, and therefore, how digital technology education is enabled in South Africa should be responsive to this uniqueness. The contextual knowledge gap defined in section 3.4.9 has been addressed.

7.5 Limitations of the Study

Out of the 26 universities in South Africa, three universities were sampled for this study, and they were categorised as metropolitan, rural and semi-rural universities. It was impractical to conduct this study in all the South African public universities. The three universities sampled in these categories might not fully represent the entire population, hence this is seen as a limitation. A similar study could be conducted on a broader scale to sample at least five metropolitan, five semi-rural, and five rural universities.

Another limitation is that ideally, the study would have benefited from including management from ICT departments, such as information systems and information technology, to gain insight into ICT infrastructures and network and technology capabilities. However, this was not feasible because of resource constraints and difficulties accessing the respondents from those departments. This means that this study does not include the views from the management of those departments, and this is a limitation because these senior managers are part of decision-making and strategy formulation, and therefore, their opinions and views matter.

7.6 Future Research

Based on the recommendations provided, several areas for future research were identified to further explore and enhance the understanding of digital technology enabled education and its impact on student performance. Therefore, the researcher makes the following recommendations for future research:

- **Longitudinal studies on digital literacy:** Investigate the long-term effects of compulsory computer and digital literacy training for both academics and students. Assess how these skills impact teaching effectiveness and student performance over time.

- **Effectiveness of online professional training:** Evaluate the effectiveness of compulsory online professional training programmes for academics. Focus on how these programmes improve virtual instructional delivery and pedagogical competencies.
- **Impact of portable e-learning platforms:** Explore the implementation and effectiveness of portable and autonomous e-learning platforms that do not require continuous internet connectivity. Assess their impact on students and educators in areas with limited digital connectivity.
- **Infrastructure and access affordances:** Examine the role of educational, technical, social, environmental, and infrastructural affordances for supporting digital education. Identify best practices for ensuring equitable access to digital resources.
- **Digital technology resource provision:** Investigate the impact of providing digital devices and ubiquitous network connectivity on teaching and learning outcomes. Focus on how these resources can bridge the digital divide and support students from diverse backgrounds.
- **Responsible use policies:** Study the development and implementation of responsible use policies in educational institutions. Assess their effectiveness in safeguarding students and supporting digital learning infrastructure.
- **Public-private partnerships:** Analyse the role of partnerships between government and private, and public entities in supporting digital education initiatives. Identify successful models and strategies for collaboration.
- **Technology enabled assessments:** Conduct research on the implementation and effectiveness of technology enabled assessments across metropolitan, rural, and semi-rural universities. Compare student performance and identify factors contributing to success.
- **Comparative studies on student performance:** Analyse success rate reports from rural and semi-rural areas and compare them with metropolitan areas. Investigate the factors influencing student performance in different contexts.
- **Alternative research paradigms:** Use different research paradigms, approaches, strategies, and designs to study the same phenomenon at South African universities. This could provide a more comprehensive understanding of the impact of digital education.

- **Confirmatory analysis:** Conduct confirmatory analysis to validate the factors identified in this study. This could involve using statistical methods to confirm the relationships and impacts observed.
- **Preparedness for future crises:** Investigate the preparedness of HEIs for future crises, such as pandemics. Assess the effectiveness of ongoing planning and practice for ERT.

By addressing these future research directions, scholars can contribute to a deeper understanding of digital technology enabled education and its potential to enhance student performance and experiences in higher education.

7.7 Conclusion of the Study

The research problem was that South African university students experienced challenges during the shift from face-to-face instruction to ERT and online learning due to the Covid-19 pandemic. This shift exacerbated the inequalities at South African universities, which resulted in some students being left behind during that academic year, despite all the plans put in place by the universities to mitigate against the digital divide, such as providing resources like data and laptops to their students. Students and some academics still encountered network and infrastructural problems that were beyond what universities could provide or make feasible.

The other problem that was inferred was the inadequate preparation before the move in terms of training for students and academics. At some point, academics were expected to make ERT possible despite the insufficient training that was provided, which also affected the outcome of student's performance. It was inferred that this problem was due to a lack of digital literacy, a lack of thoughtful instructional design, a lack of infrastructure, network, and technology, and socio-economic issues. In some cases, during lockdown, although students had data and digital devices, they could still not connect or learn online.

The existing frameworks inadequately addressed the 'what', 'how', and 'when' to achieving online learning in the context of South African universities. The CoI theoretical framework represents a process for creating a deep and meaningful collaborative-constructivist learning experience through the development of three interdependent elements previously discussed. However, this model was developed in the early 2000 and is not relevant to the South African context. The model, as described by Garrison et.al (1999), is a generic teaching template that caters for face-to-face

and online learning, which was meant for graduates. The framework requires some adaptation to inclusively accommodate both graduates and undergraduates from advantaged and disadvantaged backgrounds as well as catering for hands-on experiences. The frameworks from other authors discussed in Chapter 3 have limitations in terms of addressing the context of this problem. It was for this reason that the researcher identified the important factors to consider for the realisation of successful virtual instructional delivery or online learning fit for all South African students in HEIs to address this gap. In this way, students from all regions, socio-economic backgrounds, and rural and semi-rural environments will not be left behind during any academic disruptions.

This research also discovered that issues such infrastructures, technology, intermitted networks, and energy reduction in the country are national problems that require partnerships between government and corporate and private institutions. To combat these issues and enable equitable access to education for all students, the government and organisations must invest time and money into backup power supplies, community learning centres, and 'digital hubs', among a variety of other initiatives. Any future integration of online learning as complementary to contact instruction will require substantial investment in skills and digital communication infrastructure to ensure equal access to and benefits from online learning. It will be impossible for universities alone to combat these problems.

In addition, it emerged from this research that it is time to move beyond traditional teaching and learning, which take place in brick-and-mortar settings, and to normalise blended teaching and learning. As the threats posed by Covid-19 diminished, many universities reverted to traditional classroom-only practices. However, it is crucial to retain the lessons learned from 2020 for the future. For instance, the possibility of future pandemics necessitates that remote teaching, both in emergency situations and planned contexts, becomes an integral part of a teacher's skill set. Universities must not find themselves unprepared for ERT; thus, ongoing planning and practice for such situations are imperative. Additionally, with political unrest, economic volatility and the Covid-19 pandemic (Cilliers, 2018), South Africa is inclined to disruptions in education, and consequently, ERT will remain relevant in the future for South African HEIs.

The theoretical, practical, methodological, and contextual contributions of this thesis offer a new insight to digital technology enabled education for South African universities. The study highlighted and addressed theoretical, methodological, and practical issues and contextual

challenges. Therefore, the study adds and contributes new knowledge to the enablement of the digital technology education landscape in the context of South African universities.

The peer-reviewed publication by the author that emanated from the study is discussed in Chapter 8, and it is an indication of the relevance of this thesis and how the study contributes to the body of knowledge.

CHAPTER 8: PUBLICATION

8.1 To be Published

Motheogane, MM., Dlamini, R., Mesuwini, J., & Makda, F. (2026). Equitable education: Virtual modes of instructional delivery. *South African Journal of Higher Education, 40.*

NB: The paper is scheduled to be published in Volume 40 of the South African Journal of Higher Education in 2026.

8.2 Published

Mesuwini, J., **Motheogane, M.**, Molele, M., & Gorimbo, J. (2024). Work-Integrated Learning as a Pedagogical Tool to Integrate Theory and Practice for TVET Graduates. In *Technical and Vocational Teaching in South Africa: Practice, Pedagogy and Digitalisation* (pp. 117-141). Cham: Springer Nature Switzerland.

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ANNEXURE 1: ETHICS CLEARANCE FROM THE UNIVERSITY OF WITWATERSRAND

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

OFFICE OF THE DEPUTY REGISTRAR

20 February 2023

Millicent Motheogane
Student Number (2422894)
Doctor of Philosophy
Wits School of Education

TO WHOM IT MAY CONCERN

"Digital technology enabled education: Exploring digital education affordances on student performance."

This letter serves to confirm that the above project has received permission to be conducted on University premises, and/or involving staff and/or students of the University as research participants. In undertaking this research, you agree to abide by all University regulations for conducting research on campus and to respect participants' rights to withdraw from participation at any time.

If you are conducting research on certain student cohorts, year groups or courses within specific Schools and within the teaching term, permission must be sought from Heads of School or individual academics.

Ethical clearance has been obtained. (Protocol number: H22/06/29)

Research Expiration: (23 August 2025)

Potgieter

Nicoleen Potgieter
University Deputy Registrar

Private Bag 3, WITS, 2050, South Africa | T +27 11 717 1204/8 | E nicoleen.potgieter@wits.ac.za | www.wits.ac.za
IYUNIVESITHI YASEWITWATERSRAND | YUNIVESITHI YA WITWATERSRAND

ANNEXURE 2: ETHICS CLEARANCE FROM THE UNIVERSITY OF VENDA

Research and Innovation
Office of the Director

Date: 06 October 2022

Ms M Motheogane
University of the Witwatersrand
School of Education

Email: Millicent.Motheogane@wits.ac.za

Dear **Ms. M Motheogane**

Permission to conduct Research at the University of Venda

You are hereby granted permission to conduct research at the University of Venda.

The research will be based on your Doctoral research title: ***"Digital Technology Enabled Education: Exploring digital education affordance on student performance"***. registered at the **University of Zululand**.

Supervisor: Dr Reuben Dlamini

Approval period: October 2022 - October 2023

The conditions are that all the data pertaining to University of Venda will be treated in accordance with the Ethical Principles and that will be shared with the University upon completion of the project. In addition, consent should be sought by you as a researcher from participants.

Attached is our policy on ethics.

Thank you

.....
Prof VO Netshandama

Chairperson: UREC

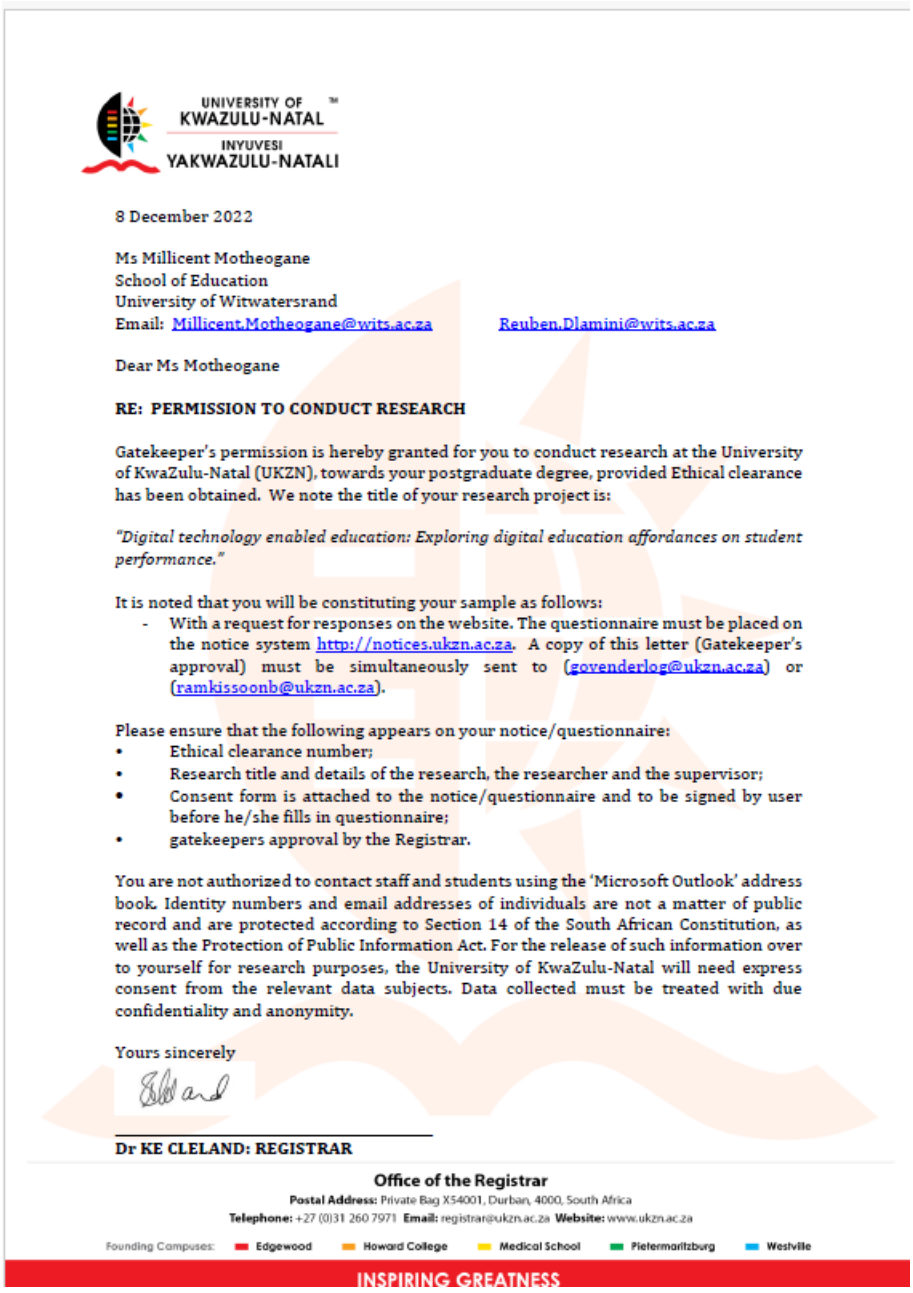
UNIVERSITY OF VENDA
OFFICE OF THE DIRECTOR
RESEARCH AND INNOVATION
2022 -10- 24
Private Bag X5050
Thohoyandou 0950

Cc: Prof N Feza (DVC Research and Postgraduate Studies)

Cc: Senior Prof GE Ekosse (Director Research and Innovation)

Cc: Prof MS Mashau (Chairperson RESSC)

ANNEXURE 3: ETHICS CLEARANCE FROM THE UNIVERSITY OF KWAZULU-NATAL



UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

8 December 2022

Ms Millicent Motheogane
School of Education
University of Witwatersrand
Email: Millicent.Motheogane@wits.ac.za Reuben.Dlamini@wits.ac.za

Dear Ms Motheogane

RE: PERMISSION TO CONDUCT RESEARCH

Gatekeeper's permission is hereby granted for you to conduct research at the University of KwaZulu-Natal (UKZN), towards your postgraduate degree, provided Ethical clearance has been obtained. We note the title of your research project is:

"Digital technology enabled education: Exploring digital education affordances on student performance."

It is noted that you will be constituting your sample as follows:

- With a request for responses on the website. The questionnaire must be placed on the notice system http://notices.ukzn.ac.za. A copy of this letter (Gatekeeper's approval) must be simultaneously sent to (govenderlog@ukzn.ac.za) or (ramkissoonb@ukzn.ac.za).

Please ensure that the following appears on your notice/questionnaire:

- Ethical clearance number;
- Research title and details of the research, the researcher and the supervisor;
- Consent form is attached to the notice/questionnaire and to be signed by user before he/she fills in questionnaire;
- gatekeepers approval by the Registrar.

You are not authorized to contact staff and students using the 'Microsoft Outlook' address book. Identity numbers and email addresses of individuals are not a matter of public record and are protected according to Section 14 of the South African Constitution, as well as the Protection of Public Information Act. For the release of such information over to yourself for research purposes, the University of KwaZulu-Natal will need express consent from the relevant data subjects. Data collected must be treated with due confidentiality and anonymity.

Yours sincerely

Dr KE CLELAND: REGISTRAR

Office of the Registrar
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 7971 **Email:** registrar@ukzn.ac.za **Website:** www.ukzn.ac.za

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS

ANNEXURE 4: QUESTIONNAIRE

SECTION 1

Demographics - GENERAL

Instructions: Make a cross in the appropriate box to indicate the answer of your choice.

1.1 What is your age group?

18-25 Years	26-35 Years	36-45 Years	46-55 Years	>55 Years

1.2 What is your gender?

Male	Female	Do not wish to disclose

1.3 Which category do you belong?

Student	Staff

1.4 If you were a student, which level of study are you doing?

Diploma	Bachelor's / BTech degree	Honours	Master's degree	Doctoral degree

1.5 If students, which degree are you doing

1.6 If staff, how long have you been working for the University

Less than a year	1-2 years	3-4 years	5-10 years	>10 years

1.7 If staff, what is your position

Associate lecturer	senior lecturer	Senior lecturer	Associate professor	Professor	Other

SECTION 2

The following questions refer to the efficacy of digital technology enabled education in institutions of higher learning - RQ1 & RQ4

Instructions: Please select your choice and kindly provide a reason for your choice

Digital Education			
How did the lock-down which resulted in the emergency remote teaching affect you?	Positive	Negative	Neutral
Kindly explain			
In your experience, do you think digital education enhance student performance and experience?	Yes	No	
Please elaborate or provide a reason for your answer			
In your experience or opinion, do you think digital education diminish/weaken student performance and experience?	Yes	No	
Please elaborate or provide a reason for your answer			
Does culture, behaviour and attitude contribute to the success of digital education?	Yes	No	
Please elaborate or provide a reason for your answer			

Learning methods
Please select the learning methods that enhance student performance and experience from the drop down
Blended learning - students learn online as well as traditional face-to-face Face to face learning Online learning
Kindly provide reasons for any option chosen

SECTION 3

The following questions are aimed at exploring the important factors to consider in realising successful digital technology enabled education in institutions of higher learning – RQ3

Instructions: Make a cross in the appropriate box to indicate the answer of your choice.

NB: 0 = Not important, 1 = Slightly Important, 2 = Moderately Important, 3 = Important, 4 = Very Important

Social presence How important is the social presence in realising a digital enabled education						
		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
3.1	Open communication and collaboration between the students					
	Students expressing their feelings, emotions, values, and beliefs					
	Collaborative activities between students					
	Students feeling secure to communicate					
	Group Cohesion (the extent to which students are committed to the group and its goals)					
	Mutual trust among the students					
	Structures/systems that support social interaction					
3.2 What other kinds of social presence resources or support are important for students during online learning?						
3.3 How does social presence enhance the learning process in online learning?						
Cognitive Presence How important is the cognitive presence in realising a digital enabled education						
		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
	Students to be able to explore, integrate and apply the knowledge					
	Collaboration between students and academics					
	Student participation interaction in the learning process					
	Grouping students with different personalities					

	Well-designed tasks for students					
	Teaching presence					
3.4 In your opinion, what can be done to enable/stimulate students to explore, integrate and apply the knowledge in an online environment?						
Kindly share						
Academic Influence How important is the Academic influence in realising digital enabled education						
		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
3.5	Academic's presence in the decision of suitable learning management systems					
Summary of the study objectives, themes, findings and recommendations						
3.6	Digital skills					
3.7	Technical skills					
3.8	Pedagogical digital methods					
3.9 What other academic influences do you think is important for successful online teaching?						
Kindly share						
3.10 What other skills do you think are important for successful online teaching?						
Kindly share						

Learners Presence How important are the following Learners Presence elements in realising digital enabled education						
		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
Students' participation						
3.11	Students' participation and interaction					
3.12	Students' engagement					
3.13 How can student's participation be enhanced in an online environment?						
Kindly share						
Learner Skills						
3.14	Technical skills					

3.15	Digital skills					
	What digital skills do learners in an online environment					
3.16 What other skills do you think are important for students to have to enhance online learning?						
Kindly share						

Management Perspective How important is the following Management Perspective in realising technology enabled education						
		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
3.17	Executives with sufficient knowledge of learning management systems					
3.18	Management buys in purchasing new applications					
3.19	Management support					
Infrastructure How important are the following Infrastructure factors in realising technology enabled education						
		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
3.20	Network infrastructures					
3.21	Reliable network bandwidth, data bandwidth, or digital bandwidth					
3.22	Reliable electricity					
Technology How important are the following technology factors in realising a digital enabled education						
		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
3.23	Intelligent tutoring systems					
3.24	Applications that enable online learning					
3.25	Application that enables effective collaborations between student and teachers					
Culture How important are the following cultural elements in realising a digital enabled education						
		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
3.26	Normalising the blended learning					
3.27	Normalising online learning					
Learning environment How important are the following learning environments in realising a digital enabled education						

		Not Important	Slightly Important	Moderately Important	Important	Very Important
		0	1	2	3	4
3.27	The learner has a conducive and safe environment					
3.28	Environment that cultivates interpersonal relationships between teachers and students					
3.29	Teacher sense humour during teaching					
	Should online learning focus primarily on academic goals?	Yes		No		
Kindly share						

ANNEXURE 5: INITIAL PRODUCED CORRELATIONS: ACADEMIC DATA

Reproduced Correlations

		SCLP1	SCLP2	SCLP3	SCLP4	SCLP5	SCLP6	SCLP7	SCLP8	SCLP9	COGP1	COGP2	COGP3	COGP4	COGP5	COGP6	LNRP1	LNRP2	ACAD1	ACAD2	ACAD3	TECH1	TECH2	TECH3	TECH4	INFR1	INFR2	INFR3	INFR4	ENVR1	ENVR2	ENVR3
Reproduced Correlation	SCLP1	,698[a]	,533	,554	,550	,530	,510	,482	,551	,573	,378	,406	,414	,521	,521	,390	,207	,370	,264	,197	,225	,206	-6,474E-5	,103	,208	,398	,355	,408	,438	,387	,501	,522
	SCLP2	,533	,674[a]	,511	,566	,467	,498	,403	,488	,449	,359	,404	,430	,570	,623	,338	,240	,461	,184	,041	,030	,526	,257	,328	,355	,108	,040	,146	,152	,493	,510	,615
	SCLP3	,554	,511	,820[a]	,752	,779	,793	,702	,700	,773	,636	,677	,702	,596	,460	,618	,442	,297	,156	,119	,235	,265	,268	,416	,559	,246	,249	,303	,320	,362	,692	,562
	SCLP4	,550	,566	,752	,779[a]	,781	,725	,585	,727	,703	,630	,682	,709	,627	,436	,495	,439	,372	,067	,028	,083	,230	,227	,342	,500	,185	,177	,192	,202	,447	,691	,633
	SCLP5	,530	,467	,779	,781	,832[a]	,746	,606	,745	,741	,677	,737	,762	,598	,332	,528	,513	,342	,091	,102	,160	,084	,168	,292	,498	,225	,249	,226	,243	,375	,696	,576
	SCLP6	,510	,498	,793	,725	,746	,779[a]	,684	,667	,726	,576	,624	,656	,549	,440	,596	,410	,250	,103	,059	,167	,271	,238	,387	,521	,157	,155	,211	,229	,295	,639	,504
	SCLP7	,482	,403	,702	,585	,606	,684	,658[a]	,550	,670	,471	,484	,502	,444	,418	,565	,267	,134	,123	,074	,230	,255	,214	,362	,447	,241	,228	,313	,330	,227	,538	,397
	SCLP8	,551	,488	,700	,727	,745	,667	,550	,705[a]	,681	,587	,625	,644	,562	,357	,446	,370	,296	,023	,009	,074	,102	,126	,238	,406	,240	,234	,224	,237	,393	,635	,566
	SCLP9	,573	,449	,773	,703	,741	,726	,670	,681	,783[a]	,659	,665	,670	,583	,421	,583	,389	,275	,181	,163	,312	,186	,269	,405	,542	,410	,414	,461	,471	,418	,694	,574
	COGP1	,378	,359	,636	,630	,677	,576	,471	,587	,659	,755[a]	,763	,756	,602	,299	,471	,550	,432	,265	,287	,376	,169	,447	,513	,655	,397	,444	,449	,438	,557	,711	,642
	COGP2	,406	,404	,677	,682	,737	,624	,484	,625	,665	,763	,810[a]	,818	,636	,317	,497	,645	,509	,306	,333	,367	,169	,393	,466	,644	,320	,378	,367	,366	,527	,727	,651
	COGP3	,414	,430	,702	,709	,762	,656	,502	,644	,670	,756	,818	,833[a]	,644	,331	,513	,666	,517	,296	,317	,337	,184	,373	,454	,640	,265	,322	,310	,314	,502	,729	,647
	COGP4	,521	,570	,596	,627	,598	,549	,444	,562	,583	,602	,636	,644	,655[a]	,525	,429	,457	,556	,335	,270	,285	,387	,374	,440	,534	,319	,312	,373	,373	,602	,661	,704
	COGP5	,521	,623	,460	,436	,332	,440	,418	,357	,421	,299	,317	,331	,525	,691[a]	,382	,182	,444	,357	,193	,224	,637	,339	,414	,378	,220	,150	,321	,326	,475	,457	,560
	COGP6	,390	,338	,618	,495	,528	,596	,565	,446	,583	,471	,497	,513	,429	,382	,539[a]	,366	,234	,277	,246	,354	,275	,277	,397	,479	,240	,256	,338	,353	,237	,506	,378
	LNRP1	,207	,240	,442	,439	,513	,410	,267	,370	,389	,550	,645	,666	,457	,182	,366	,685[a]	,538	,435	,486	,400	,115	,272	,305	,477	,131	,223	,187	,200	,316	,491	,423
	LNRP2	,370	,461	,297	,372	,342	,250	,134	,296	,275	,432	,509	,517	,556	,444	,234	,538	,756[a]	,588	,542	,392	,372	,305	,295	,379	,245	,271	,303	,310	,561	,468	,602
	ACAD1	,264	,184	,156	,067	,091	,103	,123	,023	,181	,265	,306	,296	,335	,357	,277	,435	,588	,824[a]	,808	,723	,311	,265	,266	,295	,404	,459	,542	,561	,322	,268	,314
	ACAD2	,197	,041	,119	,028	,102	,059	,074	,009	,163	,287	,333	,317	,270	,193	,246	,486	,542	,808	,856[a]	,761	,110	,185	,176	,254	,430	,520	,545	,567	,245	,236	,231
	ACAD3	,225	,030	,235	,083	,160	,167	,230	,074	,312	,376	,367	,337	,285	,224	,354	,400	,392	,723	,761	,801[a]	,147	,311	,337	,381	,555	,631	,697	,707	,282	,319	,259
	TECH1	,206	,526	,265	,230	,084	,271	,255	,102	,186	,169	,169	,184	,387	,637	,275	,115	,372	,311	,110	,147	,834[a]	,566	,596	,448	-,001	-,074	,149	,129	,431	,308	,447
	TECH2	-6,474E-5	,257	,268	,227	,168	,238	,214	,126	,269	,447	,393	,373	,374	,339	,277	,272	,305	,265	,185	,311	,566	,770[a]	,768	,672	,195	,196	,340	,289	,530	,425	,473
	TECH3	,103	,328	,416	,342	,292	,387	,362	,238	,405	,513	,466	,454	,440	,414	,397	,305	,295	,266	,176	,337	,596	,768	,804[a]	,730	,220	,218	,377	,334	,526	,511	,515
	TECH4	,208	,355	,559	,500	,498	,521	,447	,406	,542	,655	,644	,640	,534	,378	,479	,477	,379	,295	,254	,381	,448	,672	,730	,757[a]	,260	,289	,387	,359	,532	,629	,580
	INFR1	,398	,108	,246	,185	,225	,157	,241	,240	,410	,397	,320	,265	,319	,220	,240	,131	,245	,404	,430	,555	-,001	,195	,220	,260	,734[a]	,747	,784	,780	,432	,373	,377
	INFR2	,355	,040	,249	,177	,249	,155	,228	,234	,414	,444	,378	,322	,312	,150	,256	,223	,271	,459	,520	,631	-,074	,196	,218	,289	,747	,790[a]	,801	,799	,407	,383	,355
	INFR3	,408	,146	,303	,192	,226	,211	,313	,224	,461	,449	,367	,310	,373	,321	,338	,187	,303	,542	,545	,697	,149	,340	,377	,387	,784	,801	,889[a]	,882	,484	,430	,426
	INFR4	,438	,152	,320	,202	,243	,229	,330	,237	,471	,438	,366	,314	,373	,326	,353	,200	,310	,561	,567	,707	,129	,289	,334	,359	,780	,799	,882	,882[a]	,452	,425	,411
	ENVR1	,387	,493	,362	,447	,375	,295	,227	,393	,418	,557	,527	,502	,602	,475	,237	,316	,561	,322	,245	,282	,431	,530	,526	,532	,432	,407	,484	,452	,770[a]	,590	,743
	ENVR2	,501	,510	,692	,691	,696	,639	,538	,635	,694	,711	,727	,729	,661	,457	,506	,491	,468	,268	,236	,319	,308	,425	,511	,629	,373	,383	,430	,425	,590	,732[a]	,702
	ENVR3	,522	,615	,562	,633	,576	,504	,397	,566	,574	,642	,651	,647	,704	,560	,378	,423	,602	,314	,231	,259	,447	,473	,515	,580	,377	,355	,426	,411	,743	,702	,804[a]
Residual[b]	SCLP1		,052	,051	,011	-,033	-,062	-,100	,006	-,006	,022	-,035	,019	-,096	-,101	-,020	,060	,018	-,005	-,048	,015	-,023	,108	,041	,102	-,013	-,009	,002	-,003	-,097	-,087	-,017
	SCLP2	,052		-,024	,015	,008	,062	-,115	-,086	-,009	,019	,060	,025	-,071	-,158	,055	-,074	-,041	,007	,043	-,006	-,049	,025	,040	,030	-,050	,051	,011	,030	-,013	-,052	-,079
	SCLP3	,051	-,024		-,016	-,038	-,038	-,070	,051	-,005	,032	-,031	-,018	,032	,006	-,116	,020	-,016	,018	-,005	,003	,020	-,001	,034	,030	-,029	,054	-,014	-,008	-,050	-,039	-,016
	SCLP4	,011	,015	-,016		-,007	-,013	-,033	-,036	-,010	-,066	-,033	-,045	-,047	-,053	,003	,009	,018	,022	-,031	,049	-,037	,053	,001	,009	-,040	-,021	,047	,031	-,043	,004	,046
	SCLP5	-,033	,008	-,038	-,007		,019	,012	-,014	-,086	,000	,014	-,017	-,011	,016	-,021	-,056	-,005	-,006	,028	,018	,022	-,017	,014	,003	,023	-,003	,000	,000	,007	-,002	-,016
	SCLP6	-,062	,062	-,038	-,013	,019		-,024	-,083	-,011	-,051	,006	,017	,041	-,087	-,050	-,038	,000	,022	,025	-,029	,005	-,009	,007	-,035	,049	-,011	,024	,006	,019	,014	-,001
	SCLP7	-,100	-,115	-,070	-,033	,012	-,024		,097	-,001	-,037	-,041	-,037	-,018	-,002	-,113	-,024	,088	,017	,029	,030	-,003	,021	-,032	-,054	-,011	,003	-,047	-,039	,100	,055	,041
	SCLP8	,006	-,086	,051	-,036	-,014	-,083	,097		,026	-,007	-,106	-,088	-,056	-,005	-,128	,076	,025	,048	-,022	,074	,021	,062	-,014	,027	-,018	-,016	-,018	-,030	,028	-,041	,013
	SCLP9	-,006	-,009	-,005	-,010	-,086	-,011	-,001	,026		,006	-,043	,001	-,016	-,048	,008	,021	,062	,002	7,618E-5	-,003	,006	,044	-,006	-,059	-,015	-,014	-,022	-,009	,043	-,043	-,021
	COGP1	,022	,019	,032	-,066	,000	-,051	-,037	-,007	,006		-,008	,051	-,004	,039	,052	-,086	-,065	,044	,029	-,008	,028	,007	-,040	-,060	-,013	-,013	-,020	-,046	,027	-,053	-,038
	COGP2	-,035	,060	-,031	-,033	,014	,006	-,041	-,106	-,043	-,008		,042	,073	,027	,069	-,054	-,064	-,034	,023	-,044	,043	-,040	-,013	-,040	,032	,028	-,021	,029	-,022	,007	-,044
	COGP3	,019	,025	-,018	-,045	-,017	,017	-,037	-,088	,001	,051	,042		-,001	,022	,024	-,033	-,095	,024	-,001	-,031	,031	-,022	-,024	-,049	,003	-,022	,018	,007	,017	-,033	,006
	COGP4	-,096	-,071	,032	-,047	-,011	,041	-,018	-,056	-,016	-,004	,073	-,001		,067	-,032	-,077	-,055	-,056	,055	,006	,005	-,049	,014	-,055	-,018	,035	-,022	,003	-,041	-,008	-,024
	COGP5	-,101	-,158	,006	-,053	,016	-,087	-,002	-,005	-,048	,039	,027	,022	,067		,042	,071	-,066	-,047	-,025	-,019	-,021	-,104	-,020	,010	,021	,018	-,001	-,021	,011	,046	,006
	COGP6	-,020	,055	-,116	,003	-,021	-,050	-,113	-,128	,008	,052	,069	,024	-,032	,042		-,062	,054	-,058	,005	-,096	-,062	-,035	-,027	-,007	,074	-,009	-,042	-,006	,079	-,015	-,042
	LNRP1	,060	-,074	,020	,009	-,056	-,038	-,024	,076	,021	-,086	-,054	-,033	-,077	,071	-,062		,048	-,066	-,147	-,025	,054	,006	,012	,031	,038	,012	,074	,058	-,083	-,020	,004
	LNRP2	,018	-,041	-,016	,018	-,005	,000	,088	,025	,062	-,065	-,064	-,095	-,055	-,066	,054	,048		-,083	-,043	-,003	-,021	,038	,061	-,003	,026	,054	-,042	,004	-,006	-,044	-,018
	ACAD1	-,005	,007	,018	,022	-,006	,022	,017	,048	,002	,044	-,034	,024	-,056	-,047	-,058	-,066	-,083		,002	-,025	-,010	,034	-,052	,022	,017	-,054	-,006	-,034	,053	,009	,015
	ACAD2	-,048	,043	-,005	-,031	,028	,025	,029	-,022	7,618E-5	,029	,023	-,001	,055	-,025	,005	-,147	-,043	,002		-,026	-,021	-,024	,015	-,015	-,028	,019	-,038	-,039	,059	,037	-,022
	ACAD3	,015	-,006	,003	,049	,018	-,029	,030	,074	-,003	-,008	-,044	-,031	,006	-,019	-,096	-,025	-,003	-,025	-,026		-,031	,034	,002	-,012	-,062	-,065	,013	-,010	-,007	-,011	,061
	TECH1	-,023	-,049	,020	-,037	,022	,005	-,003	,021	,006	,028	,043	,031	,005	-,021	-,062	,054	-,021	-,010	-,021	-,031		,004	-,056	-,071	,058	,018	,007	,013	-,038	-,001	-,021
	TECH2	,108	,025	-,001	,053	-,017	-,009	,021	,062	,044	,007	-,040	-,022	-,049	-,104	-,035	,006	,038	,034	-,024	,034	,004		-,094	-,032	-,022	,026	-,016	-,021	-,054	-,073	,008
	TECH3	,041	,040	,034	,001	,014	,007	-,032	-,014	-,006	-,040	-,013	-,024	,014	-,020	-,027	,012	,061	-,052	,015	,002	-,056	-,094		,003	-,032	,031	-,009	,029	-,006	-,040	-,037
	TECH4	,102	,030	,030	,009	,003	-,035	-,054	,027	-,059	-,060	-,040	-,049	-,055	,010	-,007	,031	-,003	,022	-,015	-,012	-,071	-,032	,003		,040	-,015	,008	-,030	-,041	,011	,010
	INFR1	-,013	-,050	-,029	-,040	,023	,049	-,011	-,018	-,015	-,013	,032	,003	-,018	,021	,074	,038	,026	,017	-,028	-,062	,058	-,022	-,032	,040		-,047	-,046	-,094	,012	-,033	-,032
	INFR2	-,009	,051	,054	-,021	-,003	-,011	,003	-,016	-,014	-,013	,028	-,022	,035	,018	-,009	,012	,054	-,054	,019	-,065	,018	,026	,031	-,015	-,047		-,063	,002	-,049	-,019	-,081
	INFR3	,002	,011	-,014	,047	,000	,024	-,047	-,018	-,022	-,020	-,021	,018	-,022	-,001	-,042	,074	-,042	-,006	-,038	,013	,007	-,016	-,009	,008	-,046	-,063		,056	-,055	,012	,066
	INFR4	-,003	,030	-,008	,031	,000	,006	-,039	-,030	-,009	-,046	,029	,007	,003	-,021	-,006	,058	,004	-,034	-,039	-,010	,013	-,021	,029	-,030	-,094	,002	,056		-,034	,012	,004
	ENVR1	-,097	-,013	-,050	-,043	,007	,019	,100	,028	,043	,027	-,022	,017	-,041	,011	,079	-,083	-,006	,053	,059	-,007	-,038	-,054	-,006	-,041	,012	-,049	-,055	-,034		,020	-,070
	ENVR2	-,087	-,052	-,039	,004	-,002	,014	,055	-,041	-,043	-,053	,007	-,033	-,008	,046	-,015	-,020	-,044	,009	,037	-,011	-,001	-,073	-,040	,011	-,033	-,019	,012	,012	,020		,044
	ENVR3	-,017	-,079	-,016	,046	-,016	-,001	,041	,013	-,021	-,038	-,044	,006	-,024	,006	-,042	,004	-,018	,015	-,022	,061	-,021	,008	-,037	,010	-,032	-,081	,066	,004	-,070	,044	

Extraction Method: Principal Component Analysis.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 107 (23,0%) nonredundant residuals with absolute values greater than 0.05.

ANNEXURE 6: FINAL REPRODUCED CORRELATIONS: ACADEMIC DATA

Reproduced Correlations

		SCLP1	SCLP3	SCLP4	SCLP5	SCLP6	SCLP7	SCLP8	SCLP9	COGP1	COGP2	COGP3	COGP4	COGP6	LNRP1	LNRP2	ACAD1	ACAD3	TECH1	TECH2	TECH3	TECH4	INFR1	INFR2	INFR3	INFR4	ENVR2	ENVR3
Reproduced Correlation	SCLP1	,709[a]	,565	,561	,514	,495	,526	,611	,589	,358	,363	,390	,494	,299	,262	,417	,292	,280	,209	,062	,107	,223	,398	,354	,426	,445	,496	,553
	SCLP3	,565	,793[a]	,766	,777	,760	,671	,726	,765	,655	,680	,700	,634	,551	,408	,335	,123	,190	,268	,294	,418	,553	,276	,267	,312	,320	,719	,633
	SCLP4	,561	,766	,775[a]	,773	,733	,620	,736	,709	,609	,661	,697	,626	,490	,461	,397	,112	,122	,258	,232	,338	,497	,175	,164	,193	,205	,686	,632
	SCLP5	,514	,777	,773	,835[a]	,746	,607	,736	,740	,683	,743	,765	,604	,546	,499	,325	,080	,149	,080	,158	,294	,497	,228	,248	,222	,240	,701	,568
	SCLP6	,495	,760	,733	,746	,742[a]	,647	,689	,722	,612	,636	,656	,580	,528	,349	,250	,031	,104	,248	,273	,403	,523	,198	,186	,224	,229	,671	,568
	SCLP7	,526	,671	,620	,607	,647	,630[a]	,611	,669	,482	,468	,480	,499	,453	,179	,177	,047	,133	,268	,240	,352	,419	,277	,240	,314	,319	,574	,508
	SCLP8	,611	,726	,736	,736	,689	,611	,732[a]	,690	,531	,575	,611	,571	,439	,383	,350	,094	,109	,171	,107	,210	,376	,214	,193	,212	,231	,624	,576
	SCLP9	,589	,765	,709	,740	,722	,669	,690	,782[a]	,656	,659	,662	,605	,563	,358	,294	,179	,294	,202	,270	,399	,527	,417	,414	,459	,469	,703	,601
	COGP1	,358	,655	,609	,683	,612	,482	,531	,656	,747[a]	,781	,769	,589	,571	,558	,384	,291	,399	,173	,401	,512	,654	,374	,429	,436	,437	,693	,568
	COGP2	,363	,680	,661	,743	,636	,468	,575	,659	,781	,844[a]	,842	,623	,573	,658	,453	,296	,373	,144	,370	,479	,661	,318	,384	,366	,370	,720	,596
	COGP3	,390	,700	,697	,765	,656	,480	,611	,662	,769	,842	,850[a]	,640	,559	,676	,484	,281	,331	,167	,353	,458	,649	,271	,329	,312	,318	,726	,620
	COGP4	,494	,634	,626	,604	,580	,499	,571	,605	,589	,623	,640	,609[a]	,444	,499	,510	,332	,327	,368	,392	,452	,558	,290	,292	,364	,364	,643	,652
	COGP6	,299	,551	,490	,546	,528	,453	,439	,563	,571	,573	,559	,444	,475[a]	,319	,183	,134	,260	,143	,310	,419	,505	,305	,331	,352	,351	,544	,420
	LNRP1	,262	,408	,461	,499	,349	,179	,383	,358	,558	,658	,676	,499	,319	,729[a]	,627	,430	,363	,140	,272	,287	,471	,175	,245	,216	,222	,507	,515
	LNRP2	,417	,335	,397	,325	,250	,177	,350	,294	,384	,453	,484	,510	,183	,627	,779[a]	,598	,438	,397	,343	,289	,394	,232	,246	,321	,320	,442	,614
	ACAD1	,292	,123	,112	,080	,031	,047	,094	,179	,291	,296	,281	,332	,134	,430	,598	,680[a]	,628	,270	,339	,277	,313	,464	,496	,579	,574	,286	,426
	ACAD3	,280	,190	,122	,149	,104	,133	,109	,294	,399	,373	,331	,327	,260	,363	,438	,628	,697[a]	,156	,347	,339	,376	,615	,664	,729	,724	,345	,380
	TECH1	,209	,268	,258	,080	,248	,268	,171	,202	,173	,144	,167	,368	,143	,140	,397	,270	,156	,796[a]	,647	,603	,467	,009	-,058	,163	,126	,313	,501
	TECH2	,062	,294	,232	,158	,273	,240	,107	,270	,401	,370	,353	,392	,310	,272	,343	,339	,347	,647	,758[a]	,760	,655	,172	,172	,341	,300	,409	,469
	TECH3	,107	,418	,338	,294	,403	,352	,210	,399	,512	,479	,458	,452	,419	,287	,289	,277	,339	,603	,760	,803[a]	,724	,214	,220	,373	,335	,507	,502
	TECH4	,223	,553	,497	,497	,523	,419	,376	,527	,654	,661	,649	,558	,505	,471	,394	,313	,376	,467	,655	,724	,748[a]	,263	,293	,388	,365	,629	,583
	INFR1	,398	,276	,175	,228	,198	,277	,214	,417	,374	,318	,271	,290	,305	,175	,232	,464	,615	,009	,172	,214	,263	,697[a]	,724	,772	,779	,346	,312
	INFR2	,354	,267	,164	,248	,186	,240	,193	,414	,429	,384	,329	,292	,331	,245	,246	,496	,664	-,058	,172	,220	,293	,724	,774[a]	,795	,804	,361	,298
	INFR3	,426	,312	,193	,222	,224	,314	,212	,459	,436	,366	,312	,364	,352	,216	,321	,579	,729	,163	,341	,373	,388	,772	,795	,892[a]	,890	,416	,413
	INFR4	,445	,320	,205	,240	,229	,319	,231	,469	,437	,370	,318	,364	,351	,222	,320	,574	,724	,126	,300	,335	,365	,779	,804	,890	,891[a]	,417	,408
	ENVR2	,496	,719	,686	,701	,671	,574	,624	,703	,693	,720	,726	,643	,544	,507	,442	,286	,345	,313	,409	,507	,629	,346	,361	,416	,417	,717[a]	,658
	ENVR3	,553	,633	,632	,568	,568	,508	,576	,601	,568	,596	,620	,652	,420	,515	,614	,426	,380	,501	,469	,502	,583	,312	,298	,413	,408	,658	,731[a]
Residual[b]	SCLP1		,040	-,001	-,018	-,047	-,144	-,054	-,022	,042	,008	,042	-,069	,071	,005	-,029	-,032	-,040	-,025	,045	,037	,088	-,013	-,007	-,015	-,010	-,082	-,048
	SCLP3	,040		-,031	-,036	-,004	-,039	,024	,003	,013	-,034	-,015	-,005	-,049	,054	-,054	,050	,047	,016	-,026	,032	,037	-,059	,035	-,023	-,008	-,066	-,087
	SCLP4	-,001	-,031		-1,250E-5	-,021	-,069	-,045	-,016	-,045	-,012	-,032	-,046	,008	-,013	-,007	-,024	,009	-,064	,047	,005	,012	-,030	-,009	,045	,028	,009	,048
	SCLP5	-,018	-,036	-1,250E-5		,019	,011	-,004	-,085	-,006	,007	-,020	-,017	-,039	-,043	,013	,005	,029	,025	-,006	,012	,005	,020	-,002	,004	,004	-,006	-,008
	SCLP6	-,047	-,004	-,021	,019		,013	-,105	-,007	-,087	-,005	,018	,010	,018	,023	,000	,095	,034	,028	-,044	-,008	-,037	,007	-,043	,011	,005	-,018	-,065
	SCLP7	-,144	-,039	-,069	,011	,013		,037	-,001	-,048	-,025	-,015	-,072	-,001	,064	,045	,093	,126	-,015	-,006	-,022	-,026	-,047	-,009	-,048	-,028	,018	-,070
	SCLP8	-,054	,024	-,045	-,004	-,105	,037		,017	,049	-,056	-,055	-,065	-,120	,064	-,028	-,023	,039	-,049	,081	,015	,058	,008	,024	-,006	-,024	-,030	,004
	SCLP9	-,022	,003	-,016	-,085	-,007	-,001	,017		,008	-,036	,009	-,038	,028	,051	,043	,004	,015	-,010	,043	-,001	-,045	-,022	-,014	-,020	-,007	-,053	-,048
	COGP1	,042	,013	-,045	-,006	-,087	-,048	,049	,008		-,026	,038	,008	-,047	-,094	-,017	,018	-,031	,024	,052	-,038	-,060	,011	,002	-,006	-,045	-,035	,035
	COGP2	,008	-,034	-,012	,007	-,005	-,025	-,056	-,036	-,026		,018	,086	-,007	-,068	-,008	-,023	-,050	,068	-,017	-,026	-,057	,034	,022	-,020	,025	,015	,011
	COGP3	,042	-,015	-,032	-,020	,018	-,015	-,055	,009	,038	,018		,003	-,022	-,043	-,063	,039	-,025	,048	-,003	-,028	-,057	-,003	-,028	,016	,003	-,030	,033
	COGP4	-,069	-,005	-,046	-,017	,010	-,072	-,065	-,038	,008	,086	,003		-,047	-,120	-,009	-,053	-,036	,024	-,067	,002	-,079	,012	,056	-,013	,013	,010	,028
	COGP6	,071	-,049	,008	-,039	,018	-,001	-,120	,028	-,047	-,007	-,022	-,047		-,015	,105	,085	-,002	,069	-,068	-,049	-,032	,009	-,085	-,056	-,005	-,054	-,084
	LNRP1	,005	,054	-,013	-,043	,023	,064	,064	,051	-,094	-,068	-,043	-,120	-,015		-,040	-,061	,012	,029	,006	,030	,038	-,006	-,010	,045	,036	-,035	-,087
	LNRP2	-,029	-,054	-,007	,013	,000	,045	-,028	,043	-,017	-,008	-,063	-,009	,105	-,040		-,093	-,049	-,046	,000	,066	-,018	,039	,078	-,059	-,006	-,018	-,030
	ACAD1	-,032	,050	-,024	,005	,095	,093	-,023	,004	,018	-,023	,039	-,053	,085	-,061	-,093		,070	,030	-,040	-,063	,004	-,043	-,091	-,043	-,047	-,009	-,097
	ACAD3	-,040	,047	,009	,029	,034	,126	,039	,015	-,031	-,050	-,025	-,036	-,002	,012	-,049	,070		-,039	-,001	,000	-,007	-,122	-,098	-,018	-,027	-,037	-,060
	TECH1	-,025	,016	-,064	,025	,028	-,015	-,049	-,010	,024	,068	,048	,024	,069	,029	-,046	,030	-,039		-,078	-,063	-,090	,048	,003	-,007	,015	-,006	-,075
	TECH2	,045	-,026	,047	-,006	-,044	-,006	,081	,043	,052	-,017	-,003	-,067	-,068	,006	,000	-,040	-,001	-,078		-,086	-,014	,001	,051	-,017	-,031	-,057	,011
	TECH3	,037	,032	,005	,012	-,008	-,022	,015	-,001	-,038	-,026	-,028	,002	-,049	,030	,066	-,063	,000	-,063	-,086		,009	-,025	,029	-,005	,028	-,036	-,024
	TECH4	,088	,037	,012	,005	-,037	-,026	,058	-,045	-,060	-,057	-,057	-,079	-,032	,038	-,018	,004	-,007	-,090	-,014	,009		,037	-,019	,007	-,036	,011	,006
	INFR1	-,013	-,059	-,030	,020	,007	-,047	,008	-,022	,011	,034	-,003	,012	,009	-,006	,039	-,043	-,122	,048	,001	-,025	,037		-,024	-,034	-,093	-,007	,034
	INFR2	-,007	,035	-,009	-,002	-,043	-,009	,024	-,014	,002	,022	-,028	,056	-,085	-,010	,078	-,091	-,098	,003	,051	,029	-,019	-,024		-,058	-,004	,003	-,024
	INFR3	-,015	-,023	,045	,004	,011	-,048	-,006	-,020	-,006	-,020	,016	-,013	-,056	,045	-,059	-,043	-,018	-,007	-,017	-,005	,007	-,034	-,058		,048	,027	,079
	INFR4	-,010	-,008	,028	,004	,005	-,028	-,024	-,007	-,045	,025	,003	,013	-,005	,036	-,006	-,047	-,027	,015	-,031	,028	-,036	-,093	-,004	,048		,020	,006
	ENVR2	-,082	-,066	,009	-,006	-,018	,018	-,030	-,053	-,035	,015	-,030	,010	-,054	-,035	-,018	-,009	-,037	-,006	-,057	-,036	,011	-,007	,003	,027	,020		,089
	ENVR3	-,048	-,087	,048	-,008	-,065	-,070	,004	-,048	,035	,011	,033	,028	-,084	-,087	-,030	-,097	-,060	-,075	,011	-,024	,006	,034	-,024	,079	,006	,089	

Extraction Method: Principal Component Analysis.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 80 (22,0%) nonredundant residuals with absolute values greater than 0.05.

ANNEXURE 7: INITIAL PRODUCED CORRELATIONS: STUDENTS' DATASET

Reproduced Correlations

		SSCLP1	SSCLP2	SSCLP3	SSCLP4	SSCLP5	SSCLP6	SSCLP7	SSCLP8	SSCLP9	SCOGP1	SCOGP2	SCOGP3	SCOGP4	SCOGP5	SCOGP6	SCOGP7	SLRNP1	SLRNP2	SSKLS1	SSKLS2	SSKLS3	STECH1	STECH2	STECH3	STECH4	SINFR1	SINFR2	SINFR3	SINFR4	SENVR1	SENVR2
Reproduced Correlation	SSCLP1	,729[a]	,704	,471	,416	,340	,565	,553	,246	,451	,321	,364	,148	,348	,180	,368	,089	,242	-,009	,273	,330	,324	,419	,267	,216	,181	-,049	-,153	-,061	,002	,143	,193
	SSCLP2	,704	,764[a]	,399	,355	,318	,513	,464	,099	,304	,237	,276	,043	,218	,087	,314	,036	,275	,038	,191	,287	,305	,487	,248	,298	,125	-,078	-,165	-,059	,005	,194	,095
	SSCLP3	,471	,399	,762[a]	,375	,380	,580	,449	,388	,257	,400	,240	,257	,177	,089	-,007	-,030	,452	,211	,317	,104	,121	,365	,430	,033	,213	,278	,061	,062	,124	,257	,215
	SSCLP4	,416	,355	,375	,737[a]	,715	,640	,645	,575	,545	,291	,341	,188	,290	-,037	,081	,313	,301	,232	-,080	,220	,200	,140	,258	,205	,268	,094	,048	,130	,110	,228	,217
	SSCLP5	,340	,318	,380	,715	,753[a]	,633	,617	,559	,465	,303	,294	,203	,218	-,067	,011	,313	,404	,408	-,065	,244	,247	,206	,322	,299	,329	,204	,149	,224	,189	,361	,229
	SSCLP6	,565	,513	,580	,640	,633	,719[a]	,652	,496	,486	,449	,432	,315	,348	,035	,127	,272	,451	,297	,180	,311	,300	,329	,358	,195	,300	,163	,012	,081	,102	,285	,209
	SSCLP7	,553	,464	,449	,645	,617	,652	,721[a]	,573	,647	,393	,399	,277	,414	,201	,306	,279	,315	,265	,211	,430	,422	,315	,367	,329	,409	,168	,103	,186	,177	,320	,397
	SSCLP8	,246	,099	,388	,575	,559	,496	,573	,664[a]	,572	,271	,219	,220	,271	,117	,063	,176	,266	,253	,132	,268	,251	,032	,284	,134	,325	,210	,150	,183	,146	,269	,420
	SSCLP9	,451	,304	,257	,545	,465	,486	,647	,572	,721[a]	,278	,342	,217	,442	,257	,362	,250	,129	,093	,234	,465	,427	,100	,197	,218	,334	,044	,034	,111	,089	,187	,443
	SCOGP1	,321	,237	,400	,291	,303	,449	,393	,271	,278	,715[a]	,652	,692	,592	,352	,350	,450	,267	,374	,303	,323	,316	,366	,482	,203	,471	,125	-,071	-,061	-,105	,075	,186
	SCOGP2	,364	,276	,240	,341	,294	,432	,399	,219	,342	,652	,739[a]	,657	,663	,263	,398	,593	,128	,190	,180	,320	,269	,240	,271	,099	,362	-,009	-,145	-,113	-,139	-,090	,040
	SCOGP3	,148	,043	,257	,188	,203	,315	,277	,220	,217	,692	,657	,746[a]	,601	,330	,306	,540	,184	,366	,292	,309	,280	,234	,364	,104	,451	,165	-,003	-,023	-,075	,004	,121
	SCOGP4	,348	,218	,177	,290	,218	,348	,414	,271	,442	,592	,663	,601	,686[a]	,423	,524	,498	,013	,120	,245	,377	,334	,213	,297	,162	,413	-,042	-,133	-,099	-,145	-,088	,216
	SCOGP5	,180	,087	,089	-,037	-,067	,035	,201	,117	,257	,352	,263	,330	,423	,659[a]	,601	,075	-,154	,076	,290	,257	,296	,347	,453	,377	,459	,027	,023	,026	-,044	,026	,449
	SCOGP6	,368	,314	-,007	,081	,011	,127	,306	,063	,362	,350	,398	,306	,524	,601	,733[a]	,225	-,190	-,009	,218	,362	,377	,385	,343	,434	,420	-,117	-,080	-,023	-,075	-,027	,345
	SCOGP7	,089	,036	-,030	,313	,313	,272	,279	,176	,250	,450	,593	,540	,498	,075	,225	,699[a]	,058	,260	-,012	,268	,207	,071	,069	,092	,323	,132	,118	,133	,093	-,032	-,066
	SLRNP1	,242	,275	,452	,301	,404	,451	,315	,266	,129	,267	,128	,184	,013	-,154	-,190	,058	,604[a]	,492	,295	,289	,309	,235	,228	,130	,154	,258	,067	,094	,114	,437	,101
	SLRNP2	-,009	,038	,211	,232	,408	,297	,265	,253	,093	,374	,190	,366	,120	,076	-,009	,260	,492	,759[a]	,224	,372	,428	,326	,413	,438	,461	,387	,280	,291	,210	,526	,248
	SSKLS1	,273	,191	,317	-,080	-,065	,180	,211	,132	,234	,303	,180	,292	,245	,290	,218	-,012	,295	,224	,712[a]	,502	,499	,238	,165	,073	,225	,212	,055	,045	,085	,265	,304
	SSKLS2	,330	,287	,104	,220	,244	,311	,430	,268	,465	,323	,320	,309	,377	,257	,362	,268	,289	,372	,502	,694[a]	,684	,236	,162	,348	,368	,113	,053	,119	,092	,355	,359
	SSKLS3	,324	,305	,121	,200	,247	,300	,422	,251	,427	,316	,269	,280	,334	,296	,377	,207	,309	,428	,499	,684	,698[a]	,315	,246	,443	,411	,138	,081	,149	,110	,419	,407
	STECH1	,419	,487	,365	,140	,206	,329	,315	,032	,100	,366	,240	,234	,213	,347	,385	,071	,235	,326	,238	,236	,315	,689[a]	,543	,531	,429	,241	,179	,216	,218	,333	,243
	STECH2	,267	,248	,430	,258	,322	,358	,367	,284	,197	,482	,271	,364	,297	,453	,343	,069	,228	,413	,165	,162	,246	,543	,718[a]	,507	,538	,193	,085	,103	,026	,287	,424
	STECH3	,216	,298	,033	,205	,299	,195	,329	,134	,218	,203	,099	,104	,162	,377	,434	,092	,130	,438	,073	,348	,443	,531	,507	,755[a]	,513	,138	,200	,274	,180	,428	,420
	STECH4	,181	,125	,213	,268	,329	,300	,409	,325	,334	,471	,362	,451	,413	,459	,420	,323	,154	,461	,225	,368	,411	,429	,538	,513	,618[a]	,311	,288	,304	,220	,317	,436
	SINFR1	-,049	-,078	,278	,094	,204	,163	,168	,210	,044	,125	-,009	,165	-,042	,027	-,117	,132	,258	,387	,212	,113	,138	,241	,193	,138	,311	,692[a]	,700	,635	,671	,418	,165
	SINFR2	-,153	-,165	,061	,048	,149	,012	,103	,150	,034	-,071	-,145	-,003	-,133	,023	-,080	,118	,067	,280	,055	,053	,081	,179	,085	,200	,288	,700	,840[a]	,779	,808	,396	,165
	SINFR3	-,061	-,059	,062	,130	,224	,081	,186	,183	,111	-,061	-,113	-,023	-,099	,026	-,023	,133	,094	,291	,045	,119	,149	,216	,103	,274	,304	,635	,779	,746[a]	,769	,426	,195
	SINFR4	,002	,005	,124	,110	,189	,102	,177	,146	,089	-,105	-,139	-,075	-,145	-,044	-,075	,093	,114	,210	,085	,092	,110	,218	,026	,180	,220	,671	,808	,769	,837[a]	,414	,126
	SENVR1	,143	,194	,257	,228	,361	,285	,320	,269	,187	,075	-,090	,004	-,088	,026	-,027	-,032	,437	,526	,265	,355	,419	,333	,287	,428	,317	,418	,396	,426	,414	,616[a]	,336
	SENVR2	,193	,095	,215	,217	,229	,209	,397	,420	,443	,186	,040	,121	,216	,449	,345	-,066	,101	,248	,304	,359	,407	,243	,424	,420	,436	,165	,165	,195	,126	,336	,618[a]
Residual[b]	SSCLP1		-,059	-,098	-,020	,005	-,087	-,022	-,062	,006	,023	,031	,065	,003	,017	-,080	-,027	,067	,010	-,097	-,075	,027	-,045	-,028	-,037	,022	,057	-,001	,006	-,018	,041	,122
	SSCLP2	-,059		-,042	-,033	-,043	-,030	,014	,048	-,007	-,043	-,047	-,001	,040	,010	-,035	,049	-,019	,074	,013	-,029	-,041	-,096	,035	-,037	,064	,068	-,004	-,029	-,011	-,031	,032
	SSCLP3	-,098	-,042		-,051	-,016	,027	-,010	,023	,011	-,032	-,012	-,048	,031	,020	,033	,067	-,065	,024	-,035	,019	,061	,017	-,064	,068	-,053	-,102	,016	,052	-,029	,026	-,071
	SSCLP4	-,020	-,033	-,051		-,037	-,065	,030	-,054	-,097	-,001	,013	,012	,003	,049	,009	-,064	,031	-,008	,071	-,005	,033	,026	,010	-,034	-,032	-,009	,002	,020	,018	-,035	-,007
	SSCLP5	,005	-,043	-,016	-,037		,032	-,088	-,088	,033	-,014	,035	,056	-,081	-,016	,022	-,062	-,085	-,096	,097	,113	-,080	-,025	,050	,038	-,003	,059	,034	-,022	-,055	,009	-,042
	SSCLP6	-,087	-,030	,027	-,065	,032		-,073	-,030	-,025	,033	-,049	,030	-,044	-,035	,036	-,060	-,091	-,059	-,006	,096	,038	-,049	,029	,020	,047	-,074	,039	,020	,019	-,031	-,046
	SSCLP7	-,022	,014	-,010	,030	-,088	-,073		,001	-,062	-,014	-,080	,004	,060	,047	-,040	-,021	-,025	,099	-,013	-,033	,015	,034	-,053	-,017	-,003	,038	-,005	-,039	-,010	-,041	-,062
	SSCLP8	-,062	,048	,023	-,054	-,088	-,030	,001		-,092	-,047	,025	-,063	,025	-,048	,033	,067	-,074	,074	,063	-,027	-,004	,129	-,040	,050	-,050	-,040	-,045	-,012	,034	-,019	-,080
	SSCLP9	,006	-,007	,011	-,097	,033	-,025	-,062	-,092		,007	-,028	-,004	-,032	,037	,028	,045	,097	,018	-,014	-,083	-,055	-,019	,003	,035	-,003	,065	-,022	-,030	-,017	,034	-,064
	SCOGP1	,023	-,043	-,032	-,001	-,014	,033	-,014	-,047	,007		-,056	-,067	-,060	,030	-,034	-,036	,014	-,080	-,096	,096	,019	-,029	,009	-,036	-,007	-,050	-,007	,055	,041	,027	,005
	SCOGP2	,031	-,047	-,012	,013	,035	-,049	-,080	,025	-,028	-,056		-,002	-,087	-,084	,017	-,048	,024	-,048	,044	-,025	-,006	,016	,004	,041	-,019	-,027	,004	,018	,018	,007	,114
	SCOGP3	,065	-,001	-,048	,012	,056	,030	,004	-,063	-,004	-,067	-,002		-,046	-,058	,005	-,129	-,045	-,031	,003	-,029	,003	-,050	-,041	,060	,005	,036	-,003	,007	-,008	,006	,041
	SCOGP4	,003	,040	,031	,003	-,081	-,044	,060	,025	-,032	-,060	-,087	-,046		,040	-,105	-,024	-,011	,112	-,054	-,052	,014	,037	-,061	-,003	-,033	,007	-,033	,047	-,015	,029	-,020
	SCOGP5	,017	,010	,020	,049	-,016	-,035	,047	-,048	,037	,030	-,084	-,058	,040		-,030	,044	,139	,060	-,046	-,059	,017	-,107	-,031	-,005	-,100	-,027	,012	,036	,004	,049	-,168
	SCOGP6	-,080	-,035	,033	,009	,022	,036	-,040	,033	,028	-,034	,017	,005	-,105	-,030		,034	,087	-,008	,041	-,024	-,056	-,020	,003	-,001	-,061	,004	,043	-,069	,002	,051	-,050
	SCOGP7	-,027	,049	,067	-,064	-,062	-,060	-,021	,067	,045	-,036	-,048	-,129	-,024	,044	,034		,071	-,001	,026	-,065	-,047	,012	,053	-,030	-,042	-,027	-,008	-,056	-,006	,094	,038
	SLRNP1	,067	-,019	-,065	,031	-,085	-,091	-,025	-,074	,097	,014	,024	-,045	-,011	,139	,087	,071		-,017	-,079	-,127	-,040	-,088	,002	-,027	-,030	-,029	-,011	,030	,066	-,010	,064
	SLRNP2	,010	,074	,024	-,008	-,096	-,059	,099	,074	,018	-,080	-,048	-,031	,112	,060	-,008	-,001	-,017		-,009	-,105	,009	,018	-,072	-,011	-,045	,019	-,018	,004	,002	-,085	-,046
	SSKLS1	-,097	,013	-,035	,071	,097	-,006	-,013	,063	-,014	-,096	,044	,003	-,054	-,046	,041	,026	-,079	-,009		,008	-,151	,023	,058	,118	-,025	-,007	-,030	-,013	,010	-,042	-,092
	SSKLS2	-,075	-,029	,019	-,005	,113	,096	-,033	-,027	-,083	,096	-,025	-,029	-,052	-,059	-,024	-,065	-,127	-,105	,008		-,060	,019	,107	-,023	,011	-,044	,059	,022	-,012	-,069	-,030
	SSKLS3	,027	-,041	,061	,033	-,080	,038	,015	-,004	-,055	,019	-,006	,003	,014	,017	-,056	-,047	-,040	,009	-,151	-,060		,011	,009	-,055	-,021	-,006	,013	,038	,004	-,078	,000
	STECH1	-,045	-,096	,017	,026	-,025	-,049	,034	,129	-,019	-,029	,016	-,050	,037	-,107	-,020	,012	-,088	,018	,023	,019	,011		-,100	-,054	,020	-,016	-,029	-,032	-,030	-,004	,016
	STECH2	-,028	,035	-,064	,010	,050	,029	-,053	-,040	,003	,009	,004	-,041	-,061	-,031	,003	,053	,002	-,072	,058	,107	,009	-,100		-,029	-,086	,004	,036	-,006	,043	-,073	-,014
	STECH3	-,037	-,037	,068	-,034	,038	,020	-,017	,050	,035	-,036	,041	,060	-,003	-,005	-,001	-,030	-,027	-,011	,118	-,023	-,055	-,054	-,029		-,106	-,012	-,057	,059	,029	-,054	-,093
	STECH4	,022	,064	-,053	-,032	-,003	,047	-,003	-,050	-,003	-,007	-,019	,005	-,033	-,100	-,061	-,042	-,030	-,045	-,025	,011	-,021	,020	-,086	-,106		,029	-,001	-,072	-,027	,002	,069
	SINFR1	,057	,068	-,102	-,009	,059	-,074	,038	-,040	,065	-,050	-,027	,036	,007	-,027	,004	-,027	-,029	,019	-,007	-,044	-,006	-,016	,004	-,012	,029		-,029	-,132	-,088	-,015	,006
	SINFR2	-,001	-,004	,016	,002	,034	,039	-,005	-,045	-,022	-,007	,004	-,003	-,033	,012	,043	-,008	-,011	-,018	-,030	,059	,013	-,029	,036	-,057	-,001	-,029		-,069	-,065	,028	-,009
	SINFR3	,006	-,029	,052	,020	-,022	,020	-,039	-,012	-,030	,055	,018	,007	,047	,036	-,069	-,056	,030	,004	-,013	,022	,038	-,032	-,006	,059	-,072	-,132	-,069		,009	-,083	,010
	SINFR4	-,018	-,011	-,029	,018	-,055	,019	-,010	,034	-,017	,041	,018	-,008	-,015	,004	,002	-,006	,066	,002	,010	-,012	,004	-,030	,043	,029	-,027	-,088	-,065	,009		-,053	,012
	SENVR1	,041	-,031	,026	-,035	,009	-,031	-,041	-,019	,034	,027	,007	,006	,029	,049	,051	,094	-,010	-,085	-,042	-,069	-,078	-,004	-,073	-,054	,002	-,015	,028	-,083	-,053		,002
	SENVR2	,122	,032	-,071	-,007	-,042	-,046	-,062	-,080	-,064	,005	,114	,041	-,020	-,168	-,050	,038	,064	-,046	-,092	-,030	,000	,016	-,014	-,093	,069	,006	-,009	,010	,012	,002	

Extraction Method: Principal Component Analysis.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 139 (29,0%) nonredundant residuals with absolute values greater than 0.05.

ANNEXURE 8: FINAL REPRODUCED CORRELATIONS: STUDENTS' DATASET

Reproduced Correlations

		SSCLP4	SSCLP7	SSCLP8	SSCLP9	SCOGP1	SCOGP2	SCOGP3	SCOGP4	SLRNP1	SLRNP2	SSKLS1	SSKLS2	SSKLS3	STECH1	STECH2	STECH3	STECH4	SINFR1	SINFR2	SINFR3	SINFR4	SENVR2
Reproduced Correlation	SSCLP4	,753[a]	,693	,634	,553	,309	,323	,189	,350	,378	,289	-,057	,127	,209	,137	,258	,159	,255	,116	,031	,124	,122	,260
	SSCLP7	,693	,751[a]	,654	,649	,396	,386	,284	,448	,354	,361	,172	,389	,437	,268	,357	,321	,420	,169	,091	,195	,170	,430
	SSCLP8	,634	,654	,601[a]	,583	,236	,251	,140	,319	,290	,251	,083	,277	,320	,142	,215	,211	,285	,154	,121	,211	,204	,344
	SSCLP9	,553	,649	,583	,679[a]	,270	,330	,201	,439	,152	,134	,233	,460	,435	,101	,157	,193	,306	,037	,016	,112	,088	,406
	SCOGP1	,309	,396	,236	,270	,708[a]	,668	,712	,602	,255	,383	,272	,337	,334	,359	,445	,217	,489	,128	-,079	-,061	-,110	,190
	SCOGP2	,323	,386	,251	,330	,668	,706[a]	,705	,663	,106	,200	,206	,300	,254	,209	,302	,069	,414	,029	-,149	-,137	-,183	,138
	SCOGP3	,189	,284	,140	,201	,712	,705	,798[a]	,619	,152	,308	,299	,325	,274	,273	,334	,087	,473	,205	,010	-,018	-,056	,098
	SCOGP4	,350	,448	,319	,439	,602	,663	,619	,681[a]	-,002	,120	,209	,373	,312	,212	,294	,135	,444	-,025	-,143	-,107	-,169	,252
	SLRNP1	,378	,354	,290	,152	,255	,106	,152	-,002	,807[a]	,605	,272	,178	,296	,169	,234	,125	,059	,275	,049	,091	,146	,031
	SLRNP2	,289	,361	,251	,134	,383	,200	,308	,120	,605	,667[a]	,303	,278	,386	,438	,468	,390	,379	,425	,263	,291	,293	,228
	SSKLS1	-,057	,172	,083	,233	,272	,206	,299	,209	,272	,303	,658[a]	,631	,561	,172	,126	,185	,231	,165	,055	,068	,066	,228
	SSKLS2	,127	,389	,277	,460	,337	,300	,325	,373	,178	,278	,631	,736[a]	,664	,264	,236	,332	,392	,125	,061	,117	,081	,430
	SSKLS3	,209	,437	,320	,435	,334	,254	,274	,312	,296	,386	,561	,664	,646[a]	,342	,333	,414	,407	,161	,081	,153	,118	,448
	STECH1	,137	,268	,142	,101	,359	,209	,273	,212	,169	,438	,172	,264	,342	,572[a]	,584	,574	,521	,211	,163	,209	,137	,384
	STECH2	,258	,357	,215	,157	,445	,302	,334	,294	,234	,468	,126	,236	,333	,584	,634[a]	,567	,533	,157	,069	,131	,055	,378
	STECH3	,159	,321	,211	,193	,217	,069	,087	,135	,125	,390	,185	,332	,414	,574	,567	,666[a]	,503	,162	,180	,260	,181	,504
	STECH4	,255	,420	,285	,306	,489	,414	,473	,444	,059	,379	,231	,392	,407	,521	,533	,503	,657[a]	,319	,291	,322	,246	,448
	SINFR1	,116	,169	,154	,037	,128	,029	,205	-,025	,275	,425	,165	,125	,161	,211	,157	,162	,319	,706[a]	,711	,652	,687	,113
	SINFR2	,031	,091	,121	,016	-,079	-,149	,010	-,143	,049	,263	,055	,061	,081	,163	,069	,180	,291	,711	,840[a]	,776	,805	,161
	SINFR3	,124	,195	,211	,112	-,061	-,137	-,018	-,107	,091	,291	,068	,117	,153	,209	,131	,260	,322	,652	,776	,745[a]	,763	,246
	SINFR4	,122	,170	,204	,088	-,110	-,183	-,056	-,169	,146	,293	,066	,081	,118	,137	,055	,181	,246	,687	,805	,763	,802[a]	,180
	SENVR2	,260	,430	,344	,406	,190	,138	,098	,252	,031	,228	,228	,430	,448	,384	,378	,504	,448	,113	,161	,246	,180	,514[a]
Residual[b]	SSCLP4		-,017	-,113	-,105	-,019	,032	,010	-,058	-,046	-,065	,047	,087	,024	,030	,009	,013	-,018	-,031	,019	,027	,006	-,050
	SSCLP7	-,017		-,080	-,064	-,017	-,067	-,002	,026	-,064	,003	,026	,008	,000	,081	-,043	-,008	-,013	,036	,007	-,049	-,003	-,094
	SSCLP8	-,113	-,080		-,102	-,012	-,007	,016	-,022	-,098	,076	,111	-,036	-,072	,020	,030	-,027	-,011	,016	-,015	-,039	-,024	-,005
	SSCLP9	-,105	-,064	-,102		,015	-,016	,012	-,029	,074	-,023	-,013	-,079	-,063	-,021	,044	,060	,024	,071	-,004	-,031	-,015	-,026
	SCOGP1	-,019	-,017	-,012	,015		-,073	-,087	-,069	,026	-,089	-,065	,082	,001	-,021	,045	-,050	-,025	-,053	,001	,055	,047	,001
	SCOGP2	,032	-,067	-,007	-,016	-,073		-,050	-,087	,046	-,057	,018	-,005	,008	,046	-,027	,071	-,071	-,065	,009	,041	,062	,016
	SCOGP3	,010	-,002	,016	,012	-,087	-,050		-,065	-,013	,027	-,004	-,045	,010	-,089	-,011	,077	-,017	-,004	-,016	,002	-,027	,063
	SCOGP4	-,058	,026	-,022	-,029	-,069	-,087	-,065		,004	,112	-,018	-,049	,036	,038	-,058	,024	-,064	-,009	-,023	,054	,008	-,056
	SLRNP1	-,046	-,064	-,098	,074	,026	,046	-,013	,004		-,130	-,056	-,016	-,026	-,022	-,004	-,022	,064	-,046	,008	,033	,033	,134
	SLRNP2	-,065	,003	,076	-,023	-,089	-,057	,027	,112	-,130		-,088	-,011	,052	-,093	-,127	,037	,037	-,019	-,001	,004	-,081	-,026
	SSKLS1	,047	,026	,111	-,013	-,065	,018	-,004	-,018	-,056	-,088		-,121	-,212	,089	,098	,007	-,030	,040	-,030	-,037	,029	-,015
	SSKLS2	,087	,008	-,036	-,079	,082	-,005	-,045	-,049	-,016	-,011	-,121		-,040	-,009	,032	-,006	-,013	-,056	,051	,023	-,002	-,101
	SSKLS3	,024	,000	-,072	-,063	,001	,008	,010	,036	-,026	,052	-,212	-,040		-,016	-,077	-,026	-,017	-,029	,012	,034	-,004	-,040
	STECH1	,030	,081	,020	-,021	-,021	,046	-,089	,038	-,022	-,093	,089	-,009	-,016		-,141	-,096	-,071	,015	-,013	-,025	,052	-,125
	STECH2	,009	-,043	,030	,044	,045	-,027	-,011	-,058	-,004	-,127	,098	,032	-,077	-,141		-,089	-,081	,040	,051	-,034	,013	,031
	STECH3	,013	-,008	-,027	,060	-,050	,071	,077	,024	-,022	,037	,007	-,006	-,026	-,096	-,089		-,096	-,035	-,037	,074	,028	-,177
	STECH4	-,018	-,013	-,011	,024	-,025	-,071	-,017	-,064	,064	,037	-,030	-,013	-,017	-,071	-,081	-,096		,021	-,005	-,090	-,053	,057
	SINFR1	-,031	,036	,016	,071	-,053	-,065	-,004	-,009	-,046	-,019	,040	-,056	-,029	,015	,040	-,035	,021		-,040	-,149	-,104	,057
	SINFR2	,019	,007	-,015	-,004	,001	,009	-,016	-,023	,008	-,001	-,030	,051	,012	-,013	,051	-,037	-,005	-,040		-,066	-,063	-,005
	SINFR3	,027	-,049	-,039	-,031	,055	,041	,002	,054	,033	,004	-,037	,023	,034	-,025	-,034	,074	-,090	-,149	-,066		,015	-,040
	SINFR4	,006	-,003	-,024	-,015	,047	,062	-,027	,008	,033	-,081	,029	-,002	-,004	,052	,013	,028	-,053	-,104	-,063	,015		-,043
	SENVR2	-,050	-,094	-,005	-,026	,001	,016	,063	-,056	,134	-,026	-,015	-,101	-,040	-,125	,031	-,177	,057	,057	-,005	-,040	-,043	

Extraction Method: Principal Component Analysis.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 82 (35,0%) nonredundant residuals with absolute values greater than 0.05.

ANNEXURE 9: LETTER FROM LANGUAGE EDITOR

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LANGUAGE EDITOR

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