



MPhil

How is work-integrated learning adapting to the future of work and employability? A phenomenographic study of graduate mathematicians' internship experiences across selected African countries.

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by:

Mark Heerden

HRDMAR001

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Supervisor: Emeritus Professor Martin Hall

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ABSTRACT

How is work-integrated learning adapting to the future of work and employability? A phenomenographic study of graduate mathematicians' internship experiences across selected African countries.

The future of work and employability is evolving at an accelerating pace, impacted by the changes brought about by the fourth industrial revolution and the increasingly digital economy. This research study explored work-integrated learning through a sample of African graduate mathematicians' collective internship experiences.

The research methodology was based in phenomenography, which seeks to understand the collective outcomes experienced by the participants from their workspace internships. Twenty participants were purposively selected to give a broad range of experiences and maximise the likelihood of variation. All were mathematics graduates or postgraduates who sought employment in industry. They represented eight African countries, and 55% were female.

Although almost all responded that their internships were positive work-integrated learning experiences, they also highlighted their challenges in meeting the demands of the workspace internships. Six further distinct collective outcomes, or conceptions, were experienced centered around managing their expectations, company readiness, structured supervision, workplace training, team inclusion and independent working. The study also found that the learning experiences in the African workplace were largely comparable with those experienced in more industrialised countries, as reflected in the literature. However, a key recommendation arising from this study is the need for greater structure in the African internships, termed 'structured hospitable learning spaces', better connecting the learning environment for interns and employers. The participants collectively believed this greater structure was necessary to improve their internship experiences, both aimed at themselves in that they should have better prepared before their internships, and then at the internship companies, where there should have been more planning for their arrivals.

This study concludes by asserting the growing importance of work-integrated learning in the future of work and, in particular, data analytical roles in the accelerating digital economies of African countries. It also recognises the impact that generative artificial intelligence solutions will have on learning in the decades to come.

Keywords: work-integrated learning, experiential learning, African internships, future work, phenomenography, digital economies, workspaces

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Just under a decade ago, I embarked on my second career, seeking to enhance the employability prospects of Africa's brightest graduate mathematicians through work-integrated learning programs. It was a fortuitous opportunity and has proven to be an exciting and rewarding journey. Embarking on this research study was an important next step in scaling our African work-integrated learning programs and increasing our effectiveness.

Without a doubt, the journey would not have been as successful had a young Ghanaian mathematician from the African Institute for Mathematical Sciences not requested to be my intern on our work-integrated learning program, then about to be launched, the Industry Immersion Program. That young talent today, Dr David Sena Attipoe, is the Managing Director of the successfully scaled program and now a non-profit organisation, Industry Immersion Africa (iiAfrica). David, thank you for our seven years together in an incredible work partnership and friendship. It gives me great joy to see you leading our start-up program towards pan-African success.

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To the participants who took time out from their busy lives to join me in the interviews, thank you. Now, my request to you, as Industry Immersion graduates, is to please go out and live your best lives. Make the most of all your learning and achieve your full potential in industry.

The future is yours!

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ACRONYMS AND ABBREVIATIONS

4IR	Fourth industrial revolution
AIMS	African Institute for Mathematical Sciences
ARK	ARK Innovation Fund, a New York Stock Exchange-listed fund
Covid-19	The Coronavirus pandemic, first diagnosed in China in November 2019
ESMT Berlin	European School for Management and Technology
Ghana1000 Initiative	The national employability program partnership between iiAfrica and the NSS
Global North	The economically advanced countries of North America, Europe, Australia, and East Asia, also known as the First or the Developed World (Collins, 2023)
Global South	The less economically advanced countries of Africa, Asia and Latin America collectively, also known as the Third or Developing World (Collins, 2023)
ICT	Information, Communication and Technology
IEP	Industry Engagement Program, Ghana1000 Initiative
IDRC	The International Development Research Centre (Canada)
iiAfrica	Industry Immersion Africa (iiAfrica) is a pan-African organisation which is registered in South Africa as a Non-Profit Organisation
IIP	Industry Immersion Program
NSS	The National Service Scheme, Ministry of Education (Ghana)
SSA	Sub-Saharan Africa
STEM	Science, technology, engineering and mathematics
SWIB	STEM Women in Business, Ghana1000 Initiative
WIL	Work-integrated learning
Workplace	The working place linked with traditional in-office employment
Workspace	The working space linked with hybrid and remote employment

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

Over the past five years, the world has experienced an exponential change in the nature of work brought about by the fourth industrial revolution (4IR) and the resulting digital economy innovation. Whereas previous industrial revolutions led to increasing employment, the 4IR has the potential to shrink the world of work whilst increasing productivity, providing the prospect of "a mass of unemployed and unemployable people" (Marwala, 2020, p.16). In addition, the 4IR, accelerated by the recent Coronavirus (Covid-19) pandemic, is impacting employment, the workplace and work practices to an extent not experienced previously. McKinsey (2023), in their latest report, "What is the future of work", predict one in sixteen workers may have to adapt or change occupations by 2030, estimating this at impacting 300 million workers globally. The nature of work will increasingly be concentrated towards high-skill, growth industries (e-commerce, the green economy and supporting ageing populations) and away from more routine administrative roles (banking, accounting and middle office roles).

Given this accelerating change of work, students' skill needs in entering employment are also rapidly changing, increasing pressure on traditional forms of Higher Education to meet the developing knowledge gap. In a recent study of a sample of South African Higher Education institutions, Basson et al. (2023) found that only 30% of the top information technology skills per industry demand were supplied within the relevant curricula of the Higher Education institutions sampled. This finding is supported globally in the McKinsey report (McKinsey 2023).

The problem statement addressed in this study is how can the skills gap, growing between formal education and work places, be remedied so that sustainable learning continues in the rapidly changing work environment. Consequently, although much maligned historically, the benefits of vocational educational models and workplace learning are being revisited for possible education solutions (Newman & Winston, 2016); examples are the German dual system of vocational education and apprenticeship training at secondary education levels and the Canadian University system of cooperative and experiential work-integrated learning (WIL) degree programs at Higher Education levels.

"Work-integrated learning is considered a key strategy for promoting graduate employability" (Rowe & Zegwaard, 2017, p.87). Bringing together academic institutions and industry partners has allowed for systematic workplace training and institutional partnerships, improving student skills learning and development. However, traditional WIL programs have

relied mainly on the workplace and experienced interpersonal interaction to transfer these skills. Given the accelerated movement towards globally distributed organisations and blended learning, the traditional workplace learning model will need to be modified. In the world of fourth industrial revolution innovation and increasing remote interaction, not only are the required skills changing rapidly, but WIL programs will need to adapt to remain relevant in the digital workplace. In this study, the ‘workspace’, rather than the ‘workplace’, is highlighted acknowledging that WIL programs will in future have to adapt to the increasing trend towards hybrid and remote internships.

Furthermore, work-integrated learning programs are important for employees beyond internships. They should be integral to ongoing upskilling programs, keeping pace with the changing requirements of employees in their changing roles and innovation updates and, as research suggests, with life-long reach (Da et al., 2020).

This research study focussed on selected African workspaces. While Africa may have missed out on previous industrial revolutions, the continent now has the opportunity to take advantage of the 4IR by at least ensuring its education models fully prepare graduates for entering digitalised workplaces. This researcher suggests that WIL will have an important role. However, digital innovation alone will not be enough for Africa to "technologically leapfrog" in order to improve sustained economic prosperity (Solow, 1956, p.65). Several necessary socio-economic, political and infrastructural foundations will also be required to be in place.

1.2. Research questions

This research study explored WIL experiences in an African context, focusing on the priorities for developing and adapting the existing approaches for the emerging requirements of the fourth industrial revolution and digital economies. The research question is: "How is work-integrated learning adapting to the future of work and employability? A phenomenographic study of graduate mathematicians' internship experiences across African countries". Graduate mathematicians are particularly relevant to employment in the digital economy, and several sub-questions arise regarding their internship experiences, which are addressed in this study:

- Were they successful internships?
- How did their taught skills bear out in the workspace?
- Could they have been more effective?
- Were there specific African issues?
- How were remote and hybrid internships experienced?

1.3. Research contribution

This study has sought to contribute to the body of related research in two ways; by exploring WIL research and programs, developed for first-world economies, in an African context and, secondly, by examining WIL as it applies to an increasingly digitalised workplace through the experiences of African mathematical graduate interns.

As with the rest of the world, the workplace is struggling to keep abreast of the growing skills required to support digitalisation. This report focusses on how WIL can best be developed, considering the changing nature of work and workspaces, and applied to an African context. This culminates in a proposed model for the implementation of successful African internships, with a key recommendation arising from this study for greater structure in the African internships, termed ‘structured hospitable learning spaces’. The participants collectively believed this greater structure was necessary to improve their internship experiences, both aimed at themselves in that they should have better prepared before their internships, and then at the internship companies, where there should have been more planning for their arrivals.

1.4. Positionality of the researcher

Until 2015, this researcher was employed at the African Institute of Mathematical Sciences (AIMS), based in Cape Town, as Director for the AIMS’ Industry Initiative. AIMS is a pan-African tertiary education facility providing post-graduate training to Africa’s brightest mathematicians across five African country campuses to enable them to become “innovators driving the continent’s scientific, educational and economic self-sufficiency” (AIMS: African Institute for Mathematical Sciences, 2023, para 1). The researcher’s role was to facilitate the effective employment of these post-graduates in industry. He recognised that a bridge to industry was required to meet this objective and, in 2015, in partnership with AIMS and the European School of Management and Technology (ESMT Berlin), he co-founded the Industry Immersion Program, which he managed in a full-time capacity providing business and behavioural skills to industry-inclined post-graduate mathematicians, followed with workplace internships in their home countries. Since 2020, he has held a non-executive role. The participants selected for this study are all graduates of the Industry Immersion Program. The researcher is mindful of his potential bias in this study and has adopted Mantzoukas’ (2005) approach, recognising that bias is unavoidable in qualitative research studies and, in this case, cannot be avoided or eliminated; “on the contrary, it should be embraced and

become part of the research ... which may in turn give insights that an insider perspective may offer" (Mantzoukas 2005, p.291).

1.5. Report structure

Chapter 2, which follows, reviews the literature relevant to work-integrated learning. This begins with a brief understanding of constructivism as a learning paradigm before addressing seminal experiential learning theories presented by Dewey, Lewin, Piaget and Kolb. The chapter then explores more recent research, including Activity Theory (Engestrom and Vygotsky), Transformational Learning (Mezirow) and Situated Learning Theory (Lave and Wenger), framing the research within this literature. This review spans the changing nature of work, future skills required for effective employability, the future workspace and the need for life-long upskilling. The chapter then explores Kolb and Kolb's (2005) principles for creating successful experiential learning spaces which are revisited in Chapter 5, where they are compared to the African-situated conceptions arrived at in this research. Finally, Chapter 2 sets out a sub-Saharan perspective, drawing out the relevant issues compared to the global industrialised nations. Africa's growing youth presents an important opportunity for the continent to leapfrog into the future, but countries must provide the digital foundation for this to take place otherwise there is the prospect of economically unequal outcomes.

Chapter 3 introduces the research approach, a qualitative (searching for meaning and understanding), constructivist (constructing knowledge through experiences) paradigm. It also introduces the research methodology - phenomenography - which seeks to understand the collective outcomes experienced as the interaction between the study participants and their workspace internships. These collective outcomes are measured in what is known as "conceptions". Following this, the study's data collection and data analysis processes are set out.

In Chapter 4, the findings of the coded transcriptions of the participant group's interviews are discussed in detail. Twenty purposefully selected participants were virtually interviewed, comprising nine males and eleven females, and representing nine African countries. Seventeen participants experienced successful internships in their data analytical roles, across eleven workplaces and five remote and four hybrid workspaces. With no preconceived ideas, the coded transcriptions of the internship experience were then analysed over three rounds resulting in the findings being grouped into seven collective conceptions.

Chapter 5 continues with a detailed discussion of these conceptions, which were overall internship experience, managing interns' expectations, company readiness, structured supervision, workplace skills, team inclusion and independent working. The discussion chapter links the conceptions to the relevant literature covered in this study and the commentary of an independent reviewer presented to reduce the possibility of researcher bias. The chapter concludes by offering a model comparing this study's conceptions to Kolb and Kolb's (2005) recognised "learning-space" principles for enhancing experiential learning. This study suggests the prospect of '*structured hospitable learning spaces*' as particularly relevant to African WIL programs.

Chapter 6 concludes by identifying the research contribution, implications, limitations, and areas for future research. It also presents this researcher's reflections on the study and, importantly, the advent of artificial intelligence and its potential impact on both work and work integrated learning.

The Graduate School of Business Masters in Inclusive Innovation requires that the research conducted for the dissertation leads to a "praxis model" that connects the research outcomes with the practicalities of implementation. This is provided in Chapter 7, which presents recommendations for the implementation of the research findings presented in this report. These recommendations come together as a national work-integrated education program for Ghana - the Ghana1000 Initiative – which seeks to enhance the employment prospects of one thousand mathematicians entering national service internships in 2024.

1.6. Summary

This chapter presented an overview of exponential and accelerating change in work brought about by the fourth industrial revolution. It set out the growing importance of work-integrated learning programs to bridge the skill gap divide developing between the curricula of higher education and the increasing digital workplaces. It also highlighted the importance for Africa in particular. The chapter concluded with a brief structure outline of the following chapters in this study. The next chapter presents a review of the relevant literature.

2. LITERATURE REVIEW

2.1. Introduction

The World Economic Forum's "Future of Jobs" report describes how the accelerated pace of technology adoption since the beginning of the fourth industrial revolution and the more recent Covid-19 recession have led to an induced "double-disruption" in the world, accelerating "the arrival of the future of work" (World Economic Forum, 2020, p.5). This future looks very different from past industrial revolutions, with commensurate social and economic outcomes particularly impacting skills, learning, and employment. This literature review is organised as two interrelated sections to understand this future better.

The first section covers the background of foundational experiential learning-related theories. From a constructivist paradigm, the contributions of Dewey (1938), Lewin (1951) and Piaget (1977) are examined. These are the precursors of John Kolb's (1984) Experiential Learning Theory, widely acclaimed as the foundation for modern work-integrated learning programs. More recent theoretical contributions from Engestrom (1987), Mezirow (1991) and Lave and Wenger ((1991) have sought to develop and expand Kolb's work.

The second section reviews the accelerating change in the future of work and the effect on skills and the workplace. The consequences are already being felt worldwide in work-integrated learning programs, both in terms of the new required skills and relevant forms of experiential learning. Then, the section explores the conditions for effective experiential learning to take place – learning in the "workspace" rather than the "workplace" - as proposed by Kolb and Kolb (2005) in their study of higher education. Understanding the learning space provides the context for work-integrated experiential programs to remain relevant and meaningful in an uncertain future of work.

Finally, in this section, the future for Africa is also explored. The fourth industrial revolution presents the prospect of allowing Africa to leapfrog into the future if governments and institutions are committed to developing and building the necessary frameworks to enable this dynamic opportunity.

2.2. Experiential and work-integrated learning theories

2.2.1. Learning

Fundamentally, learning can be defined as "any process that in living organisms leads to permanent capacity change and which is not solely due to biological maturation or ageing" (Illeris, 2007, p.3). Based on this definition, the scope of related knowledge is immense and a complete

presentation is beyond the scope of this study. Rather, in the context of experiential learning, Marsick and Watkins (2001) suggest a narrower definition for experiential learning as “the way in which people make meaning and acquire knowledge and skill” (p.32). This, in its most simple interpretation, sets a learning paradigm that “identifies both an internal and an external component to learning” (McRae, 2014, p.7) and alludes to the complexity of a variety of inputs, including personal, social, educational, work, environmental, both explicit and implicit and continuing throughout life’s journey.

Illeris (2007) suggests “that all learning includes each of three dimensions embedded in a society-situated context” (p.87-88):

1. Content - including knowledge, skills, and attitudes;
2. Incentives - such as emotion, feelings and motivation; and
3. Social engagement - in communication and interaction is illustrated in Figure 1 below.

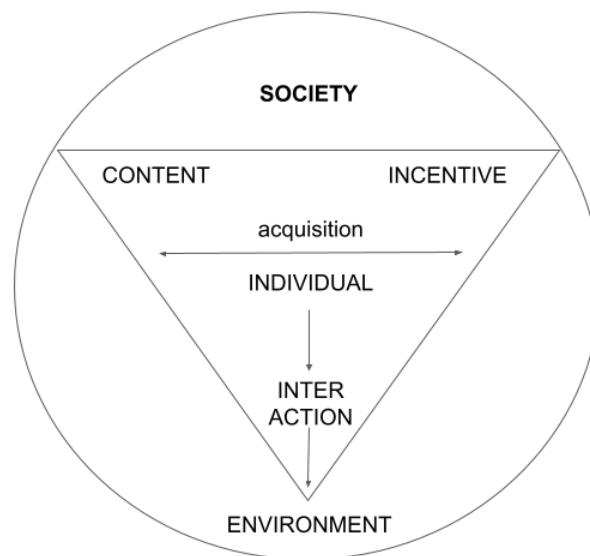


Figure 1: Learning processes and dimensions (adapted from Illeris, 2007)

There are also teaching orientations that impact educational outcomes. Miller and Seller (1985) considered the three following:

1. Transmissional - imparted by teachers in a structured format to learners, who are seen as passive recipients seeking to improve the learning being imparted;

2. Transactional - developing a more interactive outcome between the teacher and the student seeking to enhance their problem-solving skills; and
3. Transformational - where a more holistic view of the learner is considered with curricula orientated towards developing personal and social skills.

Finally, and supporting this, learning can also be set out as formal, non-formal, and informal. Schugurensky (2000) describes these as follows:

1. Formal education - is imparted in institutionalised educational systems with prescribed curricula, teachers and a hierarchical system, moving toward tertiary studies;
2. Non-formal education - describes organised educational programs, usually short-term and not considered part of schooling; and
3. Informal learning - “takes place outside the curricula provided by formal and non-formal educational institutions and programs” (Schurgurensky, 2000, p. 2).

More recently, informal learning has been recognised as essential to work-integrated learning and entrepreneurship (Bucci, 2020). Schurgunsky (2020) suggested there are three styles of informal learning. The first is self-directed learning (intentional and conscious), the second is incidental learning (unintentional but conscious) and finally, and a subtle combination of the first two, socialisation (unintentional and unconscious). Marsick (2009) believed that environmental issues, including social, cultural and organisational ones, play a large part in informal learning outcomes.

However, not all learning is of the same quality (Kolb, 2000), and it is essential to understand better how deep knowledge is attained in experiential learning.

2.2.2. Conceptions of Learning

Ellis et al. (2008) suggest that “conceptions of learning” describe how students recognise the impact of learning on their development. Byrne and Flood (2004) argue that “conception of learning captures the way how a person views learning, that is, what learning means to them” (p.26). Marton et al. (1990) further suggest that conceptions of learning reflect in students recognising, connecting and understanding what they think learning is to them, resulting in six conceptions:

1. Increasing one’s knowledge - a general description of broad learning;
2. Memorising and learning - the learner identifies the process of repetition towards replication of learning material;
3. Applying - the learner builds upon the first conception and uses the learning in practice;

4. Understanding - now the learner develops meaning with the learning rather than just applying what has been learned;
5. Seeing something differently - builds upon conception above in that the learner moves beyond merely understanding and takes a different direction to that which would otherwise have been the case; knowledge has been acquired, and now the outcome appears differently;
6. Changing a person - explained by Bucci (2020) as “exemplifies that once one begins to see the world differently, they change as a person as well” (p.42).

“The significance of the conceptions of learning lies in their intimate relationship with learning approaches” (Zhao & Hu, 2020, p.2). Peterson et al. (2010) conclude that the “reason why many researchers have persisted in trying to identify key conceptions of learning is the underlying belief that conceptions of learning have the potential to explain different learning behaviour or learning approaches” (p.168).

Biggs and Tang (2011) have also suggested that learning conceptions may correlate with actual learning outcomes, so a detailed understanding of conceptions is important. Asikainen et al. (2013) suggest that “understanding students’ conceptions of learning is important in understanding how to enhance the quality of student learning” (p.36). “Therefore, exploring the conceptions of learning is one of the critical steps toward improving the quality of learning as a whole” (Zhao & Hu, 2020, p.3). Ellis et al. (2008) argue that “research from a phenomenographic perspective has shown that students’ conceptions of learning and their approaches to learning are related to each other and to the quality of learning outcomes” (p.268). Several comparable studies support this (Prosser & Millar, 1989; Trigwell & Prosser, 1991).

2.2.3. Constructivism as a learning paradigm

“Constructivism is a theory about knowledge and learning; it describes both what ‘knowing’ is and how one ‘comes to know’” (Fosnot, 2005, p.5). From an educational perspective, constructivism supports the paradigm that individuals construct their knowledge by engaging with their multi-faceted social and cultural world and interpreting this engagement to support their involvement (Hein, 1991). This is quite the opposite of the belief that facts speak for themselves and only one reality exists. Further, this has material consequences on how learners should learn: “the constructivist teacher facilitates learning rather than transmitting knowledge” (Chipamaunga, 2015, p.52).

Building on thinking from as far back as the eighteenth century, Piaget significantly developed constructivist epistemology in the field of cognitive science (Fosnot, 2005). Piaget’s studies suggested that knowledge represented more than a single independent reality and was rather an adaptive outcome in the learner’s mind; a psychological view through their lens of life. The processes of assimilating possibilities and contradictions support this intellectual growth until an accommodation of these new intellectual stimuli reaches equilibrium, constituting new knowledge (Piaget, 1977). This was a significant move away from prevailing behaviourist views, which presented knowledge transfer was one-way directional teaching from teacher to learner, assimilation and then repeated practice (Hein, 1991). Fosnot (2005) presented Piaget’s constructivist approach as set out in Figure 2, highlighting the dynamic interaction required before the learner is able to arrive at any form of equilibrium.

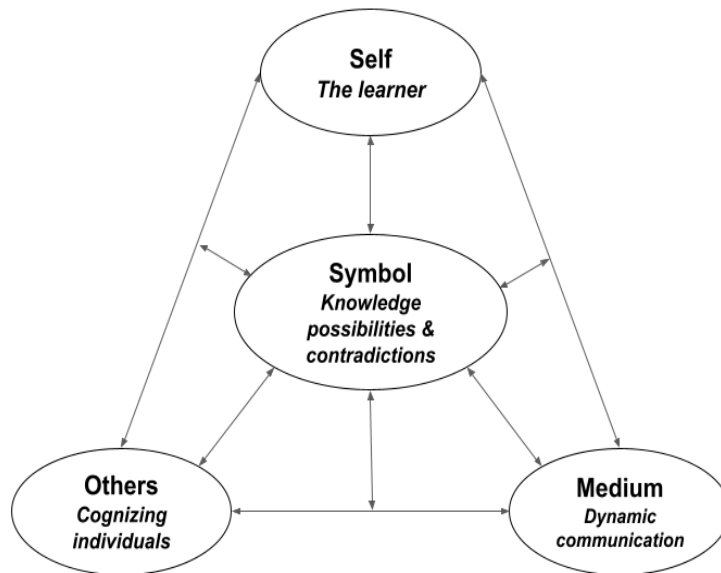


Figure 2: The constructivist learning model (adapted from Fosnot, 2005)

Experiential learning is recognised as just one of many constructivist learning models, including self-directed and problem-based learning and reflective practice (McLeod, 2018).

2.2.4. Experiential Learning Theories

Freire (1970) asserts that “knowledge emerges only through invention and reinvention, through the restless, impatient, continuing, hopeful enquiry men pursue in the world, with the world, and with each other” (p.72). Roberts suggests that “experiential learning is considered to

represent the specific techniques that an individual can implement to acquire knowledge or meet learning goals” (Roberts, 2012, p.18). In supporting this, Keeton et al. (2002) suggest that experiential learning takes place in real-world settings and where the learner is connected with these situations. This contrasts with classroom learning, where reading, writing, and listening are disconnected from realities.

“Across the globe, hundreds of thousands of students are engaged in work-integrated learning (WIL), a form of experiential education, which intentionally connects the education of those students to the world of work through a partnership between academic institutions, workplaces and students” (McRae, 2014, p.2).

Drawing from Dewey, Lewin and Piaget, Kolb (1984) developed his experiential learning paradigm as six pillars, leading to the conclusion that “learning is a process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p.38). Furthermore, Kolb (1984) recognised the critical linkages between the classroom and workplace in terms of self-direction and more effective personal and career development:

1. “Learning is best conceived as a process, not in terms of outcomes” (p.26) - a consistent theme through the work of educationalists is that learning is a continuous process, building upon and growing indefinitely through personal experiences;
2. “Learning is a continuous process grounded in experience” (p.27) - learning should be continuous, tested and reintegrated into the learning process and will continue “as long as life and learning continue” (Dewey, 1938, p44). Also, the quality of the experience impacts the learning, which becomes important in educational programs developing learners, such as work-integrated learning;
3. “Learning requires the resolution of conflicts between dialectically opposed methods of adaption to the world” (Kolb, 1984, p.29) - conflicting opinions, disagreements and challenges are essential in taking an experience into a learning outcome. Lewin (1951) suggested two dialectical challenges: concrete experience and abstract challenges, and observation and action;
4. “Learning is a holistic process of adaptation to the world” (Kolb, 1984 p.31) - experiential learning should include thinking, feeling, acting and reflection and is not limited to the classroom or structured situations. Every personal transaction is set in human settings, and each will impact the learning event. “Learning is the process of human adaption” (Kolb, 1984, p.32);

5. “Learning involves transactions between the person and the environment (p.34) - this pillar is a continuation of that set out above, and learning is grounded in real-world experience, whether tacitly provided for in educational outcomes or as a result of living in everyday life; and
6. “Learning is the process of creating knowledge” (p.36) - knowledge should constantly be in a state of change as the learner experiences and contrasts with educational practices experienced. “Knowledge results from the transaction between objective and subjective experiences in a process called learning” (Kolb, 1984, p.37).

2.2.4.1. Dewey: the theory of experience

John Dewey (1859-1952) is considered one of the most influential educational philosophers of modern times. He is renowned for his research into Higher Education, reflected in his 1938 book, “Experience and Education”, where he sought to reconcile the growing conflict between traditional and progressive approaches to education. Whereas traditional education encouraged obedience and formal set learning techniques from predetermined curriculums, progressive education preferred outcomes driven by learners’ interests and unconstrained by the teacher.

Dewey is credited with developing the philosophy of experiential learning, with his fundamental principle being that students are unique learners and will learn by doing. Dewey (1938) proposed that experiential learning, which combined experiences with educational values, was the most effective way to develop problem-solving and application skills. He suggested teachers should present learning in what he called the “theory of experience” (Dewey, 1938, p.25). Dewey believed real learning resulted from these experiences and interactions with the world and the immediate environment, leading to new ideas and outcomes and evolving into life’s experiences and interactions. He also proposed the “principle of continuity”, which stated that “every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after” (Dewey, 1938, p.27).

From his research and thinking, Dewey (1938), summarised his progressive theory of experiential education as four fundamental principles:

1. Students learn best when emotionally connected in active learning and enquiry;
2. Students should engage in shared activities with social interaction and discussion to enhance and deepen understanding;
3. Students need to engage and interact with their environment; and
4. Students should conduct their learning within an interdisciplinary environment.

However, Dewey (1938) also suggested that “the belief that all genuine education comes about through experience does not mean that all experiences are genuinely educative” (p.25). He argued that, where negative educative experiences occurred, learning would be diminished; and following from this, growth required curated, beneficial experiences.

Hargreaves (2021) summarises Dewey’s influence on modern experiential learning practice, which also has implications for work-integrated learning, as follows:

1. Individualised instruction - work supervisors need to learn about and understand their student interns to allocate better projects that will appeal to them and provoke their desire to engage and deliver superior outcomes;
2. Problem-based learning and integrated learning approaches - internships should always focus on practical tasks or problems requiring students’ knowledge, skills and understanding;
3. Student engagement - the greater the application of all a student’s skills - intellectual, problem-solving, ownership and aesthetic - the more likelihood of the student taking responsibility for a successful outcome;
4. Dialogic teaching - supportive, respectful dialogue between student interns and their work supervisors and colleagues enhances meaning-making and problem-solving;
5. Critical enquiry - all of the above leads to positive thinking, reflection and inquiry; and
6. Teaching enquiry - the role of the work supervisor in engaging student interns in an active, energetic process is critical to the successful learning outcome.

2.2.4.2. Lewin: field theory, life-spaces and action research

Kurt Lewin (1890-1947), a German-American psychologist, is primarily recognised as the founder of modern social psychology and is best known for his three significant theories: field theory, group dynamics and action research. Like Dewey, Lewin believed that learning was primarily an experiential outcome. “Lewin’s field theory states that it is possible to understand, predict and provide the basis for changing the behaviour of individuals and groups by constructing a ‘life space’ comprising the psychological forces influencing their behaviour at a given point in time” (Burnes & Cooke, 2013, p.409).

Lewin’s Field Theory (1951) proposed that all individuals’ behaviours could be explained based on their environment. This covers “all facts which exist for the person and exclude those which do not. It embraces needs, goals, unconscious influences, memories, beliefs, events of a political, economic, and social nature, and anything else that might have a direct effect on

behaviour” (Kolb & Kolb, 2005, p.199). Lewin (1951) suggested that this behaviour was an outcome of the individual within their environment and presented his “life-space” equation in the following formula: $b=F(pe)$, where behaviour (b) is a function of the person (p) and the environmental situation (e), presented in Figure 3:

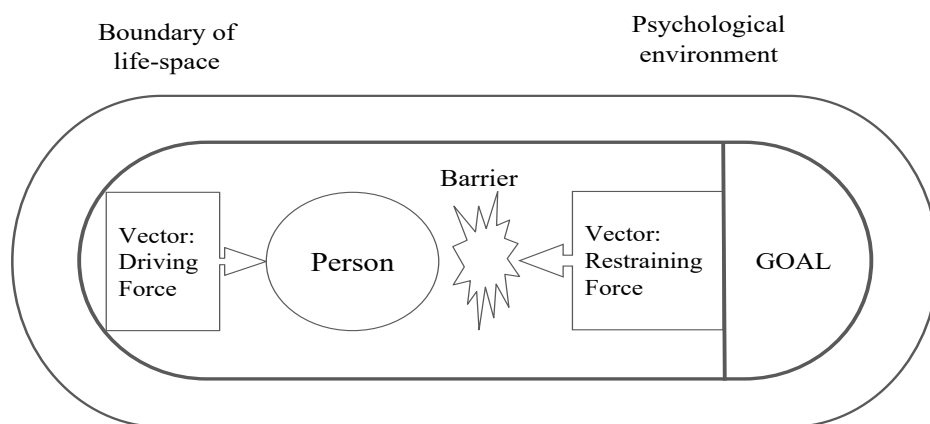


Figure 3: Lewin's (1951) theory of learning

In Lewin’s Life-Space theory (1951), individuals seeking changes to their “life-space” by moving towards chosen goals benefit from the positive driving forces pushing them towards their desired change, but also encounter the barriers from within their environment, restricting movement or change. This tension continues until the chosen goals are achieved, and a state of balance resumes within the “boundary of the life space”. Lewin, although not using the term “experiential” to describe this process and interaction with barriers or “restraining vectors”, believed this was how development in an individual occurred.

Lewin (1947, p.5) conceived of “group dynamics” rather than individuals’ actions effectively to bring about change, as society norms constrained individuals, but as part of a group, they could affect the disequilibrium required for the change (Burnes & Cooke, 2013). His training methods, “T-Groups”, with “T” equaling training, provided the foundation for subsequent approaches to organisational development (Kolb, 1984).

The concept of “T-Groups” also became the foundation for Lewin’s “action research” (Lewin, 1946, p.34), which he conceived as a means to effect change through a cycle of steps

based on concrete experiences. Lewin (1946) described this approach as "comparative research on the conditions and effects of various forms of social action and research leading to social action" that uses "a spiral of steps, each of which is composed of a circle of planning, action, and fact-finding about the result of the action" (p.34-35). Kolb (1984) presents Lewin's action research as a four-stage experiential learning mode, set out in Figure 4:

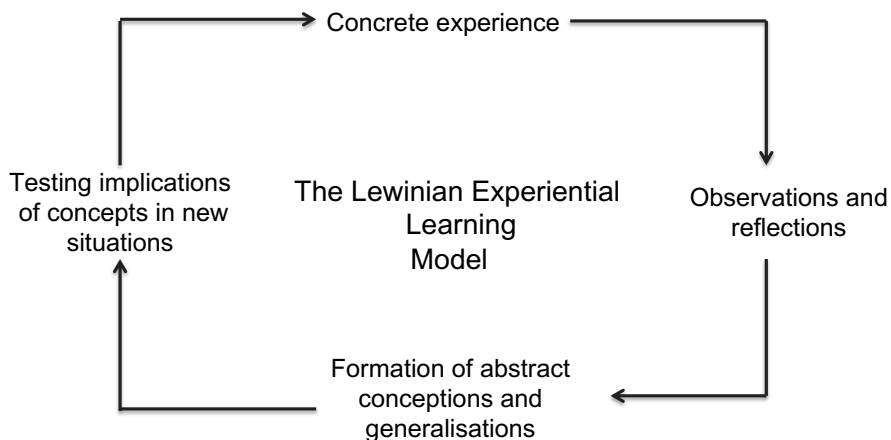


Figure 4: The Lewinian Experiential Learning Model (adapted from Kolb, 1984)

2.2.4.3. Piaget. Cognitive development theory

Jean Piaget (1896-1990), the Swiss-born psychologist, is acknowledged as the second most influential psychologist of the twentieth century (American Psychological Association, 2002). Piaget contrasted the development of knowledge with learning. He suggested that the development of knowledge was a "spontaneous process" (Piaget, 1964, p.176), tied to the development of the mind and body, whilst learning was the opposite, in that it had to be taught in a structural process. Piaget (1964) believed this development of knowledge takes place over four stages:

1. The sensory-motor, preverbal stage - which occurs during the first 18 months from birth, and children come to understand their world through senses and movements;
2. The pre-operational stage, until around the age of seven - with the development of language, memory and imagination;
3. The concrete operational stage, from the ages of seven to eleven years old - where logical and rational thought are introduced into their operational activities; and finally

4. The formal, hypothetic-deductive stage, through until adolescence - when children develop and introduce more abstract thinking and deductive reasoning in their operations. Now, experiential outcomes translate into learning and knowledge.

Piaget (1964) concluded with the following general assumptions: knowledge is built on experience, learning can take place without the influence of others, and there is a continual motivation to learn. He also advocated education and learning should include the freedom to explore and discover new information, develop the ability to problem solve and understand the stage of education relevant to cognitive knowledge development (Rabindran & Madanagopal, 2020).

In relating this work to experiential learning, Kolb (1984) states that “Piaget’s theory describes how intelligence is shaped by experience. Intelligence is not an internal characteristic of the individual but arises as a product of the interaction between a person and their environment. And for Piaget action is key” (p.12). Piaget’s cognitive development theories have had a significant effect on understanding stages of development beyond adolescence and into adulthood. This theory has been endorsed by studies of ego (Loevinger, 1976) and the development of moral judgement development in adults (Kohlberg, 1969). “The effects of these new conceptions of adult development are only now beginning to be felt (Kolb, 1984, p.15).

2.2.4.4. Kolb: Experiential Learning theory

David Kolb’s Experiential Learning Theory (1984) is widely regarded as the seminal foundation theory of experiential learning (Marks, 2012). Kolb (1984) defined learning as “the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience” (p.41). Kolb (1984) sets out his theory in terms of four significant learning modes; two dialectically related modes of grasping experience - concrete experience (feeling dimension) and abstract conceptualisation (thinking dimension); and two dialectically related modes of transforming experience - reflective observation (watching dimension) and active experimentation (doing dimension). “Experiential learning is a process of constructing knowledge that involves a creative tension among all four learning modes responsive to contextual demands” (Kolb & Kolb, 2005, p.194). Keeton et al. (2002) suggest an optimal level of learning is achieved when all four modes are in balance.

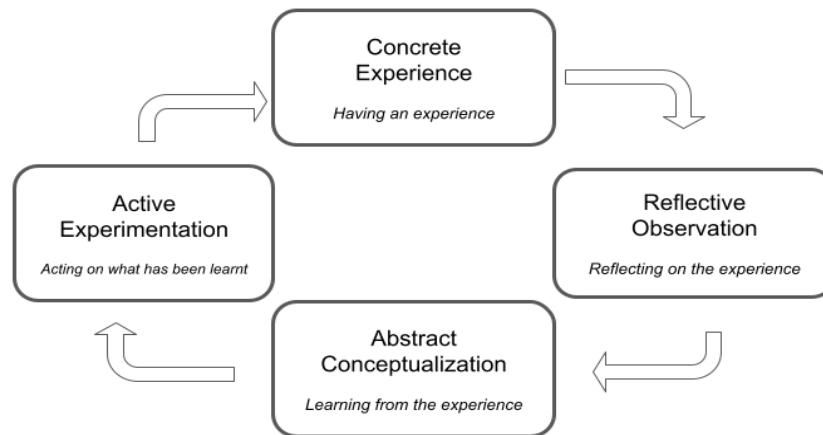


Figure 5: Kolb's (1984) four major modes of learning

However, it has been suggested that the different learning modes do not have to be completed sequentially (Stirling et al., 2016) and that “the idea that experiential learning is by definition a cycle made up of orderly, sequenced steps is neither eternal nor universally shared”, “While the concept of learning cycles has played a valuable formative role in experiential education to this point, its original purposes and its limits should be observed more carefully when basing research and program designs on it in the future” (Seaman, 2008, p.3).

Building on these four major modes of learning, Kolb (1984) went further to identify four learning styles, each favouring two of the learning modes:

1. Converging learning style - favouring abstract conceptualisation (AC) and active experimentation (AE) - with skills including thinking and doing;
2. Diverging learning style - favouring concrete experience (CE) and reflective observation skills (RO) - with skills including observing, perspective-taking and creative imagining;
3. Assimilating learning style - favouring abstract conceptualisation (AC) and reflective observation skills (RO) - with skills including interpreting abstract ideas and developing theoretical frameworks; and
4. Accommodating learning style - with skills including engaging, implementing and adapting.

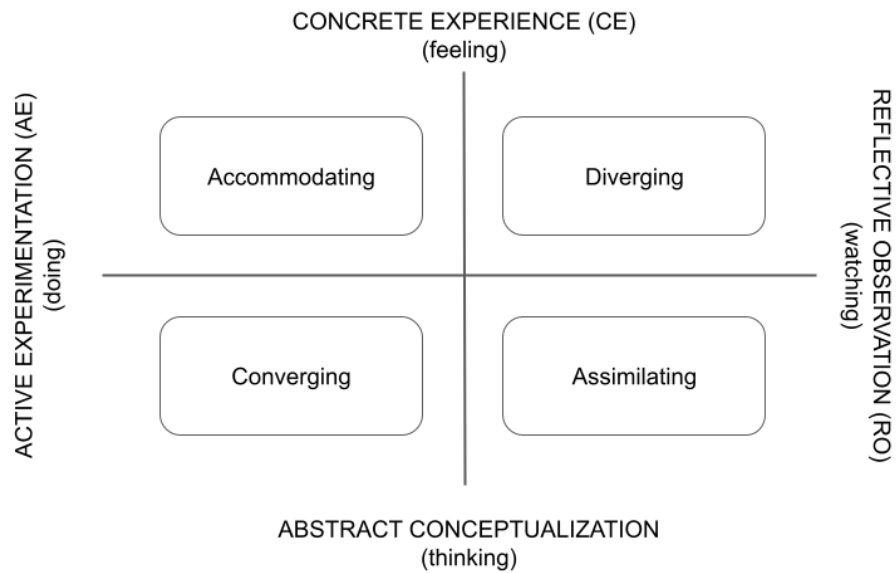


Figure 6: Kolb's four major modes of learning (adapted from Kolb, 1984)

Learners with a Converging Style (AC and AE dominant and tending towards specialist and technology careers) are best at solving practical problems and making decisions. “Individuals with a converging style prefer to deal with technical tasks and problems rather than with social and interpersonal skills. In formal learning situations, people with this style prefer to experiment with new ideas, simulations, laboratory assignments, and practical applications” (Kolb & Kolb, 2005, p.197).

Learners with a Diverging Style (CE and RO dominant and specialising in the arts) are best at seeing a situation from many viewpoints and generating ideas in group-styled brainstorming sessions. “People with a diverging learning style have broad cultural interests and like to gather information. They are interested in people, tend to be imaginative and emotional, have broad cultural interests, and tend to specialise in the arts. In formal learning situations, people with diverging styles prefer to work in groups, to listen with an open mind, and to receive personalised feedback” (Kolb & Kolb, 2005, p.196).

Learners with an Assimilating Style (AC and RO dominant and specialising in information and science careers) are best at gathering data and then compiling it into a concise and logical form. “Individuals with an assimilating style are less focused on people and more interested in ideas and abstract concepts. Generally, people with this style find it more important that a theory

has logical soundness than practical value. In formal learning situations, people with this style prefer readings, lectures, exploring analytical models, and having time to think things through” (Kolb & Kolb, 2005, p.196).

Finally, learners with an Accommodating Style (CE and AE dominant, tending towards action-orientated careers, such as sales and marketing) are best at learning from practical and challenging experiences. “In solving problems, individuals with an accommodating style rely more heavily on people for information than on their own technical analysis. In formal learning situations, people with the accommodating learning style prefer to work with others to complete assignments, set goals, do fieldwork, and test out different approaches to completing a project” (Kolb & Kolb, 2005, p.197).

Importantly, Kolb (1984) suggests these learning styles are dynamic and a function of environmental circumstances: “the choices and decisions we make to some extent determine the events we live through, and these events influence our future choices. Thus, people create themselves by choosing actual occasions they live through” (Kolb, 1984, p.64). According to Kolb, experiential learning transforms learners as they grow through three phases of development: acquisition, specialisation and integration. Initially, basic learning and cognitive skills are acquired. Specialisation results from the social, educational and organisational influences the learners’ encounter. Integration is the phase where the learner achieves the requisite level of complexity in each learning style in their working and personal lives. The more common career paths for each learning style are set out in Table 1.

Since its publication, Kolb’s theory has been criticised from several angles. These include the lack of consideration of how knowledge is acquired and transferred (Webb, 2003) and the absence of a methodical framework to integrate supporting theories (Miettinen, 2000). Practically, Forrest (2005) suggests that the learning modes are too simplistic, which becomes more of a challenge as the rate of change in the world of work accelerates. A further perceived limitation is that the main components of experiential learning – students, workplaces and educational institutions – are often considered too simplistically and in isolation, and that the integration of outcomes is not fully considered (Eames & Cates, 2011). Miettinen (2000) argued that learning appears to occur independently in Kolb’s theory and suggests learning requires feedback, collaboration and drawing from experiences to enhance knowledge acquisition. Marks (2012) also challenges Kolb’s theory, arguing that reflective observation is not adequately represented.

Table 1: Kolb's learning styles and common career paths
(adapted from Evan et al., 2010)

<u>Learning Style</u>	<u>Common Career Paths</u>
Converging	Computer science & engineering Finance & economics Applied sciences Medicine
Diverging	Arts & entertainment Communications Social science
Assimilating	Sciences & mathematics Social & physical sciences Legal professions Research & higher education
Accommodating	Management & HR Sales & marketing Teaching & nursing Government

Alternative learning approaches have been advanced to further the educational quality of work-integrated learning (WIL). McRae (2014) argues that “without a deeper understanding of the conditions and factors that lead to transformative learning in WIL, students’ educational experience will not be guided, modified or evaluated, in any meaningful manner” (p.6). The accelerating and complicated changes of future work will force traditional work-integrated learning frameworks to adapt to more personal and intuitive pedagogies to ensure their relevance is future-ready. Whereas previously, the workplace was primarily assumed to provide this basis for work-integrated learning, this is no longer the case, and a more connected learning space solution is required for the future. With this in mind, more recent learning theories that seek to advance the quality of experiential learning frameworks are set out below.

2.2.4.5. Engestrom: Activity Theory

“Similar to Kolb’s experiential learning theory, activity theory is based in constructivism, but adds the dimensions of time, context, and transformational processes” (McRae, 2014, p.5). Activity Theory, also recognised in the literature as socio-cultural activity theory, is drawn from the works and studies of Russian psychologist Lev Vygotsky (Roth & Lee, 2007). “Common to the founders of activity theory is the insight that the human mind is not located within the brain, not even bounded by the skin of the individual. The mind is in actions and activities in which

humans engage with the world, by means of cultural artefacts such as signs and tools” (Sannino & Engeström, 2018, p.44). This further developed Kolb’s experiential learning theory by explicitly recognising that experiential learning resulted from the connection and interplay with factors surrounding the learner and possibly resulting in unpredictable outcomes. Engestrom (1987) presented this activity interplay in his “structure of the activity system” set out in Figure 7:

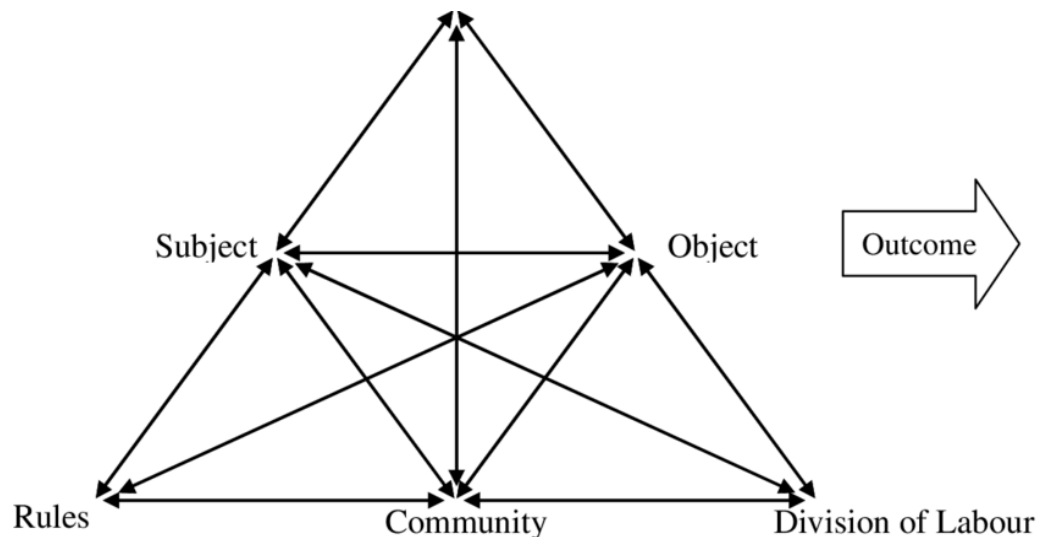


Figure 7: Structure of the activity system (Engestrom,1987)

The activity triangle presents considerations that encompass expansive learning. The overall activity of interest by the learner, which Roth and Lee (2008, p.198) set out as an “evolving, complex structure of mediated and collective human agency”, is comparable to Lewin’s (1957) “life-space growth.

Sannino and Engeström (2018) described the components of the activity system as follows:

1. The Outcome - is either the long-term goal, the desired outcome or the actual outcome resulting from the interplay of all the other interactions within the activity system. Notably, the two-way directional arrows elevate activity theory to a more inclusive construction than Kolb’s (1984) experiential learning theory, as it is not a one-directional learning circuit, as presented in Figure 7;
2. The Object - describes the focus of the activity or what drives the immediate outcome and will change with the interplay of the components;

3. The Subject - represents from whose perspective the activity is examined which is, in the case of study outcomes, the learner;
4. The Tools - are what the Subject selects or chooses in conducting the activity;
5. The Rules - include regulations and inferred rules and set the standards which must be adhered to for the performance;
6. The Community - constitutes the social-cultural environment and describes who influences work on the Object; and
7. The Divisions of Labour - set out who carries out the activity and with what authority.

Activity Theory represents a significant step up in experiential learning, recognising the importance of the interplay of factors leading to learning outcomes: “both the subject and object are influenced by mediating tools or artefacts, the nature of the community to which the activity system belongs, the rules of expected behaviour appropriate to the design and the division of labour within the system” (Wilson, 2014, p.22).

2.2.4.6. Mezirow: Transformative Learning Theory

“Activity theory and transformational learning theory share common goals of fostering both individual and social transformation” (McRae, 2014, p.5). Jack Mezirow, influenced by Jurgen Habermas and Paulo Freire, believed that all individuals seek meaning and balance in their lives and that transformative learning allows this through learners interpreting and then reinterpreting their existing experiences to make meaning and new learning outcomes (Chipamaunga, 2015). This is described by Mezirow (1997) as “the process of effecting change in a frame of reference” (p.5). To achieve this, though, the learner has to begin with a “coherent body of experience— associations, concepts, values, feelings, conditioned responses - frames of reference that define their life-world” (Mezirow, 1997, p.5), and these are reflected in their “habits of mind” and “points of view” (Mezirow, 1997, p.5-6). Transformative learning occurs with changes to these outcomes and is essential for personal growth and development (Mezirow, 1997).

For effective transformative learning, “critical reflection and discourse” are required (Mezirow, 1997, p.5). Critical reflection allows for changes in existing frames of reference through new information being imputed: either instrumental learning (task-orientated problem solving) or communicative learning (communication of feelings, needs and desires). Discourse then takes place through discussing and debating the alternative and competing viewpoints and interpretations. A community of learning occurs when an expected outcome is decided upon and

remains until new arguments are presented (Mezirow, 1997). Mezirow identified the following phases that learners will go through as they transform their viewpoints into new knowledge:

1. A disorientating dilemma - a new learning process begins with the learner recognising that an existing preconceived viewpoint may no longer be correct. This may be uncomfortable and challenging;
2. Self-examination - the learner begins self-examining their existing beliefs or understanding, seeking to understand the impact of the newfound dilemma on their current viewpoint;
3. Critical reflection and discourse - as discussed above, a process of transformational learning takes place leading to a more thorough understanding of the new viewpoint or perspective;
4. Planning a course of action - recognising the need for change, the learner now needs to consider what types of learning are required to implement the new understanding fully;
5. Acquisition of knowledge of skills - from the plan, the learner must now acquire the relevant knowledge to achieve the critical reflection. This may take extensive effort to be successful;
6. Exploring and trying new roles – having acquired the new skills, the learner now embarks on embedding the transformational learning by actively exploring and experiencing the new viewpoint personally; finally leading to
7. Greater confidence with new roles and relationships - the transformative learning phase allows the learners to build confidence in their new beliefs and continue to practice the transformative cycle going forward.

Mezirow (1997) believed learning required foundations that provided an environment where learners, for both themselves and others, become more aware and critical of the assumptions supporting frames of reference, use their imagination to look at problems differently and, through discourse, arrive at the best judgement towards selecting new learnings.

In work-integrated learning, transformative learning should be reflected in group problem-solving, such as group projects, case studies, role play, action research projects, and simulations.

2.2.4.7. Lave and Wenger: Situated Learning Theory

Finally, Jean Lave and Etienne Wenger (1991), building on Vygotsky's (1978) activity theory, presented a theory of knowledge connecting learners, their activities and their environment, which is known as Situated Learning: "the notion of situated learning now appears to be a

transitory concept, a bridge, between a view according to which cognitive processes (and thus learning) are primary and a view according to which social practice is the primary, generative phenomenon, and learning is one of its characteristics” (Lave & Wenger, 1991, p.34). In comparison, Kolb and Kolb (2005) set this out as “knowledge resides not in the individual’s head but in communities of practice that have a history, norms, tools, and traditions of practice” (p.200).

Lave and Wenger (1991) suggest that central to this approach to learning is an understanding of a process they described as “legitimate peripheral participation in communities of practice” (p.29). “A person’s intentions to learn are engaged, and the meaning of learning is configured through the process of becoming a full participant in a social-cultural practice. This social process includes, and indeed subsumes, the learning of knowledge skills” (Lave & Wenger, 1991, p.29). They go on to present three characteristics required to develop a successful community of practice:

1. Domain - the community requires an intent to share their collective competence or expertise, even though outsiders may not recognise or value this;
2. Community - community members must actively share and engage each other in joint activities and discussions to learn from one another; and
3. Practice - there must be an intention to develop a shared knowledge outcome from the community and ways of solving the interest that brought the community together; that is, they must become practitioners of their newfound learnings.

Situated Learning suggests beginner learners embark on their learning journey by being involved in authentic settings of daily routines through which they apply their learnt skills in low-risk ways until their knowledge and skills expand. From here, they transition to the periphery of a community of practice through dynamic, complex activities and reflection, becoming an expert, often informally and unintentionally. Lave and Wenger (1991) suggest that simultaneous performance at different levels and with various responsibilities creates learning and knowledge beyond the classroom. More recently, Wenger (1998) has expanded on the theory of communities of practice by providing a conceptual framework for analysing learning as social participation. Wenger (1998, p.4) identifies four components to develop practical knowledge by combining the individual and the community in interaction:

1. Meaning - individuals have to be able to share their experiences in a manner that is meaningful to them personally;

2. Practice - the learners need to be able to engage in action with their learnings and experiences with the community to reinforce the social outcomes;
3. Community - there is a need for social recognition by the community of the individual's participation as a competence; and
4. Identity - the individual must share how the learning outcome has impacted or changed them.

In work-integrated learning, transformative learning should be reflected in group problem-solving, such as group projects, case studies, role play, action research projects, and simulations. These four components that are summarised in Wenger's (1998, p.5) framework are presented in Figure 8:

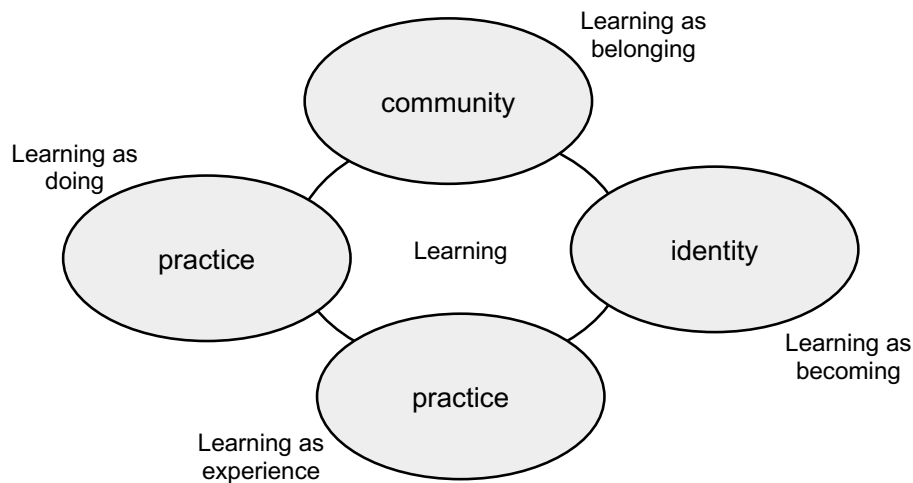


Figure 8: Components of a social theory of learning (adapted from Wenger, 1988)

Wenger (1998) notes that these components are “deeply interconnected and mutually defining” (p.5) and any one of the components could be switched and the relationship with learning at the centre. Here, the power of social engagement through actions and interactions remains core and has important implications for supporting apprenticeships, cooperative activities and work-integrated learning programs.

In this first section of this chapter, the development of experiential learning theories has been presented. Common to all is that knowledge is constructed through complex, multi-faceted experiential interactions, which can be direct, incidental, directional, personal or collective. In

more recent theories, there is a greater focus on situational experiential learning, recognising learners must primarily take responsibility for their knowledge creation and that developing their non-technical or behavioural skills is equally important to more traditional apprenticeship-styled learning programs. Recognising these theories provides powerful pedagogical frameworks to advance work-integrated learning into the future of work and to develop the required skills for employability, which are discussed in the next section.

2.3. The Future of Work

The World Economic Forum's (2023) “Future of Jobs” report predicts the possibility of a double disruption from the economic impacts of the changing nature of work and the workplace, with the pace of technology adoption likely to accelerate and up to 50% of all existing employees requiring reskilling by 2025. This unprecedented situation will drive up the rates of job destruction and creation, exacerbate inequality within job structures, impact learning and training and force governments to provide more substantial support for reskilling or upskilling retrenched workers.

2.3.1. The changing nature of work

Dramatically, Wang and Siau (2019) describe the impact of the changing nature of work as follows: “the way we work, the way we live, and the way we interact with others are expected to be transformed at speed and a scale beyond anything we have observed in human history” (p.61) and then more somberly, suggest that “the window of opportunity to understand the impact of these technologies and to preempt their negative effects is closing rapidly”.

The nature of modern work has accelerated from the first industrial revolution, which began in the 18th century with the advent of steam-powered machine production transforming manual industry and lasted approximately sixty-five years. Subsequently, three further industrial revolutions have impacted innovation and business cycles, each based on a defining disruptive technology and each with a shorter period of influence. The second industrial revolution, using electricity, enabled mass production and improved automation (approximately fifty years in duration). The third industrial revolution advanced electronics and information technology, further improving automated industry’s scale and complexity (approximately thirty years in time) (World Economic Forum, 2020). In 2016, Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, suggested that a fourth industrial revolution was underway “characterised by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres” (Schwab, 2016, para. 1).

An insight into the impact of the future of work resulting from the fourth industrial revolution is provided by a New York Stock Exchange-listed fund, the ARK Innovation Fund (ARKK). ARKK is a high-profiled, actively managed exchange-traded fund seeking long-term capital growth by investing in industries and companies with the potential of “disruptive innovation”, defined as “the introduction of technologically enabled new products or services that potentially change the way the world works” (ARKK, 2022, para. 1). ARKK’s investment management believes that these disruptive and innovative industries will materially displace older technologies and create new markets over the next decade, impacting the future of work: “we believe that historians will look back on this era as one of unprecedented technological ferment—and they will say: everything changed”. Ark Investment Management LLC (2022, p.5), in their Big Ideas research report, highlights five innovation platforms that are evolving and converging at the same time, which will have a material impact on the future of business and industry. ARKK estimates that these five technology platforms are likely to generate more than \$200 trillion in business value and wealth creation by 2030, compared to non-innovation industries at an equivalent of \$126 trillion. The innovation platforms and transformative technologies are as follows:

1. Artificial intelligence - AI software and other computational systems, mobile-connected devices, the Internet of Things (IoT) and cloud computing;
2. Robotics - dynamic productivity, 3D printing and reusable rockets;
3. Energy storage - battery technology and autonomous mobility;
4. DNA sequencing - gene sequencing, editing and living therapies; and
5. Blockchain technology – distributed databases and digital wallets.

In turn, these future opportunities have prompted increasing concerns about unknown challenges and issues yet to be adequately understood. Wang and Siau (2019) suggest four areas of uncertainty:

1. Reliance on large volumes of quality data - leading to concerns about privacy, security, biases and computational quality;
2. Processing integrity - the use of machine learning algorithms impacting on transparency and predictability;
3. Economic impact - increasing wealth inequalities and the inability of developing countries to benefit; and
4. Unknown social impact consequences - job displacement and replacement, ethical and moral issues and legal and regulatory challenges.

Finally, Moody and Nogrady (2010) suggest that a further revolution is underway in a resource-limited world, which will require disruptive technologies to incorporate sustainability as a competitive factor, saving the planet and generating economic, social and environmental benefits. This, in turn, will lead to waves of further innovation. They also predict that the endpoint of this sustainability revolution will be economic growth that is not dependent on the consumption of resources but on creating value through human time and ingenuity.

2.3.2. Digital skills for employability

The rapidly changing nature of work will require graduates to develop diverse and transferable skills, necessary for adaptation to their changing experiences (Jackson et al., 2019). Bandura (1986) foresaw this, suggesting that future careers will “require more than the specialised knowledge and the technical skills of one’s trade” (p.433) This was supported by Birkett (1993), arguing any successful performance will require problem-solving and behavioural skills. More recent research supports these early insights, recognising that non-technical skills are likely to be more important than technical ones into the future (Coll & Zegwaard, 2006).

Building on these foundations, the World Economic Forum's (2020) report on the “Future of Jobs” states that 50% of employees will require reskilling by 2025, with the majority requiring up to six months to cope with the “double disruption” (p.5) of the economic impacts resulting from the changing nature of work and the workplace. The report also highlights the top ten skills that will be most required by 2025, and are argued to be the most suitable for the ever-increasing hybrid workspace employment solutions:

1. Problem-solving
 - a. Complex problem-solving
 - b. Critical thinking and analysis
 - c. Creativity, originality and initiative
 - d. Reasoning, problem-solving and creativity
2. Self-management
 - a. Active learning and learning strategies
 - b. Resilience, stress, tolerance and flexibility
3. Working in teams, with leadership and social influence
4. Technology use and development
 - a. Technology use, monitoring and control
 - b. Technology design and programming.

Earlier, however, Caudron (1999) had pointed out that behavioural, or non-technical, skills have traditionally lagged in development because they are considered more difficult to develop and measure. This was supported by Arnold and Davey (1994), who argued that academic institutions and employers neglect behavioural skills because they cannot link their measurement to work benefits. In this context, Xing and Marwala (2017, p.10) stress that “critical thinking, people management, emotional intelligence, judgment, negotiation, cognitive flexibility, as well as knowledge production and management” are critical for preparing for digital workspaces. In addition, since the Covid-19 pandemic, skill-building has been found to be far more important to organisations than hiring or contracting (McKinsey & Company, 2021).

2.3.3. The future workspace

Historically, the workplace featured prominently in traditional experiential learning and work-integrated learning (WIL) programs and was seen as a place of learning alongside educational institutions (Billett, 2002; McRae, 2014). However, accelerated by the Covid-19 pandemic, McKinsey's (2021) research report titled, “Building workforce skills at scale to thrive during—and after—the COVID-19 crisis”, suggests that hybrid workspaces not requiring a full-time presence in the office are here to stay. This report argues that the workspace models which employees most desire include work-life support, team building and mutual respect (relational factors), which are largely missing from full-time workplaces. The move towards remote and hybrid working will impact experiential learning programs. Dean and Campbell (2020) argue that: “work is no longer simply completed within the confines of a bounded office and constraints of time periods. Instead, the nature of work has evolved new practices and ways of being, which has seen the adoption of remote work settings, fluid time constraints and continuous connectivity. Work placements are not the only solution to authentic work practice when work practice itself continues to shift and is enabled by technology” (p.355-356). Consequently, future WIL solutions should seek alternative practice-based, work-based and authentic learning experiences, including small-to-medium enterprises, hackathons, structured projects and incubators (Kay et al., 2019; Smith et al., 2019).

The increasing shift towards technologically enabled remote learning practices, accelerated by the current pandemic-related impact, is driving WIL solutions towards more diverse, innovative practices and, especially, alternatives to traditional WIL work placements. In particular, how and where WIL is adopted and practiced will require review: “what is required in concepts of learning

in WIL is a disconnection between immersion as learning and practice as learning” (Dean & Campbell, 2020, p. 360).

Winchester-Seeto and Piggott (2020), noting concerns over the changing nature of work and how it is presented, argue that “if WIL is to remain instrumental in facilitating job-readiness, the design and delivery of WIL models will need to accommodate preparing our graduates for the workforce more broadly, and not only for the workplace” (p.5). Billett (2009) suggests that designing future WIL programs should begin with assuming students will not be in physical workplaces.

Dean and Campbell (2020) argue that “the experience of a student in the placement or non-placement model will be different, just like the experience of a student in one physical workplace is different to that in another. The non-placement model is not a direct substitute for a placement option but is instead a new way of undertaking WIL that requires specific considerations as to how quality in product, process and presage is realised” (p.359). Billett (2014), though, warns that separating experiential learning and the workplace is not without theoretical and pedagogical challenges. This is supported by Zegwaard et al. (2017), who argue that time spent in the workplace is an integral part of WIL, particularly in the context of organisational culture and teams.

While the sector understands the benefits of workplace-based WIL, Dean and Campbell (2020) suggest that although there is broad acceptance of the benefits of non-placement WIL, the quality of the learning outcomes is still under assessment. However, Steinhardt et al. (2017) warn though quality, as defined in this context, is subject to interpretation by various stakeholders and may not have a consistency in output.

2.3.4. Project-based learning

This research report focuses on hybrid WIL workspaces with team-based projects as an authentic WIL model that is relevant to the changing needs of workforces. Blumenfeld et al. (1991, p.371) argued that: “project-based learning is a comprehensive perspective focused on teaching by engaging students in investigation. Within this framework, students pursue solutions to nontrivial problems by asking and refining questions, debating ideas, making predictions, designing plans and/or experiments, collecting and analysing data, drawing conclusions, communicating their ideas and findings to others, and asking new questions.” All of these dimensions are key to developing the future workforce.

A corporate example of the accelerating power of project work is Stakwork Inc., a US-based technology business platform “that combines the power of human intelligence with machine-learning automation to break complex business problems into easy-to-learn simple tasks and cloud sourcing workers to complete them (Stak, 2023, para. 4). The success of the model is twofold: firstly, it allows organisations to break down problems into micro projects and then determine which can be automated and which requires knowledge workers. Secondly, the micro projects requiring human input are offered to “a global virtually connected workforce giving them unparalleled freedom to work, to earn, and to do it on a schedule and in a location that they choose”. These project styled work activities will be further enhanced with the involvement of generative artificial intelligence solutions, increasing the need for project-based learning.

2.3.5. Upskilling in the digital workspace

In addition to understanding the impact of the changing nature of work and the skills required for employability in the digital economy, the increasing importance of ongoing technological upskilling is highlighted in the literature. Pedota et al. (2023) suggest that “understanding how Industry 4.0 technologies complement each other on one side, and human skills on the other, is essential for the optimisation of firm-level sociotechnical interactions” (p.1).

Neumann et al. (2021) argue that, although the adoption of technologies and upskilling of workers are recognised as complementary and interdependent, the practical implementation of this interdependency is not as clear and requires further study. For example, Pedota et al. (2023), in their study of over one thousand Italian firms, break down this mutual complementary relationship into digital versus physical technologies implemented into the workplace and workforces and between their Information, Communication and Technology (ICT) and non-ICT employees. Examples of digital technologies include artificial intelligence, data analytics and virtual reality and are seen as enabling physical technologies such as robot-enhanced manufacturing production lines (Wang & Siau, 2019). Pedota et al.'s (2023) results provide “evidence that the adoption of I4.0 technologies, whether digital or physical, is likelier to be coupled with a conjoint ICT upskilling of both ICT and non-ICT employees, rather than a selective upskilling of either of the two” (Pedota et al., 2023, p.2).

McKinsey (2020), in their Future of Work report, support this upskilling research, highlighting that 87% of the companies that participated in their survey are either experiencing technology skill gaps now (43%) or are expected to within the next five years (44%). The respondents highlighted that their ICT business areas had the greatest need to address the potential

skills shortage, and that non-ICT areas, such as executive management, human resources, sales and marketing and product and service design, also scored highly. Furthermore, McKinsey (2020) predicts that by 2030, 60% of occupations globally could have at least 30% of work activities automated.

Hecklau et al. (2016) raise concerns that upskilling models currently tend towards selective upskilling of the workforce based on their precise technical requirements. In contrast, more effective solutions in the future will require a more holistic combination of technical and behavioural skill orientations. Fisk (2017) supports this increasing requirement for broader cross-functional skill sets being required in the future.

As discussed earlier, studies also indicate an increasing requirement for improved behavioural skills in the digital economy, including emotional intelligence, critical thinking, communication, leadership, and creativity (Ciarli et al., 2021). In turn, this emphasises the importance of smart human resource solutions and more focussed training. McKinsey's (2022) report, "HR's new operating model", forecasts that, to stay abreast of technology upskilling requirements, future talent management will have to:

1. Adopt agile policies - to ensure that capacity and resources are allocated where they are most needed in the face of a fundamentally faster rate of business change;
2. Recognise the employee experience journey - to ensure employees' retention, health and resilience;
3. Offer individualised human resource services - to address increasingly varied expectations and requirements;
4. Develop fit-for-purpose upskilling services - to effectively meet the needs of the changing workplace; and finally
5. Automate human resource solutions - to drive efficiency and harness the power of digitalisation.

Zolas et al. (2020) qualify this by pointing out that the size of the firm is a factor in upskilling and that smaller firms find it more difficult for technological upskilling of their workforces. In large part, this is a consequence of two factors. Firstly, in their Italian firms' study, Pedota et al. (2023) found that, while most large firms and about one-third of medium firms were adopting new technologies, the overwhelming majority of small firms had not adopted any. Secondly, smaller firms did not have the human resource support to meet the needs of the rapidly changing workplace.

Finally, there is an increasing realization that upskilling within the fourth industrial revolution and digital economies will require lifelong and multidisciplinary learning (Da et al., 2020) as well as endeavors to develop sociability and creativity (Ciarli et al., 2021), all of which will support employee interconnectivity and technological recombination.

2.3.6. Principles for creating successful experiential learning spaces

Kolb and Kolb (2005) suggest that “the enhancement of experiential learning in higher education can be achieved by creating learning spaces that promote growth-producing experiences for learners” (p.205). Their concept of the “learning-space”, compared to the “workspace”, is an important distinction in the current post-Covid-19 new normal. Whereas traditional research into experiential WIL education presumed the workplace as the obvious fulcrum for learning, this may no longer necessarily be the case. Kolb and Kolb’s research and findings significantly impact the study reported here, given its focus on the world’s “new normal” post-Covid, which has impacted the future of work and the workplace.

Kolb and Kolb (2005) summarise their framework as follows “The experiential learning theory learning-space concept emphasises that learning is not one universal process but a map of learning territories, a frame of reference within which many different ways of learning can flourish and interrelate. It is a holistic framework that orientates the many different ways of learning to one another” (p.200).

From their research, Kolb and Kolb (2005) set out several educational principles to support creating learning spaces and improve experiential learning for students in Higher Education:

1. Respect for learners and their experience - for a “growth-producing experience” (p.207), they argue the whole environment supporting the learner must be conducive to sustaining a successful experiential outcome, including their “physical and social environment and quality of relationships” (p.207);
2. Begin learning with the learner’s experience of the subject matter - as supported by Piaget and Vygotsky, learners construct their new experiences from a platform of what they already know and believe. So, it is important to acknowledge and understand their existing experiences to enhance and grow them further;
3. Creating and holding a hospitable space for learning - in contrast to point 1 above, a hospitable space is more about participation with teachers and fellow classroom pupils in a learning space. It is about the ability of the learner to feel supported and not threatened in building their life experiences. Kegan (1994) observes that “people grow

best where they continuously experience an ingenious blend of challenge and support” (p.42), and Kolb and Kolb (2005) suggest that “creating and holding a learning space requires a climate or culture of support that the learner can trust to ‘hold’ them over time” (p.207).

4. Making space for conversational learning - Keeton et al. (2002) suggest that conversation allows learners to reflect on their experiences and is critical for developing new knowledge. This should not always just be a spontaneous conversation, but the learning space should also allow broader team discussions always but within the hospitable space.
5. Making space for the development of expertise - for learners with a base of learned knowledge, the learning space must allow them to organise, structure and implement their new knowledge as solutions, the core of work-integrated learning outcomes.
6. Making spaces for acting and reflecting - Dewey (1934) noted, “nothing takes root in the mind when there is no balance between doing and receiving” (p.45). So, the learning space must allow learners to test their skills and reflect on outcomes to build their knowledge and “expertise related to their life purpose” (Kolb & Kolb, 2005, p.208). Furthermore, this reflection should be structured into curricula and supervised to enhance the outcome.
7. Making space for feeling and thinking - it is recognised that emotions and feelings have a material impact on learning: “negative emotions such as fear and anxiety can block learning, while positive feelings of attraction and interest may be essential for learning” (Kolb & Kolb, 2005, p.208). However, it is also acknowledged that providing structured space to attend to these is difficult, given the personal nature of feelings and emotions. Being aware and empathetic to those in need provides that space.
8. Making space for inside-out learning -This model of learning describes a process that begins with the learner rather than the classroom curriculum. By understanding their personal needs, including interests, desires and goals the educational agenda for the learners is set outside of academia and developed to support their needs for a more effective outcomes (Heick, 2012).
9. Make space to take charge of own learning - Kolb and Kolb (2005, p.208) argue that learners can be “conditioned by their previous educational experiences to be passive recipients”, hindering their learning development Therefore taking charge of

constructing their knowledge, as described by Kegan (1994) and Boyatzis (1994, p.64) as “self-authorship”, becomes an essential component of the learning space.

Finally, and supporting their learning space principles, Kolb and Kolb (2005) suggest that successful implementation requires an overall institutional development approach, including curriculum, personal resources and administration. In Chapter 5, this research study will return to the principles set out above and compare them to the interns’ collective experiential findings, grouped into “conceptions”, leading to a proposal for the implementation of effective work-integrated learning in the African context.

2.4. A Sub-Saharan Africa perspective

In 2019, Ban Ki-Moon, the former Secretary-General of the United Nations, in an address to young African entrepreneurs in Ghana, stated: “with the rapid development of the global digital economy and the availability of technology, the next century belongs to Africa” (Ki-Moon, 2019). This emphatic statement is tempered, though, by the World Bank sponsored report, “Can Africa claim the 21st century?”, suggesting that “major changes are needed if Africans - and their children - are to claim the 21st century”(Gelb et al., 2000, p.1).

In 2022, the World Economic Forum estimated that over 60% of Africa’s population was under the age of 25 and by 2030, young Africans will comprise 42% of the global youth. Although this presents many challenges in terms of food security, healthcare, sustainability and infrastructure, this demographic pattern is already starting to shape the economies in African countries, such as Ghana, Kenya and Nigeria. In 2021, over \$2 billion dollars was invested in start-ups led by Africans under the age of 35 years old (World Economic Forum, 2022).

Gross (2019) suggests that the 4IR is the opportunity for Sub-Saharan Africa (SSA) to catch up with the world both socially and economically: “technological change would also allow SSA to skip certain development stages as they are not bound by out-aged technologies, but rather the region could take the lead in innovation and technologies of the 4IR” (p.1). Furthermore, Africa is not a country, but a continent of fifty-three nations with extraordinary diversity, from climate to geography to the well-being of their economies. At the same time, Africa is recognised as an emerging market and a member of the “Global South” (UNCTAD, 2018, p.1), regarded as having a relatively low level of economic and industrial development.

However, technology alone cannot ensure SSA’s sustainable economic development. Ramirez (2018) suggests that, although technology is growing rapidly on the continent, this is not at a rate commensurate with population growth nor is it adequate to meet the associated and

fundamental societal issues and infrastructure challenges. Therefore, the prospect of technology scaling and leapfrogging is only feasible if the continent has a platform of progress conducive to future needs.

“Technological leapfrogging” relates to models of economic growth where “latecomer countries have two main advantages: avoiding incomplete technologies at the early stages of development, related to high costs due to necessary R&D investments, and having access to cheaper, further developed technologies” (Gross, 2019, p.12). Sub-Saharan Africa has had several significant leapfrogging successes, such as mobile money in Kenya and 4G connectivity in Rwanda (African Development Bank Group, 2019). However, several critical socio-economic and political structures must also be in place for sustainable economic development to occur. Cilliers (2018) argues that governments must establish policies supporting institutional frameworks, quality education and social equality.

Research into the ways in which leapfrogging was an successful strategy for East Asian economic development again demonstrates that strategic policies must be successfully implemented first: macroeconomic stability and quality governance, open trade, supportive technology and infrastructure and flexibility in labour markets (Quibria, 2002).

In its 2019 report, the Brookings Institute argued that Africa was lagging in terms of several indicators key for leapfrogging, including technology access and use, and preparedness through Higher Education (Ndung’u & Signe, 2019). The report offers three critical strategies for countries’ economies to take advantage of the fourth industrial revolution:

1. Fixing the labour-skills mismatch. The World Economic Forum (2017) predicts Africa’s workforce will be ranked among the world’s largest, with its workforce share with at least a secondary education increasing from 36% in 2010 to 52% in 2030. Educational policies supporting Africa’s 4IR empowerment opportunities will benefit the continent’s youth workforce, reduce poverty and have positive economic consequences.

2. Providing secure governance so there is confidence in integrating the technology into industry solutions. A key to technological leapfrogging lies with state governance and institutional support. This ranges from legal frameworks supporting technological IP, fighting cybercrime, continental trade agreements and reducing barriers to entrepreneurship and innovation.

3. Developing physical and digital infrastructure. Africa’s most significant constraint to leapfrogging remains the lack of access to related advanced technology infrastructure. For

sustainable, inclusive growth, governments must take the lead in closing the gaps in digital infrastructure , highlighted in Figure 9.

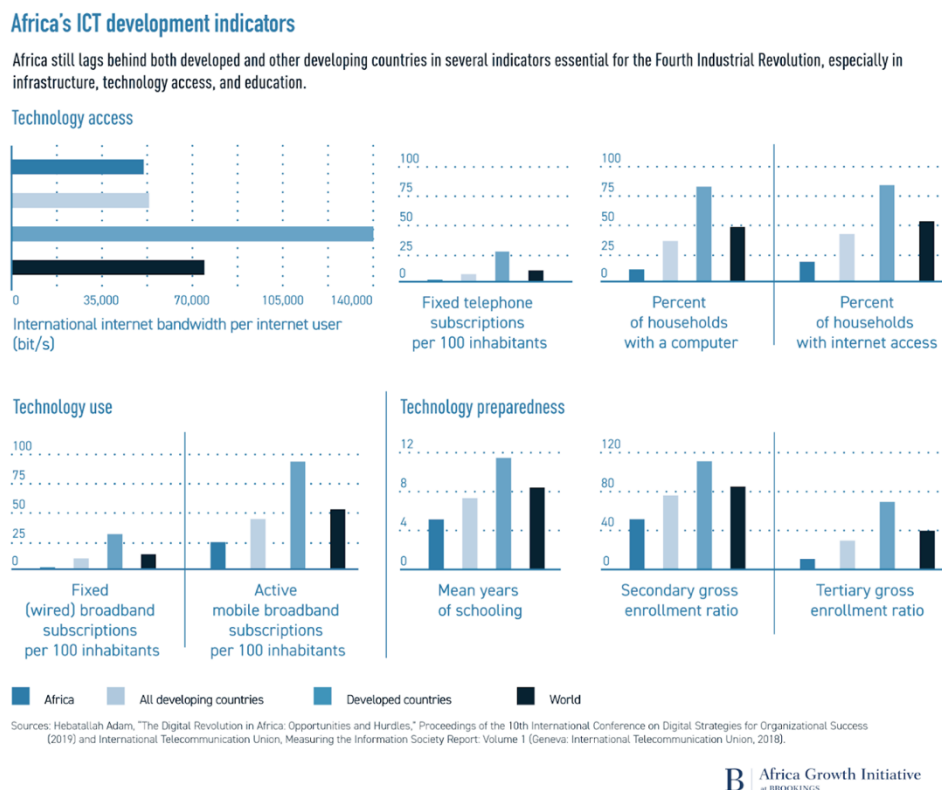


Figure 9: Africa's ICT development indicators

(Brookings Institute "Foresight Africa" Report, Ndung'u & Signe 2019, p.62)

A more detailed discussion of the factors required to enable Africa's successful transition into the digital future us set out in Appendix A: an extract from an African Development Bank report entitled "Unlocking the potential of the fourth industrial revolution to transform Africa."

Ranking Sub-Saharan African countries in terms their heterogeneity and potential for successful technological transformation also throws light on the conditions necessary for successful leapfrogging. According to the World Economic Forum's 2019 Global Competitiveness Index, Sub-Saharan Africa is the world's least competitive region, with only 9 of the 34 economies assessed scoring above 50%, led by South Africa (62.4%) and including Botswana, Cape Verde, Ghana (51.2%), Kenya (54.1%), Mauritius, Namibia, Rwanda and Seychelles. The prospect of widespread leapfrogging success remains elusive, again emphasising the importance of enabling the widespread adoption of work integrated learning.

2.5. Summary

This literature review comprised three parts. The first reviewed the literature supporting constructivist and experiential learning pedagogies. Beginning with foundational theories and leading up to Kolb's (1984) Experiential Learning Theory, there is a strong school of theory supporting the proposition that knowledge creation is facilitated beyond educational syllabuses through interaction and experience. Since Kolb, these experiential theories have continued to evolve, recognising that a large part of this learning cannot be built into formal educational curricula. Rather, knowledge creation takes place in behavioural skills development and only if learners accept their responsibility to be a part of the experiential learning journey.

This has important consequences for learning and employment in the workspaces of the future, and the second part of this chapter explored the accelerating changes in the nature of employment, primarily brought about by the fourth industrial revolution and increasing digital economies worldwide. The requirement for digital skills, the need for lifelong upskilling and the changing requirements in workplaces have been discussed. Common elements are the increasing importance of work-integrated learning to bridge the growing gap between skills learnt in Higher Education institutions, and then skills required in changing employment roles.

Finally, the impact of the fourth industrial revolution has been discussed in a Sub-Saharan context. Africa's young demographic profile provides the potential for rapid adoption of technological advances, allowing the continent to leapfrog more established economies into the future. On the other hand, the literature reviewed in this chapter warns that governments must provide the infrastructure and governance to enable this leapfrogging. Evidence is already suggesting that many African countries may not have the opportunity to benefit the digital economy revolution unless significant change takes place in the near future.

3. METHODOLOGY

3.1. Introduction

This chapter starts by setting out the theoretical basis for exploring graduate mathematicians' learning outcomes as interns in their workplaces and workspaces and sets out the basis for selecting phenomenography as the most suitable research method. The Industry Immersion Program (IIP) is introduced, which provided the hub from which the sample of participants was selected. The data collection and analysis processes utilised in the study are then detailed before finally addressing matters of ethics and trustworthiness.

3.2. Research approach

This study's research approach is founded in a qualitative (searching for meaning and understanding) constructivist (constructing knowledge through experiences) paradigm. As Merriman (2002, p.3) puts it, "the world, or reality, is not the fixed, single, agreed upon, or measurable phenomenon". Instead, she argues there are many and varied interpretations socially developed by individuals through their experiences and interactions with their world. Qualitative research seeks to analyse these interpretations at a singular moment and is "characterised by the search for meaning and understanding, the researcher as the primary instrument for data collection and analysis, an inductive investigative strategy, and a richly descriptive end product" (Merriman, 2002, p.6). An investigation into learners' experiences of work-integrated learning, as presented in the internships, lends itself to qualitative inquiry of this nature.

Phenomenography is informed by the theory of phenomenology, which is defined as a "philosophical paradigm aimed at understanding, whilst not explaining, people" (Chipamaunga, 2015, p.93). Because of the philosophical nature of phenomenology, it provides the foundation for qualitative research that seeks to understand human experience: "the phenomenologist emphasises that all human beings are engaged in the process of making sense of their (life) worlds" (Babbie & Mouton, 2001, p.28) and that their experiences and world are "inextricably related through the person's lived experience of the world" (Sandberg, 2000, p.11).

Although phenomenology and phenomenography are similar in that both seek to understand experiences that are "concrete, existential, descriptive, and un-abstracted" (Cibangu & Hepworth, 2016, p.151), the two methods are different in so far as "phenomenology aims to understand the essence of a phenomenon while phenomenography uncovers the variation in how people experience" (Bucci, 2020, p.38). Phenomenography is an appropriate research methodology for

the study reported here, given the focus on understanding the range collective experiences across the sample of participants in their workplace and workspace internships (Marton, 1981). These collective outcomes are measured in what is known as “conceptions” (Marton, 1986, p.42).

3.3. Phenomenography

3.3.1. Origins and approach

Phenomenography was initially developed in Sweden in the late 1970s by educational researchers Ference Marton, Lars Owe Dahlgren, Roger Säljö and Lennart Svensson as an empirical research model to study and describe the qualitative variations in how students experience the *same* phenomenon (Marton & Saljo, 1976). It was subsequently expanded to examine the “qualitatively different ways in which people experience, conceptualise, perceive, and understand various aspects of, and various phenomena in the world around them” (Marton, 1981, p.31). Today, phenomenography is accepted and adopted as a research approach across many academic fields, such as technology (Englund et al., 2017) and mathematics (Kapucu, 2014).

“Phenomenography as a research tradition is located broadly within an interpretive epistemological orientation and focuses on the variation in how a phenomenon is experienced by a group of individuals” and “is underpinned by, amongst others, a focus on the relational nature of human experience, a non-dualistic ontological perspective, an explicit focus on the experience of phenomena, and the adoption of a second-order view” (Collier-Reed et al., 2009, p.2).

Phenomenography aims to set out “the qualitatively different ways in which people experience, conceptualise, perceive, and understand various aspects of, and various phenomena in, the world around them” (Marton, 1986, p.31) otherwise known as categories of descriptions or “conceptions” (Marton, 1986, p.42). Phenomenography diverges from other interpretive methodologies as it takes the perspective of people’s experiences of the world, also known as a “second-order perspective” (Marton, 1981, p.178), where “the researcher must understand the phenomenon of study through the experience of others” (Bucci, 2020, p.8).

The ontology (the nature of the reality) of phenomenography assumes that “an individual cannot experience without something being experienced” (Marton & Pang, 2008, p.535) and accordingly, the phenomenon cannot be separated from those who experience it (Sin, 2010). Marton (2000) states that “there are not two worlds: a real, object world, on the one hand, and a subjective world of mental representations, on the other. There is only one world, a really existing

world, which is experienced and understood in different ways by human beings. It is simultaneously objective and subjective” (p.105).

Bowden (2005) explains that “the object of study in phenomenographic research is not the phenomenon being discussed per se, but rather the relation between the subjects and that phenomenon. So the focus of the research is on the researcher trying to find out about the object of study which is the relation between the subjects and the phenomenon” (p.12).

Figure 10 illustrates this focus of phenomenography, which is not on the phenomenon or the subjects but the relationships between them, describing the world as experienced and revealing the variation that exists (Bowden, 2005). From this Bowden (2005) suggests that “phenomenography takes the position that experience is relational, not purely objective, independent of people, nor purely subjective, independent of the world. Knowledge is then created from the relations between persons and in relation to the world” (p.12-13).

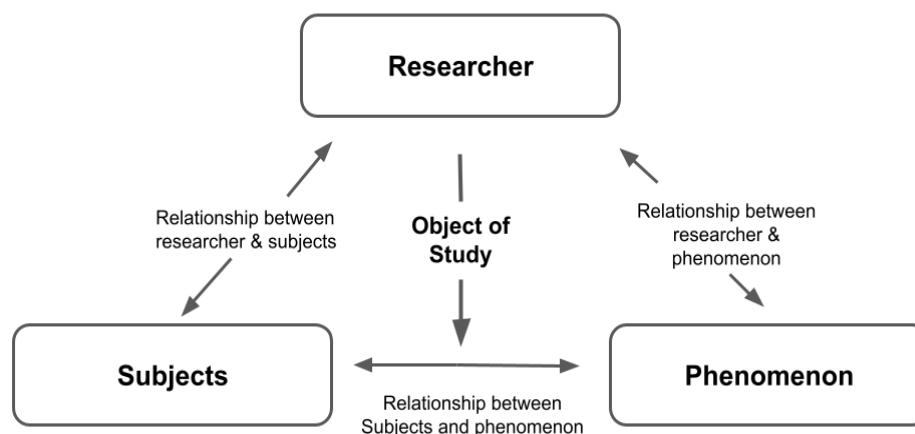


Figure 10: Relationship between objects with subjects and researcher (based on Bowden, 2005)

Furthermore, the focus on the world as experienced gives phenomenography a non-dualist ontology. The subject and phenomenon are connected, rather than separated (Marton & Booth, 1997). This has implications for the relationship between the researcher and the aspect of the world under investigation. Bowden warns that “the researcher has a privileged position in relation to the subjects through the interview process. The relationship between the researcher and the subjects also has the potential for imposition of the researcher’s view of the phenomenon if subjects seek

or receive guidance or approval from the researcher for what they say during the interview” (Bowden, 2005, p.13).

3.3.2. First-order and second-order perspectives

What is the relationship between phenomenology and phenomenography? Phenomenology is a “first-order perspective”, through which the researcher observes, analyses and interprets the data through the actual experience of participants (Marton, 1996; Marton & Pang, 2008). Following from this, phenomenography is a “second-order perspective”, which seeks the collective meaning and variations of, and between, phenomenon that have been experienced (Marton & Pang, 2008). Amplifications of these first- and second-order perspectives are provided by Åkerlind (2018, p.954): “the first- and second-order perspectives represent very different approaches to the positioning of human experience, and in particular, variation in human experience, within the research. From a second-order perspective, human experience and variation in experience are the core of the investigation; from a first-order perspective, human experience is, but the medium for collecting data, and variation in human experience (within the same experimental conditions) is white noise to be filtered by statistical tests of significance to determine better the reality underlying the noise.”

Phenomenography also presents data in a framework known as “the anatomy of experience”, which describes “the two components of the conscious awareness of an experience, namely a referential aspect and a structural aspect” (Marton & Booth, 1997, p. 88). This distinction is summarised in Figure 11.

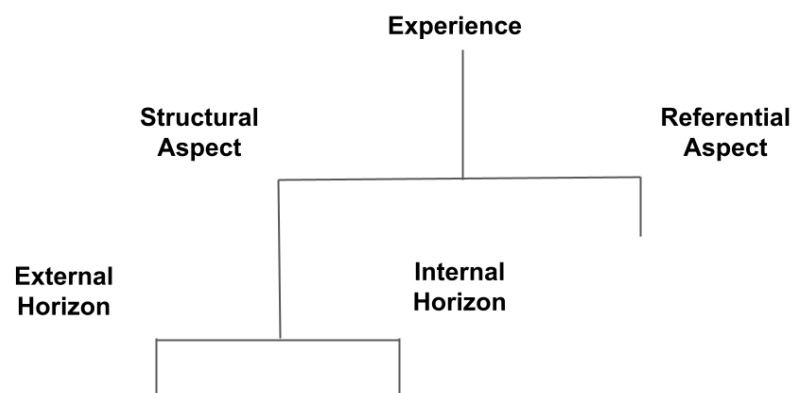


Figure 11: Anatomy of the experience (adapted from Martin & Booth, 1997)

While *structural* relates to the *structure* of that experience, *referential* refers to the *meaning* of an experience (Marton & Pong, 2005). The two aspects are simultaneously intertwined (Marton & Booth, 1997). The *structural* element can be further divided between an *external* and an *internal horizon*. The *external horizon*, the “discernment of the whole from the context,” enables the experience to be differentiated from its context and background (Marton & Booth, 1997, p. 87). In contrast, the *internal horizon*, the “discernment of the parts and their relationships within the whole,” denotes the inner relationship of various parts in an experience, how the features are distinctive from each other, and how the elements jointly form a cohesive entity (Marton & Booth, 1997, p.87).

In an educational context, students’ learning experience can be separated into *how they carry out* their learning (*structural aspects*) and, *what they think about learning*, their experience or comprehension of learning as a direct object (*referential aspects*). Furthermore, the *how* and the *what* are inextricably related by students as they describe the entire learning experience to the researcher (Marton & Booth, 1997). These distinctions are summarised in Figure 12 As such, phenomenography suits the research described in this report, with its focus on African students’ internship experiences in traditional workplaces and hybrid project situations.

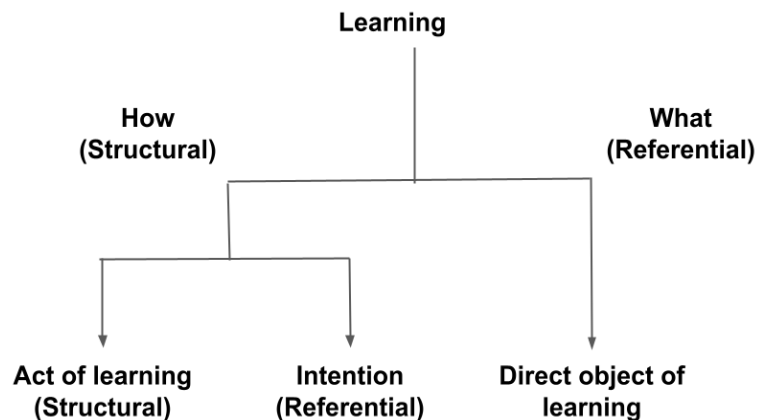


Figure 12: Experience of learning (adapted from Martin & Booth, 1997)

3.3.3. Conceptions

Phenomenography aims to distil interpretations into limited groupings (Åkerlind, 2012). From this, “the research outcome is a set of categories that describe the qualitatively different ways

of experiencing that phenomenon, and are logically related in structure and meaning. The categories are not descriptive of how *individuals* perceive the phenomenon – rather, they describe the phenomenon at the collective level” (Collier-Reed et al., 2009, p.2). These categories are known as “conceptions” (Marton, 1986, p.42), and each conception focuses on one way of experiencing the phenomenon. Taken together, a set of conceptions all of the ways the phenomenon is experienced (Svensson, 2016).

As a set, conceptions aim “to explore the range of meanings within a sample group, as a group, not the range of meanings for each individual within the group”(Åkerlind, 2012, p.117) and the variation in outcomes should “represent the full range of possible ways of experiencing the phenomenon in question, at this particular point in time, for the population represented by the sample group collectively” (Åkerlind, 2012, p.116). The collective experiences, represented through the set of conceptions, “are thus seen as representing a structured set, the ‘outcome space’” (Åkerlind, 2012, p.116).

Marton and Booth (1997) suggest three primary criteria for judging the quality of the conceptions that make up a phenomenographic outcome space:

1. each conception should reveal a distinctive understanding of the phenomenon;
2. the conceptions are logically related; and
3. the full extent of the variations of experiences should be represented by as few conceptions as possible.

3.4. The Industry Immersion Program

The African Institute of Mathematical Science (AIMS) and the European School of Management and Technology (ESMT) designed and implemented the Industry Immersion Program (IIP) as a pilot program in 2017 to meet the growing need to assist Africa’s top post-graduate mathematicians in achieving meaningful employment in industry in their home countries, particularly in data analytical roles. Mathematics studies in Higher Education institutions in Africa, unlike, for example, Engineering or Computer Sciences, are not typically vocationally aligned. So, although post-graduate African mathematicians achieve a high level of skills learning, connecting and integrating these into the workplace is still a challenging objective.

Following graduation with their Masters degrees, selected AIMS participants were chosen to participate in the Industry Immersion Program based on their wish to gain employment in industry. Those chosen then embarked on an initial six-week residential skills program comprising two core pillars; business skills and personal behavioural skills training. Following this, they began

three-month internships with suitable industry partners. The Industry Immersion Program pilot has mainly been successful, with over 80% of IIP participants (and 40% female) from 14 African countries placed into three-month internships or employment (AIMS: African Institute for Mathematical Sciences, 2023).

However, with the Covid-19 pandemic engulfing the world in 2020, significant challenges had to be resolved to continue the delivery of the program. From 2017 until 2020, the residential business skills program had been delivered in South Africa with participating ESMT lecturers flown from Germany. Afterwards, the program's internships took place in industry workplaces in participants' home countries to achieve experiential learning outcomes. However, the Covid-19 pandemic in 2020 resulted in AIMS campus lockdowns and companies closing workplaces and moving towards remote working. Around the world, educational institutions and work-integrated learning program teams grappled with the 'new normal' of the pandemic.

In the case of the Industry Immersion Program, four significant changes had to be implemented and, in hindsight, with considerable benefit to the program's future. Firstly, in partnership with ESMT, the physical delivery of the business skills module was converted to a blended delivery mode, with modules selected from the ESMT online MBA program presented by lecturers via Zoom and supervised by classroom-based tutors. The positive upside of this change was that in 2020 the program was successfully delivered to participants in lockdown at four AIMS campuses (Ghana, Kenya, Rwanda and South Africa), showing that the program could be scaled from a lower cost base.

The second significant change came in 2021, with the introduction of a non-AIMS partner. Kenya's Strathmore University joined the Industry Immersion Program with a cohort of engineering students, showing it was possible to consider a more significant footprint of independent Higher Education institutions across African countries.

Thirdly, because most workplaces were closed during the pandemic, hybrid internships were introduced in 2021. As businesses were learning to work remotely, the prospect of project-based internships with limited workplace participation became readily more acceptable, particularly for data analytical work projects. This had the effect of scaling the prospective marketplace by including remote and hybrid internships in comparison to traditional workplace internships.

The fourth and final significant change was a pilot partnership with Riipen Networks Inc ., a Canadian-based technology company that had developed an online experiential learning platform and marketplace.(Riipen, 2023) The online platform matches industry projects with suitable

learners across the world, supported by Higher Education institutions. Using this platform, learners can get access to complementary learning courses to upskill them for a project's successful completion. This allowed the Industry Immersion Program to select suitable remote internship projects for participants unable to find appropriate internship opportunities in their home countries.

By the conclusion of its seventh year in 2022, and despite the limitations imposed by the Covid-19 pandemic, 274 students had completed the Industry Immersion Program's business skills module as well as one of three styles of internships, each of three month duration:

Workplace

- a. physically located in the industry partner's office
- b. supervised team project participation

Hybrid

- a. teams of two to three with tutor supervision
- b. on outsourced projects from industry partners
- c. in a combination of remote and office working

Remote

- a. individual participation;
- b. on outsourced projects from industry partners

The success of the Industry Immersion Program has provided the data used in the research reported here, allowing a deep exploration of the experiential outcomes for participants during their work-integrated learning experiential internships.

3.5. Data Collection

3.5.1. Sampling and selection

Phenomenography seeks to examine “qualitatively different ways in which people experience, conceptualise, perceive and understand various aspects of, and various phenomena in the world around them” (Marton, 1986, p.31). Therefore, the participants must have experienced the phenomenon being studied (Marton & Svensson, 1979). Furthermore, because phenomenography focuses on collective differences, purposeful selection is critical to increasing the range of experiences and maximising the likelihood of variation (Collier-Reed & Ingerman, 2013). Accordingly, the selection is typically deliberate and non-random and influenced by the specific phenomenon being studied (Booth, 1997; Marton, 1986). Phenomenography seeks to analyse data at the group level, and individual details of the participants are less important

(Akerlind, 2012; Collier-Reed & Ingerman, 2013). However, the “selection of participants should avoid presupposition about the nature of the phenomenon or the nature of the conceptions held by particular ‘types’ of individuals while observing common-sense precautions about maintaining ‘variety’ of experience” (Ashworth & Lucas, 2000, p.300).

For this study, twenty-five Industry Immersion Program graduates were invited by email to participate in Zoom interviews. They were selected with the assistance of the program coordinator to elicit as much variance in experience as possible. Three of the original invitee batch did not respond, and four said yes but did not follow up on the Zoom interview invite. A second round of invitations was sent out to achieve the requirement for twenty participants, details of whom are set out in Appendix B. The broad characteristics of the sample group were as follows:

1. All were MSc graduates in mathematics-related studies and had completed the program in 2021;
2. Only two had any previous experience in industry before their internships;
3. All hoped for employment in industry in data analytics or business intelligence roles;
4. Eight African countries were represented, with 60% of the participants coming from Ghana and Kenya;
5. Of the twenty participants, eleven were female and nine male;
6. The internships were split with eleven in the workplace, five remote and four hybrid; and
7. Industry-wise, there was broad representation across the internships, with financial and technology services comprising the majority and the balance spread across various other industries, including consulting, engineering, government and non-government agencies, education and property.

3.5.2. Interviews

Åkerlind (2012) suggests that semi-structured interviews are the optimal form of data collection for phenomenographic studies. The goal of the phenomenographic interview is to reach “a detailed and rich encounter with the lifeworld” of each participant (Ashworth & Lucas, 2000, p. 302) and Bowden (2005) supports this by stating: “the central purpose is to encourage the interviewees to reveal as much as possible about their ideas and their experience” (p.18).

Ashworth and Lucas (2000, p.302) suggest these interviews can be viewed as a “conversational partnership” and should be in-depth and open-ended. Bowden (2005, p.18) suggests a combination of “neutral questions”, aimed at getting the participant to speak openly and

generally and then “specific questions”, either delving further into the replies given by the participants or inviting reflection by them about things they have said. With these, and with follow-up questions, the researcher must avoid influencing the interview or the participant’s responses (Bowden, 2005).

Although open-ended interviews may begin with pre-prepared questions, the researcher must be ready to adopt a flexible approach to the conversation and be prepared for the interview to take a different direction from that contemplated at the outset (Booth, 1997; Marton, 1986). In-depth interviews should continue until such time as a complete understanding of the phenomenon or conception is reached (Booth, 1997).

Bruce (1994, p.49) describes the phenomenographic interview as a “specialised form of the qualitative research interview”, and Kvale (1983) suggests phenomenographic interviews “are centred on the interviewee’s life-world; seek to understand the meaning of the phenomenon in the interviewee’s life-world; are qualitative, descriptive, specific and presuppositions; are focused on certain themes; are open to ambiguities and change; take place in an interpersonal interaction, and may be a positive experience (for the interviewee!)” (p.174)

Accordingly, semi-structured interviews were based on a list of questions set to explore the participants’ internship experience and were based on Kolb and Kolb's (2005) “learning-space” conceptions, discussed in Chapter 2, and designed to encourage participants to share openly. After the first eight interviews and the preliminary conception findings were analysed, the list of questions was refined to explore the experiential aspects of this study better, and with an African focus set out in Table 2.

Table 2: How participants experienced their internships - the interview questions

No	Zoom questions asked (with guidance to share “experiential” answers)
Q1	<p>Please introduce yourself and your internship?</p> <p>State your name, nationality and your address?</p> <p>Please describe your internship details</p> <p>Name of the company? Which industry?</p> <p>Your internship role?</p> <p>What was the title of your direct supervisor and position in the company?</p> <p>Was your internship in the workplace/ remote/ or hybrid based?</p>

	How long was your internship?
Q2	<p>Please describe your physical environment during the internship?</p> <p>Where did you live during the internship? Did you have internet connectivity? Was this a positive experience?</p> <p>Please share your relationships with family and friends in relation to your physical environment?</p> <p>How were you supported during the internship?</p> <p>How did you experience the Covid pandemic? How did it impact you and your physical environment during the internship?</p>
Q3	<p>What were you hoping to experience during your internship?</p> <p>Why did you wish to participate in an IIP internship? Do you have any previous industry experience?</p>
Q4	<p>Please share more about your internship?</p> <p>Was this a positive experience? Why? Share how your supervisor supported you?</p>
Q5	<p>Were you heard during your internship?</p> <p>Please share your experience with colleagues? And supervisors? Were there formal or informal sessions? How did you feel when you spoke up? If working remotely, could you have the learning conversations described above?</p>
Q6	<p>Were you able to develop the skills you had learnt during the IIP?</p> <p>Please share this support in developing your technical, business and behavioural skills? And describe any skills you wish you had been able to develop? Why were you unable to do so? Were these new skills compared to those of AIMS/Strathmore and the IIP? Was this a challenging experience for you?</p>

Q7	<p>Were you able to act independently during your internship?</p> <p>Please share if you were strictly supervised during the internship or whether you were allowed to act independently? Please give examples?</p> <p>And were you allowed to reflect on your progress and take new actions?</p>
Q8	<p>Were you able to step back and just think about your internship experiences?</p> <p>Please share the type of thoughts you had on the internship? did you feel? Were your feelings positive or negative?</p>
Q9	<p>Were you able to continue learning during the internship?</p> <p>Please describe any further learnings? Were these personal development learnings or additional skills?</p> <p>Please share if these were positive or negative experiences?</p>
Q10	<p>Are there any learning experiences you'd like to share from your internship?</p>

The interviews were conducted over two separate sessions, the first from March to August 2022 and the second from November to December 2022. All the participants were invited by email to participate in the approved format and at a time and date that suited them. A reminder email was sent to the participant the day before the interview appointment to set out the study's aim and the questions to prepare for a more considered interview. None appeared confused about the objectives of the interview; that it was their experience of the internship that was the subject of the study and not an evaluation of their project delivery.

The interviews were conducted through Zoom video communication (<https://zoom.us/>) and uploaded into Otter.ai voice meeting transcription software (<https://otter.ai/>). No significant technical difficulties were encountered in connecting with the participants nor the quality of the calls, which can be attributed to the participants ensuring that they were in suitably well-connected Wi-Fi zones. Zoom also provided interview backups. All interviews were conducted in English, and participants requested to speak slightly louder and slower to facilitate the transcription. Each

interview began with a relaxed introduction between the interviewer and participant and ensured the participant understood the aim of the study.

The question format set out in Table 2 was followed, and participants were able to respond openly and freely; the interviewer only asked further questions to clarify or confirm the experiences presented during the interview (Harris, 2011). At the conclusion of the set format, the participants were offered the chance to discuss any other experiential outcomes not touched on with the direct questions (Zygmunt & Naidoo, 2018). Generally, this appeared to be the first time they had such an opportunity to share their internship experiences. They were all very open to discussing both positive and negative responses. Interviews lasted approximately thirty to forty-five minutes.

After the interview, recordings were played back via Zoom and Otter to edit incorrect words or phrases. During this editing, high-level observational notes were also made regarding participants' overall experience sentiment during the interview and notable comments that stood out and influenced future interviews.

3.5.3. Saturation

Saturation is deemed to occur when no new learning experiences are uncovered in the interviews (Booth, 1997; Marton, 1981). In this study, the researcher adopted an informal approach towards saturation (Bucci, 2020). A target of twenty interviews was embarked upon at the outset. After eight interviews, the participants' transcribed responses were coded, and a first draft of preliminary experiential conceptions derived. The interview questions were revised to understand relevant workplace experiences better. The sample size for a phenomenographic study should allow for finding variation in conceptions while ensuring that the data collected is manageable; often, fifteen to twenty participants can achieve a reasonable range of variation (Bowden, 2005; Trigwell, 2000). After the first fifteen interviews, it was decided that a further five interviews should be conducted in order to ensure that adequate data had been collected. By the conclusion of the twenty interviews, the researcher believed that, although these additional individual responses were interesting, there were no additional contributions to the various collective experiences, and that saturation had occurred.

3.5.4. Ethical considerations

In phenomenographic research, ethical issues might arise due to the qualitative nature of participant interviews (Rovio-Johansson, 2018). In this study, all the participants signed informed

consent letters, as approved by the Faculty of Commerce at the University of Cape Town, before proceeding with their interviews. These consent letters provided the background and purpose of the study, the nature of the interview questions, time commitment expectations and the voluntary nature of participation. Furthermore, all participants were guaranteed anonymity.

Before the interviews started, the participants were again reminded of their rights in the process and that they could withdraw at any stage, that the Zoom interviews were to be recorded, transcribed, and verbatim extracts would be included in the study's findings. For the record, none of the participants requested withdrawal at any stage of the interviews.

Because this was a phenomenographic study, the interviews were analysed collectively, and individuals were highlighted in any discussion of findings (Åkerlind, 2012). Data collected was stored securely on the researcher's computer and in the cloud, all password-protected for security.

3.5.5. Transcriptions

All the interviews were transcribed verbatim, including grammatical errors and false starts, to avoid bias in the data analysis (Collier-Reed & Ingerman, 2013). The Zoom interviews were recorded and uploaded into the Otter.ai voice meeting transcription software (<https://otter.ai/>). This was a paid service, and the first outcome of each interview transcript was of a high standard. Then, the researcher embarked on two rounds of manual editing for each transcript. During the first round, the recordings occasionally had to be slowed to properly compare the transcripts to the spoken interviews and correct any incorrectly transcribed word mistakes. Although all interviews were in English, sound quality and accents required editing in all the transcripts. However, there were very few occasions where speech was unrecognisable. The second manual transcript edit helped ensure the participant's interview presentation made sense. This inevitably required some punctuation to improve readability and the removal of identifying material from the interview. The second round also allowed the researcher to gain a deeper familiarity with the transcript.

3.5.6. Coding

The aim of coding is to facilitate identifying the various categories of conceptions (Åkerlind, 2012). After discussion and investigation, the researcher decided not to code the transcripts using automated coding software, such as Atlas.ti. Given the required knowledge and familiarity, the researcher chose to set up a Microsoft Excel spreadsheet instead and manually cut and pasted quotations from each transcript from the twenty participants. Each transcript was then revisited and read again to ensure the researcher understood the participant's total experiences. Then all

relevant quotations were copied and pasted into a Microsoft Excel spreadsheet. Finally, 381 quotes were extracted. No effort was made to code the extracted quotations yet, but the researcher began to build a broad intuitive understanding of the broad preliminary conceptions.

The researcher reviewed Saldana's (2015) coding manual to become familiar with coding techniques. On the first coding round, the researcher separated all the quotes into the two broad categories of context and internship experiences. Within internship experiences, quotes were also categorised in terms of the workspace setting; for example, workplace, remote or hybrid. In the second coding round, all the quotes were given a preliminary key code. In many cases, the same quote was given two key codes, for instance, intern expectations or co-readiness, as the researcher held no preconceived ideas on the expected number of preliminary groupings that would arise. For the third round, the researcher began at the beginning of the quotes again, this time allocating detailed descriptive codes for all experiences referenced. The researcher by now held a far clearer understanding of the quotations and experiences, and the data could be viewed as a collective base of experiences rather than selected individual quotations (Åkerlind, 2012). Details of the coding that emerged from this analysis are provided in Table 3.

Table 3: Detailed coding levels

Context | overall | experience | positive
 Context | overall | experience | mixed
 Context | overall | experience | negative
 Context | workspace | workplace
 Context | workspace | remote | challenges | home working
 Context | workspace | remote | challenges | connectivity
 Context | workspace | remote | challenges | international
 Context | workspace | hybrid | challenges | workspace participation
 Context | workspace | hybrid | challenges | home participation
 Context | postgrad internships | role details | data analytics
 Context | postgrad internships | role details | other roles
 Context | Africa | challenges | family
 Context | Africa | challenges | gender
 Context | Africa | challenges | culture
 Internships | expectations | apply taught skills | educational skills

Internships | expectations | apply taught skills | iip | technical skills
 Internships | expectations | apply taught skills | iip | soft skills
 Internships | expectations | learn new skills
 Internships | expectations | industry experience | general
 Internships | expectations | industry experience | teamwork
 Internships | expectations | industry experience | mentorship
 Internships | co-readiness | unprepared | negative |
 Internships | co-readiness | unprepared | negative | pre-preparation
 Internships | co-readiness | unprepared | positive |
 Internships | co-readiness | prepared | orientation | no orientation
 Internships | co-readiness | prepared | orientation | management
 Internships | co-readiness | prepared | orientation | rotation
 Internships | co-readiness | prepared | orientation | company values
 Internships | co-readiness | prepared | orientation | skill sets
 Internships | co-readiness | prepared | orientation | dress codes
 Internships | supervision | roles | formal roles
 Internships | acceptance | work colleagues | positive
 Internships | acceptance | work colleagues | negative
 Internships | acceptance | work colleagues | workplace
 Internships | acceptance | work colleagues | culture
 Internships | acceptance | work colleagues | language
 Internships | acceptance | fellow interns

3.5.7. Interpretation

“A core premise of phenomenography is the assumption that different categories of description or ways of experiencing a phenomenon are logically related to one another, typically by way of hierarchically inclusive relationships” (Åkerlind, 2012, p.323).

Marton and Booth (1997) suggest that categories of description refer to the “collective level” and “the outcome space is the complex of categories of description comprising distinct groupings of aspects of the phenomenon and the relationships between them” (p.128). They suggest three primary criteria for judging the quality of a phenomenographic outcome space: each category should reveal something distinctive about a way of understanding the phenomenon; the categories

should be logically related; and there should be as few categories representing the outcomes as possible.

Consequently, although a group of participants may experience the same phenomenon but then perceive it in different ways and under differing circumstances, phenomenography offers a collective way to view the experience of that phenomenon (Åkerlind, 2012). In following these guidelines, the researcher began the interpretation phase by reflecting on the final list of key codes of categories of experience and reducing these to a minimum set of eight conceptions: interns' expectations, company readiness, supervision and assessments, internship activities, mentorship, acceptance, independence, and learnings

Then followed multiple rounds of fitting codes into sub-categories within the high-level conceptions, each reflecting participants' detailed collective experiences (Marton, 1986). Finally, the researcher reflected on all the codes and categories to ensure the interpretation of their experiences met Martin and Booth's qualitative criteria, set out above.

3.5.8. Trustworthiness

“The core question of credibility in a phenomenographic study is that about the relationship between the empirical data and the categories for describing ways of experiencing a certain phenomenon. The researcher has to show that a chosen way of describing differences and similarities is well supported by the empirical material” (Sjöström & Dahlgren, 2002, p.342). Bucci (2020,) states that “phenomenographic researchers must show how they have both controlled and checked interpretations during the entire research process. This should be done at every stage, beginning with formulating the research question and ending with reporting results” (p.53). A researcher must explain and justify participant selection, data collection, and data interpretation (Sandbergh, 1997).

Kvale (1996) identifies three areas in an interpretive study that can influence the dependability of research findings. The first area involves the interviewer during the data collection exercise, the second is relevant during the transcription of the interviews, and finally, during analysis, dependability issues are again raised.

To ensure data analysis quality control, Bowden (2005) suggests the following:

1. The use of no other evidence except the interview transcripts;
2. The bracketing of the researcher's relation to the phenomenon;
3. The use of group analysis in order to ensure the first two controls are effective; and

4. Postponing the analysis of the structural relation between the categories of description until after the categories have been finalised (p.15).

Researcher bias describes the risk of the researcher selecting or over-emphasising detailed data because it stands out for one reason or another or fits the researcher's expectations, goals, or theories (Maxwell, 2009). However, Maxwell notes that insider knowledge can positively affect a qualitative study, provided it is acknowledged and understood. Then it can be productively applied to deepen respondents' input and the subsequent analysis.

Given the researcher's close association with the Industry Immersion Program, potential bias has been managed by strictly adopting and consistently applying the recommendations presented in the literature to support the credibility of the study: participant selection, data collection and data analysis. The outcomes are presented in greater detail in the sections above.

Furthermore, Åkerlind (2012) suggests an additional reliability check in which independent researchers compare the conceptions through open discussion and deliberation. In this study, an independent researcher undertook this role. The draft discussion chapter was forwarded to him, and then he was independently interviewed within the ethical considerations set out above. The interviews were conducted by Zoom, and he was requested to comment and give his opinion on each of the conceptions. The interviewer's comments on each conception are set out in the discussion of findings in Chapter 5.

3.6. Limitations of research

It is recognised that there are limitations to the current study, including design and context. As the study design is based on the participants' experiences of their internships, there is the risk that the portrayal of their experiences is not fully empathetic with actual engagement (Ashworth & Lucas, 2000). This could be attributed to several factors. Firstly, the participants may not have been comfortable fully sharing their experiences. Robson et al. (2009) go further, providing research that in Africa, participants may provide answers that they think the interviewer wishes to hear. Secondly, the participants may not accurately remember the experiences from their internships or, subsequently, further experiences elsewhere may consciously or unconsciously impact their reconstruction for the interviews (Cope & Watts, 2000).

The context of the study is also limited as it is only the collective experiences of the graduate interns that have been researched. The experiences and perceptions of the relevant employers are not available to counter the conceptions arrived at by the participants, thus preventing more robust findings from being presented.

3.7. Summary

This chapter introduced this study's research approach as a qualitative constructivist paradigm. The research methodology is based in phenomenography, which seeks to map out variations in collective experiences of a phenomenon rather than understand it directly. The methodology is well suited to explore the experiences of graduate mathematicians in their industry internships undertaken. The chapter set out the rationale for using semi-structured interviews, selecting participants to achieve maximum variation in experiences and using virtual interviews in different African countries to arrive at a data set. The chapter then described in detail the data analysis process, which includes transcribing the interviews, coding and interpreting the results into groups of collective experiences, or conceptions, which are presented in the next chapter. Ethical considerations and trustworthiness were also discussed in this chapter. In the case of the latter, and because of this researcher's involvement with the participants, an independent interviewer's comments on the conceptions are presented as part of the discussion in Chapter 5.

4. RESEARCH FINDINGS

4.1. Introduction

This research study seeks to interpret a selection of purposefully chosen qualitative semi-structured interviews representing the collective experiential outcomes of the participants' internships (Åkerlind, 2012), the phenomenon of this study. A summary of the participants' interviews is set out in Table 4 and in greater detail in Appendix B. These interpretations were coded and collected into categories of description, also known as conceptions, representing the various collective ways the participants' understood their experiences (Åkerlind, 2012).

Table 4: Summary of participants' interviews

Total participants	20
Male participants	9
Female participants	11
Number of countries represented	9
Workplace interviews	11
Hybrid workspace interviews	4
Remote workspace interviews	5

4.2. Experiential Context

4.2.1. Overall internship outcome

Before exploring the conceptions in detail, providing a sense of the overall experiential outcome of the participants' collective interviews is informative. From the twenty interviews, seventeen participants experienced "successful" internships in their data analytical roles, understood as the experiential outcome in the eyes of the participant. The following quotations highlight these overall perceptions:

Yeah, overall, the internship was really successful for me. p1

Yes. It has been a good learning experience to me. p2

So overall, I would say the internship was, was enjoyable, and in other words, the internship was an is a success. p7

Okay. Okay. So I was saying that I was very happy about the experience at [company] because they have given me the chance to learn to explore and they touched me with more than I can handle really. But then I learned how to handle that. And it helps me to grow and develop myself. p8

So the workplace the environment was really good. p11

So that in general, the whole experience was positive, especially because I also learned how small compartments of business work. p12

Two participants experienced mixed outcomes:

Yeah, of course, it was, it was for me. It was a success. But I needed a more, a bigger challenge. And that's why I was thinking of trying to apply in the data science team. p9

Yeah, I did (enjoy the experience). It was difficult to grasp at first, but later on, yes, I did. p17

And finally, three students experienced negative internships, which neither offered the participants any data analytical activities nor any useful workplace experiences, as described below:

So I was, let's say what I was expecting as a data analyst. I didn't do a lot of it. I was doing a lot of, like, client relations or customer service when they come into the office. p11

The negative was really on the personal growth, getting that personal development. There wasn't really that opportunity (with regard to data analytics). p15

So initially, yes, we were expecting to have a very, like, very nice internship. But it wasn't. It really was very bad. So at the very few occasions, we had some tasks where we filled in some forms, but very, very, they were very, very few occasions. p19

4.2.2. The changing workspace

Participants interviewed in this study had carried out their internships during the Covid-19 pandemic of 2020 and 2021. During that time, there was substantial disruption to participation in the traditional workplace. As a result, internships for the first time were undertaken in a combination of workplace, remote and hybrid settings, and this is reflected in the participants' interviews and responses.

Of the twenty interns interviewed, eleven reported into traditional workplaces, whilst four undertook remote internships and five hybrid ones. Specific challenges associated with the latter two forms of internship, which were new to both companies and interns, included remote supervision and mentorship, connectivity issues and, in certain situations, time difference challenges across different company locations. However, all the remote and hybrid internship participants reported successful internship experiences.

Remote internships

For participants in remote internships, working from home and related connectivity issues were the main challenges:

When I started the internship, I was working from my rural home. So my experience there was a bit challenging because it's hard to explain to African parents that you're still working, but you stay in the room the whole day. p2

So the other the interesting thing was actually that was my first time working from home. So it was quite challenging at the beginning trying to adjust and understand, like trying to get those facilities, and the connection here is quite bad, actually. p15

So so, for me personally, I think for an entry level, like for the first three months for me, personally, I wish I worked in an office setup. p18

But they in terms of connectivity, internet connectivity, it has been okay (remote in Kenya). p2

I got I had opportunity to work from home, and the connectivity was very poor (remote in Ghana). p7

Okay, so I'm saying I'm grateful for the company because there was a stipend that I used to receive at the end of every month that to secure our connectivity where I spend it on securing our wifi in the house. p5

Some of the remote internships were across international borders, introducing challenges around supervision and connectivity across time zones. However, none of the participants experienced really negative outcomes. All seemed to adjust to their circumstances:

So my internship was based in Ghana, but myself I was in Kenya. And then, being in a different country, they expect different things, and you have to you have to know what they always work with. Which is, which was a bit different from what you're used to. p5

So the role was project based, really. My internship was basically the role was data analyst plus software engineer in Ghana, and it was remote whereby I was working from Nairobi, Kenya. p1

The only difficulty, if I can add in terms of physical environment, was the time difference, which is three hours from Accra to Nairobi. p1

It's with [company], which is a real estate company located in Maryland in the USA (remote internship in Kenya). p2

Yeah. So I was working with teams from Germany and South Africa. p15

Hybrid internships

For many companies, developing successful and effective hybrid workspaces during the Covid-19 pandemic became a material challenge in the very short time frame available to achieve the expected outcome. These challenges continue today. The participants felt this directly, but again, it was a case of adjusting to their workspace requirements:

Yes, so before, before the pandemic, people work 100% from the office, but when the pandemic starts, I think in March 2020, they become hybrid. You work five weeks from home and one week from the office. But later, when the number of cases diminish, we work three weeks from home and one week from the office. So the hybrid benefits from both parties. It's win-win strategy. p16

So because of the Covid restrictions, we we did some weeks virtually, where we connected to the courses daily for about ten weeks, ten or eleven weeks. So the remaining three to four weeks was on a physical location. p17

So there was a time during Covid, I think it was in January, where Covid was very bad, so the hybrid style of working was implemented. p20

So outside the workplace, I was working from a resort that was next to my residence. So this resort has a hub, a workspace. p4

4.2.3. Postgraduate placements

All the interns were mathematical postgraduates, with over 80% graduating as mathematicians, and all had completed the Industry Immersion Program. It was the desired intention that all would be placed into data analytic or business intelligence roles with participating industry partners with a view to work integrated learning outcomes. Participants' experiences of these placements varied:

This is a field where they expect you to be a professional or, let's say, an expert. You have a master's in mathematical sciences, so they expect you to

come up with a solution yourself and come up with an idea, and when you come up with ideas, you have to find a way to make the idea relevant to them.
p3

So the role was project based, really. My internship was basically the role was data analyst plus software developer. p1

I was an intern as a data analyst intern with quite a range of duties and responsibilities. p5

So I'm with the data analytics department of the bank. p7

I got a chance to join [bank], as a as a trainee. I joined the monitoring and evaluation team, whereby my role specifically was data management. p9

I am a logistic and industrial engineer and researcher. At the same time, I work in [an engineering consultancy] which is located in Casablanca. p16

I did my internship in in a marketing in a digital marketing agency as a data scientist intern. p12

There were, however, several internship roles not as focussed as these. This is not to say that the participants did not benefit from their experiences. However, as they were all postgraduates and had been preparing through the Industry Immersion Program data analytic internships, one can understand a certain frustration in not being able to build upon their educational background:

So I basically do almost everything that pertains to the company in terms of marketing, for marketing, doing all the analysis work that needs to be done.
p2

I work for a university as a lecturer, where I help students with mathematical courses. p10

So I was working as a product and pricing analyst (at a bank). p20

So I was I was filling the position as the regulatory support intern for six months. p11

So my internship was in a company that specialised in growing what we call in Cameroun, plantain, which is like, okay, bananas. p19

4.2.4. African-specific issues

The semi-structured interview questions were intended to allow the participants the chance to share experiences that were specific to their location in Africa. By and large, participants did not share a significant component of African-specific issues as either positives or as challenges impacting their internship experiences. However, a range of family, gender and cultural issues were raised.

Family

Some participants struggled to convey to their parents that they were able to work effectively outside of the workplace. That they did not need to travel into offices was hard for older generations to understand and accept:

When I started the internship, I was working from my rural home. So my experience there while I was working at home, it was a bit challenging because it's hard to explain to African parents that you're still working, but you stay in the room the whole day. p2

I was given some sort of support from family in terms of the laptop, even though at first they didn't adapt or understand that there is actually a way you can work remotely just with the laptop. p4

Also, in terms of home, I actually left home to my brother's place because homes we, you know, working at home yeah, it might get noisy your parents you see at home and so like, okay, so what is she doing. p15

Gender and Culture

Gender and cultural experiences were not as significant as might have been expected, particularly given the inclusion of female participants graduating with mathematics degrees. This seems at odds with prevailing assumptions, but it is important to recognise that the large majority of participants lived in urban cities, such as Accra and Nairobi. A few examples of where gender and cultural issues were encountered were:

It's true that it's challenging, especially in my in my, in my society. And especially for girls that are coming from my rural area. Actually, I was born in a rural area, and at least was very, very hard for me to keep studying. But I surpassed those challenges. I think I suppose these challenges before, the fact that I come from a rural area and continue my study helps me to surpass the problem of being female. So that's encouraged me to surpass the challenge of being female in industry. p16

The second one was the fact that there were people who had to report me. And that was quite a challenge for me in the beginning; it was, it was really a challenge. Because I, especially I, don't know if it's just me, but or if it is just our culture to respect people. Age really matters. p20

It was a hectic period in Cameroon in the sense that there was, there was a kind of tribe (protests), and there was some guys with some protests. Most of the time, they will block the route and so on, and so sometimes it was scaring; you know, when you travel, you don't even know where the bullet can come from. p14

4.3. Internship conceptions

Phenomenography seeks to categorise participants' understanding of their collective experiences into a limited number of categories, also known as conceptions (Åkerlind, 2012; Collier-Reed & Ingerman, 2013). In this research project, no pre-existing conceptions were formulated, and interview responses were categorised over five rounds of coding. This process required sorting and resorting the codes, which was continued until the seven final conceptions were arrived at. This set

of conceptions is analysed and interpreted in the following chapter. The following sections provide the context by introducing the conceptions as they were expressed in the words of the study's participants.

4.3.1. Interns' expectations

All the participants held expectations of what they hoped they would experience during their internships. They recognised that work-integrated learning was necessary for their future employment, and three distinct themes emerged regarding what this internship learning should comprise.

Apply learnt skills

Many of the participants saw the prospect of the internship as a chance to apply their learnt skills in a business environment. This is a very encouraging outcome as it is not apparent that students completing mathematics degrees would necessarily see their employment future in industry:

So my expectations were how can I ever really apply or whatever had been taught during the ESMT, the soft skills, the technical skills, how can I translate all these to know the real world? p18

My first hope was to be able to utilise my skills, my mechanical and statistical skills and data analysis skills. And I was very sure that when I get there, I am going to do this with data analysis. p20

I now wanted to actualise myself where the potential because the knowledge seemed to be diverse, that I had acquired so many things, and I needed to really know how to, you know, apply them. p4

Technically, I, with my math background, when I went there, my expectation first was to apply the knowledge, my math knowledge, you know, to solve some real problems in the company. p14

So the first thing was basically the to get to the workplace to get the skills, whatever I've learned for the IIP program to be able to apply. p1

Fully speaking, when I was going for an internship, my expectation was to really use the knowledge I learned from IIP. p14

My goal was to use my data analytics skills in order to make sense of the information they had. p12

Learn new skills

There was also recognition that, despite their postgraduate degrees and the Industry Immersion Program, more skills learning was still required.

So my main goals for going into this internship were to learn and develop myself and also use my skills. p13

My expectation before before starting the internship was was kind of adding learning, learning, learning processes. p7

Before I started my internship, I was looking forward to gaining more skills. p2

Industry experience

In addition to learning new skills, participants were also seeking industry experience. Some acknowledged the importance of experience in seeking employment. This experience included general workplace experience, teamwork and mentorship, as highlighted in the following quotations:

I was really looking forward to really kickstart my career journey in data analytics. And I was much interested in engaging in a role whereby we'll be exposed to the tools and how data and decisions are made for the real-world problems. p9

So let's say an internship is a way to get skills before normally when you're going to look for a job, they require some amount of skills, like two years of experience. p11

I always told myself that I needed experience; experience was the main focus for why I headed to the industry space instead of maybe continuing directly with further education. p8

So actually, I knew I was going to meet new people. People I've never seen before, people with different culture and different backgrounds. p7

I was going to learn a lot from coming here. I was going to work with with a team with a team that is in data science data science group are going to work with people that have much experience in this area. p3

So all I wanted to achieve was experience as well as in the sense that I wanted to be mentored by industry experts in the field so that I can be able to grow. p6

So, you know, before going to work, I had some studies, including engineering, mathematics, and some skills that I learned from IIP too. So all those tools are theoretical for me. So the first thing that I wanted to have is an application of my knowledge, including, for example, how can I use data science to solve industrial problems. And how can I use management? How can I learn from working with teams and teamwork in general, and time management projects management that so there was a branch of of skills that I wanted to learn from from my work? p16

4.3.2. Company readiness

Overall, only five participants reported positive comments on the state of company readiness for their internships. For the balance, the lack of company readiness led to participants struggling to deliver effectively on their projects and feeling their work-integrated learning was compromised.

Internship preparation

Preparation was often lacking for the interns arrival in terms of defining their projects, understanding their skills, and allocating supervisors. In addition, training for specific skills was often lacking. This was a surprising and disappointing outcome of the research:

I could feel by myself that it was kind of they were not ready for interns. p5

We could have had a maybe a great internship if things had been organised or prepared, like if they had a plan. p19

I'd say the negatives would be the lack of organisation. I think the fact that it was so disorganised in the beginning, and there was just a whole lot of work put on me as as a beginner. p20

So I mean, if they can be a short questionnaire where each intern give his expectation, in terms of the company, and the tasks they will be doing in the company, I think that will really help you. p14

So I think all that they think we can do is to just grab coffee, print papers, and those kinds of things. p13

But there was one favourable situation discussed where a formal program has been set up:

It is a graduate program, so the whole idea is tailored towards teaching you, having you develop your skills. They welcome the fact that you are new to the environment. p8

Interns' orientation

A typical response from the participants was that there was minimal introduction to their companies. This impacted, in particular, on acceptance of the interns by full-time colleagues. It also took away from the learning benefits associated with participation in the workplace:

So I think it took me that month to kind of familiarise myself with everything, and everything was just all over the place for me because of lack of organisation. p20

I think, if I give orientation my own definition, I would say that orientation would be introduction to teams and introduction to the actual work that I have to do, just to give me an idea of what it is that I'm going to do. p20

So if the company were not expecting you, or if the company, I don't know, says yes, if the company wasn't expecting you, then you will for sure have a bad experience. p19

When new people come into the workplace, they don't know how maybe to get around the building or don't know what is expected of them, especially interns. p10

I have learnt a lot of things about how asking people for resources, depending on other people for their input, if you go to people how to manage situations. Yeah. So it's been challenging. p8

Yet, when interns received an orientation and introduction, a noticeable positivity came through in their responses:

Like it was so good for at the onset, like everything was so explained very well at the beginning, I think the whole week, it was just an orientation. So for me, that was really good. And I think it was the best thing. p18

I think with the [the Foundation], they really have that onboarding, okay, with a lot of features, so that onboarding gets you to really know the organisation deep down. p15

So you get to know about what the organisation, that what we are trying to achieve our goals or outcomes, and like how your values and your personal aspirations align with what the organisation is looking to do. p15

Other responses regarding interns' introduction and orientation included:

Management involvement:

So the culture was actually very good. And I think I believe that was due to the fact that the CEO was someone that was quite experienced, so, like a very accommodative environment. p13

Okay, yeah, so during the introduction, it was really good, actually. It was done by HR, her name was [], really friendly, and you can always reach out to her. p18

Then after we were assigned into our main departments, we had a general orientation with all the interns and all the heads of departments in the organisation. p9

Rotation through different departments:

When we first got there, there was just a mini introduction. It wasn't really an orientation. Then afterwards, we were asked to work in different departments every week to get knowledge about how each department worked before actually moving into our assigned departments. p13

Company values:

If you're in an organisation, and your value matches with the values, you have the values of honesty, the value, hard work, the value diligence, you, you don't get burnout, even though sometimes it's hard, you don't get burnout, and the organisation it aligns with your personal values. p15

Interns skill set:

I don't know; maybe they were expecting us to know all this while before we came. But that wasn't the situation on ground. p7

So for me, for the first one week, it was just, we're just taught her like how, what, what package they use, how which, like, they have different days, they have different occasions, like Fridays, this is what happens. p18

Dress code:

And one thing that's used to be the norm was that everyone had to dress properly. So no matter how bad your day is going, you have to dress properly.

p13

4.3.3. Supervision and assessments

There was a mixed response from the participants regarding their experiences with their supervisors. This ranged from supervisors being very supportive, to having very little involvement. What come through is that there was very little formal preparation for the supervision of interns in a structured manner. Other than in the case of one participant, none reported assessments taking place or receiving feedback regularly. The quotations below illustrate the variability in the relationships and experiences with their supervisors.

Supervision

Other than in one internship, all the supervisors were technically proficient and in teams or departments, aligning with the interns' skills. The responses below illustrate the positive relationships that were encountered, leading to better work-integrated learning outcomes:

She was a data analyst. And she was our immediate supervisor, but we also had our main manager. So, they were both on us and monitoring side by side. p3

The relationship with his supervisor, um, my supervisor is one one person who will tell you everything straight. If you did not get this right, he will not hide it from you. He will tell it you you straight. So um, I had that kind of respect for my supervisor. And then he also had respect for all of us. p7

He has been very supportive, always challenging me to go to go beyond my limits, always encouraging me. He tries to identify my weaknesses and then pushes me just a little over the edge beyond those points because he feels that I need to learn more and there's a lot more that I can do, so he has very supportive. p8

The culture was more horizontal, which means we have the flexibility to talk to each other quite often and communicating to the supervisor. And she actually gave me the freedom because that was also a small size company that was willing to grow. So, she was actually willing to listen to every criticism.
p12

Let's say it was someone I really was, I mean, I really appreciate him. He was very open. He was very knowledgeable, that I could discuss some extra stuff with him at the time. p14

I think working with my supervisor was quite easier because he was like, he will come down to that same level with me, and he was friendly. Like, he's easily approachable. p15

So, my supervisor, his name was [], a really good supervisor. He's been friendly, actually, to everyone. Even if you're just an intern, he's very friendly. And always give you that environment where you can ask anything like so open to that. p18

Yeah, so I had a great relationship with my manager. And she later became my she's still my mentor, even today after breaking after leaving the workplace. p20

My manager and our boss, the head of the department, they were always open to people actually exploring new ideas and trying out different ways. p20

There were a few mixed and negative relationship experiences. In each response, this impacted on the internship and the quality of the workspace learning as there were no clear lines of support that participants required to deliver on expectations:

What we did with my supervisor, we had to come to an agreement. She had to compromise a bit of her time, and I had to compromise a bit of my time. p2

But with time, I came to realise that she had a lot to handle, but earlier on, I was like, they were not ready for interns. Yeah. p5

And for the project, the given project, the goals may have been clear, but with my team with my colleagues, we always had to find out how to come up with something good. They just give us the work, and we will just go about discussing and discussing how you'll be able to solve the problem, so it wasn't supervised. p3

But really, if I'm being completely honest, the entire shift came when the manager was changed. So, my manager was changed just a month into the team. That completely disrupted the team, if I should say, and we all started from some sort of scratch. p8

My supervisor was, I would say, a very busy person. Most times, she has to leave office for travels, work-related travels., I didn't actually have any work to do, each time she wasn't around. It's like, oh, my depended on her presence in the office. p13

Maybe making it more structured, not very freestyle, where they expect you to bring something up, and they work with that. Maybe they give us a certain bar we have to meet even if it feels imposed. p16

When we arrive, we were directed to, I think to, a man who was probably the supervisor, yes, the person in charge of the group that we were going to collaborate with like he was an office. So, we were directed to that person, so we didn't have we didn't really interact with him a lot. p19

There was a lack of organisation he was he was not really organised like we were there, and they asked themselves, what can these students do? Because they are already there. p19

Assessments

In spite of the recognised importance of assessments in an internship relationship, the only formally supervised internship experience was reported from a participant in Morocco:

So the policy carried in Morocco is if you are doing an internship, you will have the supervisor, and he is the one who supervises everything; like he will give you the project, he will keep tracking with you your advancement and see the tasks that you have achieved, and you will track everything from the beginning till the end of the project, but this case it is for dedicated for people who are doing an internship. p16

Other than only in a few informal situations, supervisors adopted no assessment policies. Nor were participants offered the opportunity to provide feedback to their supervisors. The following quotations illustrate the problem:

So, no, no, there were no assessments. p2

We only really chatted about my progress when they were looking at my work. But no, I wouldn't say this was an assessment. p4

Really, we didn't know how it was going in the minds of our supervisors. p10

I don't think anyone had asked her to assess me directly. p.13

No, well, no, I was not given a chance to say how this was all going. p.16

4.3.4. Internship activities

Overall, the participants experienced a wide range of activities, and their comments were positive. As described above, most recognised that work-integrated learning was a necessary next step in preparing for employment:

So I only had a theoretical perspective of what an industry experience could look like. But the moment I stepped on the floor, it's a different story. It was basically day-by-day learning. p12

(Small Company) And I think that was maybe the primary lesson I learned from from from that small size company, to be able to have a chance to operate in many departments and understand how the whole thing works as a whole.

p12

Three of the participants worked in international remote internships. Two were Kenyan students participating in Ghana projects:

And I've never worked for an international company like from outside Kenya. And it was a chance for me to learn from other people and know how they operate and how they work, and I can really say that it's really different from our working environment here in Kenya. p2

So the role was project based, really. My internship was basically the role was data analyst plus software engineer in Ghana, and it was remote whereby I was working from Nairobi, Kenya. p1

The third student, based in Ghana, was part of a team working for a German company with a project in South Africa:

So, I was working with people from Berlin and Joburg. So, we would meet on Teams. What we always use was Teams in (company). We never use Zoom. p15

So, one of the things that I can add is, is that my company is international, which it gives me the opportunity to stay in touch with a lot of people around the world, which gives me the opportunity to keep practicing my languages. p16

The nature of the internship influenced the internship activities, and participants' experiences are set out in the three categories set out below.

Workplace

The workplace participants experienced a wide array of experiences. Given that all were postgraduates with the industry immersion training, there was a greater expectation of their data analytics deliverables from the outset and without much introduction or further workplace training. In the case of two participants who interned with a bank, they had to resort to YouTube videos to learn the specific skills required to complete their project. This was exacerbated by the bank blocking YouTube as a standard employment policy and the participants having to make use of personal accounts to access YouTube:

So, the entire project was a learning journey, and I had to meet my deadlines while learning to use these entirely new things. p8

So personally, I enjoyed the internship because the assignments that I was being given or the duties that I was responsible for were directly connected to what I was doing or whatever I just dreamed of doing. p5

Now the challenge that we had was that at first when the projects were drawn to us, we didn't have knowledge in the finance sector. So, you have to go and read, read, read, read. And that was taking a lot of time. p7

So, another challenge was the way they wanted us to get this done fast as quickly as possible. So, the pressure, the pressure was very tough from the beginning. p7

So, the most negative experience I can think of right now is the fact that most of the (web)sites were blocked.....Okay, so most of the sites that we used to learn, we used to research, were blocked. So if you want to, for instance, YouTube is blocked, and we know that YouTube is one of the channels that we learn most of us. p7

Hybrid

The challenge for the hybrid internships, beyond those described above, was adapting to the mixed workspace environment and not always being in the office, with responses set out below. In the case of all the participants, they did not find this detracted from their work-integrated learning:

This internship was hybrid. So, hybrid in the way that most of the tasks that I was doing them remotely, but a once in a while, we will sort of meet, especially when they flattened the organisation in a way that they now moved away from because of COVID. p4

Yes, we will meet four times in a week. So, these meetings were mostly at the team level. But now, once in a week, we will also meet with the other teams, which means getting the insights from the data to actually be used by other departments. p4

Remote

All the remote participants found the internship activities far more challenging than workplace and hybrid participants. Time zone challenges around meetings, an important component of remote working, were common:

Because you will find that some [online] meetings that you will organise, but it won't happen. Yeah, I think the time difference is three hours, actually. So we are three hours. We are three hours ahead. p5

When we're in Kenya, I think people really concentrate on time, like the quantity of time that you give in work, you have to work eight to five. But the first thing that my supervisor told me when we had our first meeting was that she didn't care if I work for two hours or for 45 minutes, or for 24 hours. But what you want is just results, so it's result oriented versus time quantity. p2

Okay, so I was doing a remote one from home. So, I was working from home all the time. But when you're working with teams across the country that has

like six hours or five hours, four hours' time difference, it becomes very hard. It means you need to adjust on that time. p15

Although for me, if I asked, I think when you're new, like it's just an entry-level, I think going to the office, that office setup is better than the remote work. p18

Data analytics and modelling

All the participants entered into their internships with an expectation that their activities would largely be inclined towards data analytics or modelling, but without really knowing or understanding how that would transpire:

I was first assigned to the micro, small and medium enterprises as a data analyst so that I can manage the data that comes in each and every day. And then advice on what kind of decisions to make based on the analytics that's done with this data. p13

I was then moved to the monitoring and evaluation unit because I was told that my skills are more needed since they actually write reports, analyse data for monitoring and evaluation, and try to like analyse data for work on end of year reports. p13

And my work is basically I have three components. So, the three parts are managerial data science and technical part. p16

So, like from Ground Zero, you can model something in mathematics, and you have to explain to them in the business sense. And the baseline idea is how much will it bring to the business? p3

So more or less where we're trying to create financial models. So, most of the problems we have to learn most of the things ourselves. So, for instance, model building, we didn't learn much of it in, in our schools, so we had to go download and learn new tools to be able to solve their problems. p6

So, when I actually started the internship, I realised that the tasks that we've been assigned were, excuse me to say, but kind of basic form because I used to work with Excel spreadsheets, and I thought like most of the skills that I had, were not actually being used, but it turned out that that was just what they needed. They didn't need anything more expert than that. p13

Meetings

It is also important to note that, other than in two cases, none of the participants had ever experienced a company environment. Meeting activities with supervisors and colleagues became an important part of their workspace learnings:

But we also have weekly meetings, weekly meetings, where we have to report to our HODs and tell them how we are progressing in class in how best we are managing our classes. p10

So, we used to have a monthly meeting, where everyone is talking about what we are doing, and it's like, is very related, what we are doing with other teams is related. p11

However, in the case of two participants, their activities were not related to their skills training and they expressed disappointment in their internship experience:

And in my in my daily tasks, I joined in a team of engineers, mechanical engineers, where every day we have to go and check the engine and how the engines working, if the oil is leaking somewhere, we have to know, work on that, and so on and so forth. p14

Now that to make a long story short, what we learned during our (IIP) program, we really did not apply it at all because our main task was maybe to, you know, to take documents or some paper from office to office jobs to receive just to facilitate, you know, this facilitate, like, if someone needs a document, or if maybe if someone is needed and the person cannot be reached

through phone, then yes, they will send you to see if the person is in the office, or is around, things like that. p19

4.3.5. Mentorship

Besides the Moroccan intern experience described above, mentorship by the supervisor was an informal outcome. Nevertheless, many supervisors effectively assisted the learning experience through this informal approach. However, without assessments, it is difficult to ascertain just how beneficial these experiences were. Some of the positive responses are set out below:

But the supervisor still played a vital role in steering us towards the right direction as what we are supposed to do and what we are not supposed to do. p6

So, our supervisor, actually, when we came fresh, he was actually very supportive, trying to impart what he knows on us, especially the business side of everything that we are doing, but as time goes on, the Supervision is getting reduced, because he realised that where we are much more advanced in trying to do most of the things ourselves. p6

So, in some cases, she listens to my ideas, but in some cases, there were protocols that has to be followed and like the organisation had a standard way of discussing things. And she tells me that this is how we've been doing it over the years. So, this is how it should be. But in some other cases where there can be some little adjustments, she really listened to what I have to say and how we can actually incorporate that into our way. p13

And you know, usually, when you are trying to solve a problem, even if it's on Zoom online, you share your idea. So maybe you realise, okay, this is not working. Then I realised, okay, maybe we can do it this way. And he would still be like, okay, yeah, sure. Let's try it. Let's do it this way. p15

And of course, because of the support of my team and the support of my mentor, at that time, and because of all trainings that I have done, and the

knowledge that I gained, I managed to be independent. They think after one month, I managed to take my own actions and my decision by my own. I think this is one of the good things that we can gain from industry, having this kind of independence and being more confident of making decisions. p16

He always listens; he always says that no, no answer is wrong. Just give you an answer as long as you can support it. If he sees a six as a nine, and I see it as a six, let me convince him. It's a six. That's what he wants. p18

So, I had; I'd say I am actually very grateful that I had such a support system from both of them. So, it was so easy for me to catch on to the work and actually learn the skills that I needed to learn you In a very short period of time. p20

And I would just report to my manager, and she would go through what I did. And she would show me, oh, okay, I used to do this this way, but this is quite interesting to see that you've done it differently. Um, yes. p20

So, the (the supervisor) had to group us again so that it will make the work more more more more effective. And, yes, individually, we were doing doing a good job, but the teamwork actually helped to complete the whole set. p7

4.3.6. Acceptance

The interview question dealing with acceptance and being heard by work colleagues and fellow interns during the internship elicited a mixed response of outcomes. The overall conclusion from the participants was the greater the acceptance, the more successful the internship learnings and the more productive the work and project-related outcomes. What is clear from the responses, however, is that there was a minimal coordinated effort to integrate the interns into the work teams.

Work colleagues

Participants' responses on engaging work colleagues ranged from supportive to hostile experiences. Positive experiences with work colleagues included:

And our CEO built an environment where we can you can feel comfortable where you are working, and she also created an atmosphere where if you have an issue, you can talk to her directly. p11

The culture was more horizontal, which means we have the flexibility to talk to each other quite often and communicating to the supervisor. Part of it was because the company was small-sized one, like, even though they have more than five years of existence, I think they were quite willing to grow. p12

Because I realised that whilst working in the other departments, it became more clear to me on how to actually use the data in our departments because I had a feel of what everyone does, and even sometimes, although working in your departments, people in others like the head of departments in other areas, they got to know my skills, and then once knew what they actually require me to do something for them, they just come into my department. p13

So yeah, funny, I was the youngest person in the whole bank, and that it's something that people knew. And sometimes I could, I could see that some people would use that to kind of intimidate me. But I got to understand that there's a difference between personal relationships and professional relationships, and if you don't have an age, you just have to be able to talk to people professionally. p20

However, many participants experienced far less support from work colleagues. This was not always a deliberate stay away but rather a result of work colleagues not being prepared for the interns in their workplace. The fact that all the participants were postgraduates in mathematics or sciences compounded the fear of getting to know the participants:

From the very beginning, getting into a team that was already close knitted, if, as you say tight, they were comfortable with each other, coming in as a newbie to invade this space and not even having a very good idea of what they did I should say it was difficult, being able to get into the team. p8

From the discussions, I could clearly see that they used to see me as someone who can go and come back and be their boss, you know, and take the place and be like, I mean, on the top, and that is something they were kind of fighting. p14

You are not supposed to be here. This is not your place. We are engineers, and we are supposed to be here, but not you. p14

So, I think that the actual thing was actually she thought I was coming to take away her role, but she just felt like maybe I tried to push her out of place. I tried to make her look like she wasn't doing her work. p13

And yeah, and there was a sort of imbalance because I was new, and I was the supervisor, and they were more experienced. p17

Workplace respect, culture and language also played a part in acceptance:

A bit of frustration was the fact that in the workplace, people don't use the language, a common language like English or French, but they prefer to use their native language, you know. p14

I mean, one of the things I also learned there is how, in terms of managing the culture, the culture really influences. p14

During the first few weeks, you know, because you are new, you need to learn how to do this and do that. You have to be respectful; you have to understand everything, you have to be patient and all of that. p12

You have to be polite to everyone, no matter who you are and no matter the position you're holding in the company, you have to be polite when it comes to the office, you have to greet everyone, the cleaners, each and every person we've seen you have accorded them the same kind of respect. p13

(On being Ghanaian) It didn't really impact my work. It actually, even if it did impact, it was more like in a positive way. Because, like, I think I was the only Ghanaian on the team, like the only person based in Ghana. p15

Two participants interned in all-female teams, and they found the workplace environment far more supportive.

So, in, my company, it was dominated by actually a lot of females; even the CEO was a female. So, I remember one of the questions during our orientation, one of the interns asks, is it that only females are supposed to work here? p13

Teamwork

Only three internship partners took more than one intern from the participant group. Consequently, it is difficult to draw substantive conclusions about interactions with fellow interns from the participants' interviews. However, participants appeared to bond together and work towards common solutions as members of teams:

I didn't really get a team of data scientists to work with. The data science team I had was the colleagues that I came with. So, they became the data science team that I had to work with. p3

So yeah, on the teamwork, more ideas were generated and implementing it was was awesome. It was great. p7

So, most of the times, we do our work together, try to share ideas, and then sometimes we do have the small small conflicts in between, between us, which we'll try to solve and then get to right. p4

I think it's very, very important because, you know, you get to the workplace and you might not agree on some, some ideas or some discussions with your team colleagues, but you need to come to a point, and you need to, even if you're sharing your dispute or your ideas, you need to do it in that manner that it doesn't come off, like conflicting. p15

And of course, I will not forget the efforts of my my teams, like if I need any help from them, I can just go and ask them directly, and they will, they will support me. p.8

So for me, I'd say I was well accepted because even my colleagues, most of them has done a masters, only that they've done statistics, which is almost similar to just mathematics. p18

The two negative responses reaffirm that acceptance was more difficult when no structured introduction existed:

Let's say, from the beginning, I was a bit frustrated by their attitudes. You know, as I say before, with a team of three and two were engineers and the fact that I was from the, from academia. p14

So my introduction was quite crazy. I was supposed to go through the introduction, introduction to the teams and different teams at the bank and just get some sort of an orientation. But that didn't really happen because there was a consultant waiting for me to arrive so that we can start with the pricing implementation. p20

4.3.7. Independence

Experiencing independence during internships is an important learning outcome. Not only does it reinforce the confidence placed in the interns by their supervisors, but it also allows them to take more responsibility for their activities. Only eight participants could say they had enjoyed a level of independence, and of these, four were in remote and hybrid internships. The quotations below illustrate this conception of independence experienced during the internships:

Workplace

So my work was solely independent. I was doing everything independently. So I would say, yes, there was a percentage to independence, I'll put, I'll give it a 99% independence that I had. p20

But the supervisor will tell you what they want, and she and she has some ideas about how the direction will be, but she doesn't know how the end game will be. p3

Actually, when we're given a problem, we're allowed to independently solve the problem, and we were even the ones to bring up the balance statement and then try to come out with a solution. p6

Remote

And yeah, so there was that difference; there was not that micromanagement as compared to when you are going to the office directly, whereby the supervisor will be there. p1

Oh, yes, I was able to work independently during my internship program with just weekly supervision, where I just give my reports. Yeah, but I've been able to work independently, and it's working for me. p2

Yes, yes. Yes. I've really learned how to work on the quality of work. So, I work when I'm more comfortable. If I'm comfortable to work during the nights, then I maximise my energy there. p2

Hybrid

So, because of that, I work very closely with the person, and initially, I depended a lot on the person on the availability to work with me on things to check everything for me. But with time, as I became more conversant with the tools I was using, I became more independent, and then I would do it. p8

And of course, because of the support of my team and the support of my mentor, at that time, and because of all trainings that I have done, and the knowledge that I gained, I managed to be independent; they think after one month, I managed to take my own actions and my decision by my own. I think this is one of the good things that we can gain from industry, having this kind of independence and being more confident of making decisions. p16

4.3.8. Learnings

The extent of the learning was linked directly to the intern's role. It is clear that in almost all instances, the participants called upon their Industry Immersion Program skills. However, there were specific new workspace skills required for the internship roles. In discussing this, it is useful to distinguish between the Industry Immersion Program and the workspace.

Industry Immersion Program

By its very nature, the Industry Immersion Program syllabus provides STEM graduates, most of whom have never encountered any form of business training or project experience, the chance to acquire the knowledge required for entry into the workspace. The syllabus is broken into three sections: general business skills, data analytical skills for business and soft skills for personal development.

Generally, none of the participants spoke negatively of the syllabus:

Okay, so my my experience with IIP program in general, the things that we were taught, some of it did not seem so important at the time was being taught, but then things come up at the workplace, and then you realise that, oh, this was what this is what we spoke about, this is what we were taught. And then you remember, this was how we were taught to do with it and and then you're able to, it's really did give me a heads up, very good heads up. p8

And fortunately, because of the kinds of training I had from the industry immersion program, it was very easy to succeed in this interview because most of the questions and requirements they were looking for was exactly what was being sourced during my time at the IIP. p13

The skills that we learned were preparing us to thrive in a business environment. Yes. So, everything was fine. p10

Yeah, I think the learnings in the workplace, most of them built up on what I learned already or do during the IIP, so, like, on enhancing the communication. p15

All right, so IIP, for me, it was, was a very, very good experience. p16

Industry Immersion Program business skills

The largest component of learning for the mathematicians during the Industry Immersion Program was from the courses on business skills. This included organisational skills, design thinking, project management, economics and marketing. This accelerated jump into the business world was a large but very necessary one to improve the prospects of employability and success in the workplace:

So the skills helped me a lot, especially the design thinking that we did, because some of the projects that come up, as I said earlier, we are given the project, but we don't actually know what the end game would be. p3

So if you look at the IIP, it offered really very practical techniques that we use. Yeah, so I will start with the design thinking. p4

So for the, for design thinking. It actually helps us to know what the problem really is. p7

I found data analytics for business really interesting. p10

Courses that are mostly relevant, such as organisational behaviour. p5

Industry Immersion Program data analytics skills

Given their education in mathematics and the likelihood of employment in data analytical or business intelligence roles, this component of the syllabus was also essential. Students worked to bring their mathematical toolkit to bear on business-related solutions:

What I can say is mainly the data and decision making that we did on on the IIP data and decision for creating the dashboard and everything. It's really played a big role. p1

So, data and decisions, I believe that that course was one cause so that I actually got employed. And it helped me a lot, even during the interview. p13

I found data analytics for business really interesting. p10

Without doubt, data in business was most helpful. For the first time, I was able to understand how to take my mathematical skills into business. p15

Industry Immersion Program soft skills

The final learning leg of the syllabus was to improve and enhance students' soft skills. The courses in the program included people, teams and organisations, communication and workplace skills (including virtual delivery) and personal branding. Research findings consistently rank industry soft skills training as a priority training area in digitally inclined roles. This was very much the case with the participants:

I think, really, the soft skills, the communication skills, networking skills, interpersonal relationship skills with your colleagues helped a lot. p15

You give us the soft skills. I remember when we used to go for those speeches. And, you know, we have to like sell yourself. Yeah, I'm still using it, actually, even right now. Yeah, it was very helpful. p18

People in organisation. I made mention of meeting people with different cultures, different backgrounds they will the way people might speak to you, maybe you might not like it, but because of people in organisational course I was able to handle all these days you do so, and someone will have to speak to you harsh, but you don't have to retaliate. You need to talk. p7

And the other part was also about the managerial skills, the leadership. p3

And fortunately, because of the kinds of training I had from the industry immersion program, it was very easy to succeed in this interview because most

of the questions and requirements that were looking for was exactly what was being sourced during my time at the IIP. p13

However, improvements to the curriculum were also recommended. In particular, interns requested more specific workspace skills:

One skill that I wish I could have learned from the IIP will be better than, say, the presentation skills. p1

There could be just a bit of a course that deals with coding. p5

So, I think if data science of the IIP is going to go in the way of data analytics and data science, SQL should be one thing that should be taught...I know we are doing Excel, but Tableau and Power BI will be so good. p7

The courses I like more of is marketing and communication because I think some of us we suffered during internships because we don't know how to communicate. p2

Workspace learning

All the interns experienced workspace learnings, which were a combination of new specific tools to deliver on their allocated projects and broader personal developmental skills discussed below.

My internship, I think it's 100% it was learning, was learning because everything was kind of new. p5

For me, I'd say every day was a learning day, actually. p18

You can be trained for specific tasks from your, from your, from the university, but in a company, you end up doing something completely different from what you were trained to do. And you should do that, because the position for your training may not only always be available, so you have to adjust to the new realities. So, this is what I learned. p14

What it means for business to bring somebody on board for business, is it's all about about input and output; whatever goes in, something should come out of it and that what should come out should be better than that which went in. p3

So, the internship helped me to build new skills, skills I never even thought of learning. So, this internship actually forced me to learn new things. p6

And you know, you better position yourself in a space where you want to learn, accept mistakes, and accept criticism, because you're willing to grow. p12

Workspace business skills

Each internship provided a different set of business skills learnings to the participants, and, in most responses, they accepted the benefits of workspace participation. Many of the learnings were better understood because of the Industry Immersion Program training:

I think one of the most powerful tools that I learned from there is, is the managerial part because it gives us the opportunity to work on projects with teams and develop a lot of skills. And also, data science courses and statistical parts that we learned from the IIP. p16

Yeah, I know so much; I can do all those programs, like using machine learning. But now I'm talking to someone who doesn't know anything about machine learning. So, I need to really break it down to just come in. This is what this is; this is the result. And this is what it means to the business, you know. p18

So, I realised that all of the projects that I did there, were somehow helping me to learn more, challenging me more to find out what do you research and everything. p5

So, I learnt in that area (customer marketing), but it was not exactly the career path I was hoping to learn in. p5

Workspace data analytic skills

The largest component of workspace learnings was with the data analytical skills required to manage large volumes of data. In almost all participants' responses, new company-specific tools were required. However, the lack of pre-preparation by industry partners often resulted in interns taking more time than necessary to learn the new tools, particularly when left to themselves, relying on resources such as with YouTube. Several participants also had to learn more simple data analytical tools than they had used during their mathematical education, such as Microsoft spreadsheet solutions:

I had to learn Oracle and I, and the lady who was my mentor from the product side, she was great. She was fantastic. And I literally learned Oracle in a very short period of time. p20

I had some some platforms, some platform, online platforms, where we can learn, for example, anything that is related to our job; there were some mandatory trainings that we need to do through the through those platforms. p16

Then I had a project to manage. I was asked to use tools that I had never used before. Specifically, Tableau and automation in Excel, that I had never done before. p8

We had a report called the MDS report. And I had never written a report before. What an industry report, I only know, academic reports. So that was my first big learning; I literally had the responsibility to compile the MDS report for the department. p20

Workspace soft skills

The workspace provided the participants the opportunity to build on the soft skills learnt and practiced during the Industry Immersion Program. Many of them felt more secure in reaching out and confident in taking responsibility for the projects and tasks given to them:

We also had presentations and so on and so forth. Even though I am not the type who loves presentations, and I normally fumble when I do presentations. But right now, I know I can see an improvement. A very good improvement in how I do presentations. p7

So that's and I think that's another thing that improved a lot. I would say my communication skills professionally and how to represent myself professionally. p20

I must sincerely say the group presentations and the rigorous opportunity we had to present our project during the IIP it was quite helpful for me. p9

But I'll say it was really a learning for me; I really enjoyed just seeing how they were able to give them the solution. And they are taking your solution. And they are explaining it to you in so good. I mean, it was so interesting. It was a good learning. p18

Other learnings

Finally, one participant shared a unique approach adopted by her company to support workspace learnings:

And another thing that I would like to share is clubs. In my company, there is a lot of kinds of clubs, including some social clubs, others in AI and machine learning, where I am a member of and another one in programming. So we used to, to share a lot of knowledge through those those clubs and like share the knowledge of data science and, and keep informing people the importance of data science. Yes, it's not compulsory, it's by choice, you can choose to belong to our club. p16

4.4. Employment outcome

Although not part of the research questions, it was interesting to follow up with the participants to find out whether or not they are, or have been, employed. For those employed, the follow-up question was to what extent, in their opinion, their experiences during the Industry

Immersion Program and the internships had assisted them with gaining employment. Table 5 sets out a summary of their responses:

Table 5: Participants' employment outcome post-internships

Employed	40%
Employed by their internship partner	25%
Returned to further studies	20%
Unable to find employment	5%
No response	10%

Overall, 65% of the participants were employed, 25% with their internship partners. Only one student confirmed being unemployed. All the employed participants acknowledged that their Industry Immersion Program training and internship experiences had positively affected their subsequent employment:

My internship experience really helped with my employment in terms of both the academic training and with connecting me with my current employer. p.2

Yes, it provided me with the right skill set and experience to gain employment. p.8

And yes, I can boldly say the training I received during my internship was very helpful.p.11

Yes, the internship experience helped me a lot. It provided an avenue to apply theoretical class knowledge to solve real-world problems. p.12

The international exposure that I got from my internship, I can say, somehow was crucial for me to land into this employment. p.4

4.5. Summary

Overall, eighteen of the twenty participants experienced successful internships in different African countries. This chapter has provided the rich context of these internships through the words

of the participants themselves. In turn, these experiences serve to introduce the set of seven qualitatively different conceptions that will be formally described and analysed in the following chapter: overall experience, interns' expectations, company readiness, structured supervision, workplace skills, team inclusion and independent working.

What was also apparent from participants' responses was that, although they believed they were successful, the quality of the internships varied significantly and may not have been as successful as they should have been. Kolb and Kolb (2005) set out eight requirements to deliver successful work-integrated learning outcomes in internships. The next chapter will discuss the conceptions arising from these findings, placing them in the context of relevant literature and comparing them to Kolb and Kolb's (2005) model for successful workspace learning.

5. DISCUSSION

5.1. Introduction

The speed of change in the future of work is accelerating. On the one hand, over 125 million jobs are predicted to be created through the growth of the digital economy worldwide (McKinsey & Company, 2023). On the other, Goldman Sachs Research (2021) in their “Post-pandemic future of work report” predicts that 300 million jobs will be lost by introducing artificial intelligence solutions. This speed of change leaves existing education models at risk, and the importance of bespoke workplace training and upskilling taking on far greater significance

The relevance of mathematicians’ experiences is important as they provide a critical subset of skill providers entering the digital economy with data analytics and business intelligence. Their educational skills are not vocational ones nor easily converted into workplace and internships are critical in providing the bridge to industry for effective employment.

This chapter is a discussion of this study’s findings. The chapter starts by placing the experiential research in an Africa context and then continues with the conceptions arrived at from the analysis of the participants’ interviews. Each section seeks to connect the findings with the literature reviewed in Chapter 2 and with the perceptions of the interns themselves, described in Chapter 4. This chapter then further explores the implications as they translate into everyday experience and practice. Finally, these conceptions are compared to Kolb and Kolb's (2005) principles for successful learning internships in an effort to arrive at a more specific African focus.

5.2. The African context

Within the limitations of the sample, this research journey sought to explore African workplace learning through participants’ experiences. Firstly, this was to evaluate how the individual countries making up the participant group have embraced the prospects of the fourth industrial revolution. Secondly, the aim was to better understand how the internship experiences in these countries are building the skill base for an effective digital economy. Thirdly, the objective was to identify specific groupings of experiences – conceptions – to provide further insights for the future of work-integrated learning.

For the purposes of this study, the selection of countries was secondary to the selection of participants, who were chosen through a purposeful sampling approach to provide variation in their experiences. However, this spread of countries enhanced the variation outcome sought in

phenomenographic research studies. The range of countries represented in this study is provided in Table 6.

Table 6: African countries represented in this study

Cameroon	Ghana
Kenya	Lesotho
Morocco	Nigeria
Uganda	Zambia

5.3. Conceptions

The main research question sought to explore how work-integrated learning is adapting to the changing nature of work and digital economies as experienced through graduate mathematicians' internships across sub-Saharan countries. The phenomenographic analysis of the mathematicians' collective experiences was grouped into nine conceptions expressing the quality of their workspace experiences. This provided the basis for discussing each, opening the possibility of building principles for building improved models for future.

5.3.1. Conception #1: overall experience

The research findings showed that the participants, other than two, experienced successful overall internships. This was an important positive finding. It highlighted a strong take-up of African companies reaching out to embrace the digital revolution. In almost all cases, the participants entered internships with non-technology companies but experienced positive engagement. Still, reviewing all the quotes and building the conceptions, it was clear that their internships were qualified successes. To be more effective in the digital workplace, a more structured approach to work-integrated learning is required, both before and during the internships.

Before the internship starts:

5.3.2. Conception #2: managing expectations

Research shows that the intentions and expectations of the interns are important considerations in preparing for their learning process (Levinsohn, 2016). The learning outcome will depend on their commitment and willingness to participate (Nieminen & Hytti, 2016) and their motivation to achieve the outcomes set for them (Rae & Carswell, 2001). Often, the interns cannot

recognise their learning gaps or underestimate the skills required to perform their outcomes (van Weele et al., 2017). So ahead of any internship, for successful co-produced learning to take place, the intern must have a knowledge of the target internship company, the role or project to be carried out, the technical and behavioural skills required. Where there are knowledge gaps, remedial learning should be undertaken (Rice, 2002).

There was a positive overall expectation towards the internships by the participants. This sample group already had the benefit of being selected for the Industry Immersion Program because they were interested in employment in industry, so this bias was expected. They all benefited from the IIP skills course, business and personal development skills. Consequently, there was an expectation that they would be prepared for their internships. Three distinct themes were evident from the participant interviews:

1. They saw the internship as a way to apply their learned skills, with a focus on data analytics;
2. Internships would give them a chance to learn further skills; and
3. They hoped to gain industry experience;

However, drawing from the research findings, it is clear that from the interns' experiences that they were still underprepared:

1. Generally, they thought they would be able to take on meaningful data analytical tasks at the outset, which was not the case;
2. They were not prepared for the team dynamics encountered. They thought existing teams would welcome them without recognising they might be seen as threats; and
3. Presentation and communication skills were far more important than they had anticipated.

The question arises then: who is responsible for managing this process? Does it sit with Higher Education institutions preparing their graduates or with the companies accepting the internships? What is evident from the participating group's experiences is that expectation management is not taking place effectively.

The independent reviewer "somewhat agreed" with this conception. Although he agreed that managing interns' expectations was necessary, he felt this could not be satisfactorily attended to ahead of the internship by the interns. Instead, it should happen in an orientation program upon arriving at the company. He also questioned who would take responsibility for managing

expectations if not the company. He did not believe it was the role of the universities from where the interns had graduated.

5.3.3. Conception #3: company readiness

There is a volume of research, both academic (Adepoju & Aigbavboa, 2021; Richard K. Coll & Zegwaard, 2006; Li, 2022; Schwab & Zahidi, 2023; Xing & Marwala, 2017) and from consulting (McKinsey, 2020, 2021; World Economic Forum, 2016, 2020), supporting the increasingly urgent need for organisations to better prepare for the digitalisation of economies and, consequently, their markets. As part of this preparation, upskilling the workforce is a priority (Li, 2020)

McKinsey's "Upskilling apprenticeship study" (2023) proposes that apprenticeships should be institutionalised at all levels of the organisation and not only focussed on entry-level employees, and management can take four steps to introduce apprenticeship training as a powerful skill-building tool to reshape culture around the idea of continuous learning:

1. Create a clear organizational expectation for both learning and teaching;
2. Build apprenticeship skills in every employee;
3. Identify the skills that individuals need to develop personally; and
4. Be broad and inclusive about who can apprentice;

A significant conception arising from the findings was that the interns felt their industry partners were not prepared for them. They had hoped to experience a more detailed introduction into:

1. The background of the specific industry and company, which would prepare them to deliver more effective project solutions early on; and
2. The specific software tools likely to be used would also have helped.

Linked to interns' pre-preparation discussed above, some company pre-preparedness would also have helped kickstart their internships. This would have given the interns greater insight into the companies, the expectations and understanding of how best to prepare for the upcoming projects. Furthermore, companies would have benefited from a more detailed understanding of their students, their academic backgrounds, other skills, and expectations during the internship.

The majority of participants wished for a more formal orientation on arrival. Bearing in mind that the internship typically ran for three months or more, the benefit of a structured orientation would have established a far better introduction to their roles, particularly with the high expectation of early project deliverables. These findings highlighted a number of orientation subjects: general

company descriptions, management organograms, human resource policies, corporate culture, and ethos. This was supported by those participants who had experienced orientation events on arrival.

The participants highlighted the following, through their collective experiences, as further issues of a lack of company preparedness:

1. No introduction to their internship company human resource policies or workplace regulations - considering that most participants had never worked in a company, policies and regulations were quite alien to them. Even dress code was a challenge for many;
2. A lack of supervisor participation - a structured preparation with their supervisors would have improved the coordination of their deliverables and work-integrated learning outcomes. In particular, it is evident from these findings' results that supervisors had very little idea of the objectives of the internships. In as much as providing solutions for the company, they were not aware that it was also a learning journey in the workplace for the interns; and
3. A more structured program, including rotation through different areas of the business, and participation in various aspects beyond just data analytic projects.

The independent reviewer “fully agreed” with this conception. His concern lay in particular with knowledge-workers who enter workplaces run by operationally inclined managers who believe that their interns should follow “business as usual”. Without proper preparedness, this then leads to uncertainty on how to manage the interns, distancing them from other employees, and resulting in their skills not being employed effectively.

5.3.4. Conception #4: structured supervision

As discussed in the literature review, the disruptive forces impacting organisations are accelerating. These include the nature of work itself, workforces and workplaces (Wang & Siau, 2019; World Economic Forum, 2023). This disruption at all levels is forcing management to be far more proactive towards organisational survival and, notably, developing effective workforces. So, whereas this research report focused on internships, the learnings from this study are also a subset of a more holistic solution to workforce supervision and upskilling. The importance of business transformation begins with Chief Executive Officers' leading change policies with ongoing reviews, and embedding transformation disciplines into business-as-usual (McKinsey & Company, 2021).

Numerous studies specifically support internship learning through supervised interaction (Hallen et al., 2016; Theodorakopoulos et al., 2014). However, in the opinions of the participants in this research study, there was a notable lack of structured supervision, which impacted their workplace learning experiences. While it was beyond the scope of this study to investigate why appointed supervisors did not naturally incline to their internship supervision roles, the impact of these attitudes was material.

The findings also distinguished between supervision and mentorship, although the two functions often rested with one individual. The participants recognised the supervisor as the person in the organisation who set their projects and tasks and to whom they reported. The mentor was seen as the one who assisted and supported them in the workplace, whether this be with their projects or with general familiarisation with the organisation and its employees. Where supervisors did take an interest, this provided encouragement to the interns, and a better experience was enjoyed. This reinforced interns' perceptions that the time spent with the company was a valuable work-integrated learning experience.

Collectively, the participants experienced a lack of regular assessments, formal or informal. Where informal assessments did take place within participants' groups, this improved the interns experiences and outcomes. They felt that they had contributed more effectively to the projects undertaken. However, for most participants, assessment of project delivery was the only form of feedback received. Even this level of engagement was valued, and many participants shared how their presentation experiences, despite being quite intimidating, were highlights of their internships.

The independent reviewer “fully agreed” with this conception which complemented his views on conception #3. He believed, particularly in the case where interns were bringing new digital skills into workplaces, that structured supervision was necessary to create work-integrated learning experiences and delivery of productive projects.

5.3.5. Conception #5: workspace skills

Several key themes were presented in the literature review that are relevant to this conception: the importance of employee reskilling into the future (World Economic Forum, 2016), the required skills to deal with the increasingly digitalised economies (Bandura, 1986) and the increasing need to develop behavioural skills (Coll & Zegwaard, 2006; Xing & Marwala, 2017). So, and as discussed above, although this research study focussed on the experiential outcomes of

the participants, the findings are also relevant to broader workforce needs. This is also supported by Li (2022), who suggests upskilling the existing workforce is a more effective outcome than employing the required change skills.

Increasingly, organisations recognise that skills development needs extend beyond formal training and combine workplace training and structured complementary learning programs. This uplifts internship programs for entry-level employees and institutionalises them across all workforce levels, including executives and senior technical leadership.

With regard to technical or hard skills, and without exception, participants had to adapt and learn specific workplace requirements to complete their projects. This did not always mean more advanced data analysis, which they believed was the goal of their internships. In many cases, Microsoft Excel was the application platform for their projects, and this came as a surprise given their depth of advanced mathematics learning, both at university and in the Industry Immersion Program. In many cases, more detailed knowledge of a basic software package was required, for which they had not been prepared.

Of greater concern was the lack of behavioural or interpersonal skills training for the participants. Basson et al. (2023) assert that the top information, communication and technology skills demanded by industry now include analysis, problem-solving, communication, team management, facilitation, self-awareness and change management. Yet, from a sample of South African Higher Education institutions, only 30% of these required skills were included in their curriculums (Basson et al., 2023). Given this mismatch, the importance that organisations remedy this gap is high and growing. The level of training should be commensurate with the role's responsibility. In the case of the interns, it is understandable that they might not be included in existing employee plans as they are perceived as temporary by their organisations, but as this study's findings show, the companies' high expectations of project delivery outcomes warranted at least some introduction to commensurate skills, such as communication and facilitation.

The independent reviewer "somewhat agreed" with this conception. Broadly, he believed that this was all part of their workplace learning to be undertaken by the interns and to be expected. He suggested that no one can ever be expected to arrive with a complete technical and behavioural skill set ready for implementation. So, he believed this was an essential lesson for the graduates in that their learning and upskilling actually began in the workplace and would be ongoing throughout their careers.

5.3.6. Conception #6: team inclusion

The prospect of co-created learning is an important opportunity. Levinsohn (2016) found that participants in incubation programs learned more from their interaction with one another than from the program's design. Monsson and Jørgensen (2016) supported this outcome, which found that participants valued the benefits of their relationships with other participants more than other program elements. Furthermore, the frequency and quality of the participants' interactions impact learning (Levinsohn, 2016).

The internship experiences recorded in this research project covered not only traditional workplaces but also hybrid workplaces and remote ones. Experiences in each workspace were quite different, with specific challenges, as supported by the research literature.

In the case of this participant group, what was common to the hybrid and remote internships was the absence of human interaction. Although all the respective participants acknowledged successful internships, they felt their experiences were not as rich as they might have been. Their inability to discuss challenges and problems informally with colleagues on a face-to-face basis left them wishful for a richer experience. Their experiences contrasted strongly with the workplace participant teams who bonded to solve project problems, even when their supervisors did not fully support them. Participants in remote internships faced further challenges with time zone dislocations.

A catalyst for improving co-created learning is to introduce structured mentorship relationships. Campbell and Campbell (2000) suggest that, in addition to the transfer of knowledge in the workplace, the mentorship role provides emotional support for students, including guidance and encouragement. Consequently, Kram (1985) suggests a mentor should be a senior, knowledgeable team member committed to supporting the intern. These skills cannot be assumed to be in place, and Evertson and Smithey's (2000) findings suggest that preparing mentors is essential to enable them to support interns more successfully. In addition to being knowledgeable in the relevant field, essential qualities are open-mindedness, the ability to motivate and being a good listener (Kram, 1985). With the exception of one participant, the mentorship relationships were informal, in almost all cases, with their supervisors and, from the interview responses, very helpful.

Linked to mentorship are policies fostering open communication and feedback, encouraging constructive criticism (Levinsohn, 2016; Politis et al., 2019). Communication should be multi-directional, between the supervisor, fellow employees and interns. Levinsohn's (2016) study

showed that active conversations lead to new ideas and solution improvements. These research findings support the literature. Communication and feedback provided to, and within, the participant group was always supportive, even though some participants found it quite critical at times.

Gaining acceptance from within the existing employee teams, though, was more challenging. This could have been because the participant group comprised graduate and post-graduate mathematicians and focussed on data analytics, a new area of expertise, with the result that interns found their presence intimidating to the full-time employees around them. The opposite was the case for those participants in remote internships, for whom there was a far better, more sociable response and greater acceptance.

Several participants commented on culture and gender, but too few to draw any research conclusions. From the interviews, those remote students who connected elsewhere to projects in Africa experienced a positive reception, which augurs well for pan-African project collaboration. With regard to gender, a number of the female participants experienced gender bias, but not to the point that it materially impacted their experiences. This contrasts with much evidence to the contrary and possibly, the advanced academic qualifications and data analytics internship roles of the female interns were mitigating factors.

Finally, the development of interns' communications skills was noted. In the workplace, surrounded by supervisors and colleagues, this was a positive experience for the participants. However, for those interns acting alone in remote or hybrid internships communications was highlighted as an experience that could have been improved. This is supported by McKinsey's (2021) report focusing on the future of the workplace, which encourages management to build collaboration groups for remote and hybrid work teams.

The independent reviewer "fully agreed" with this conception. He compared the working environments of large multinationals to small start-ups, each with different workplace cultures. From his experiences he believes that, for successful internships, it is essential to have an "introductory engagement" respectful of the workplace culture, to onboard the interns into the employee community. Furthermore, he believes, as contrasted to the structured supervision discussed above, that team inclusion programs should be more informal and welcoming amongst peers, making it easy for the interns to thrive in the workplace.

5.3.7. Conception #7: independent working

In the context of the digital economy, McKinsey (2021) has found that the skills on which companies are increasingly focused are social, emotional and advanced cognitive abilities, including leadership, managing others, adaptivity, continuous learning, interpersonal skills, and empathy. This is supported by Mainemelis et al. (2002), who suggest that organisations' success in dynamic economies requires employees to break away from preferred ways of thinking in order to generate new and useful ideas and products. Roberson (2005) argues that interns taking charge of their own learning is critical to building their self-direction. Keeton et al. (2002) take this further, suggesting that students must take responsibility for their own learning of skills and, more so, those with which they are uncomfortable.

Those participants who enjoyed a degree of independence suggested that this enhanced their internship experience by giving them the confidence to trust themselves in providing and presenting solutions. From their responses, it was clear that they all earned their independence from their supervisors as they gave evidence of their abilities.

This outcome is consistent with the literature review, which supports the importance of building the behavioural skills required for information technology roles. Research now supports that some non-technical skills are valued more highly than technical skills (Coll & Zegwaard, 2006). This is endorsed by Jackson et al. (2019) and Bandura (1986) who emphasise the importance of a dynamic and diverse skill set to adapt to the changing nature of work.

However, what was also evident from the participants' responses was that their progress towards independence was partly due to their success in their projects, but also the result of a lack of understanding by their internship companies of the data analytic solutions they provided. Hence, supervisors left them alone to get on with their projects. So, in part, independence was an outcome of supervisors trusting the interns while not having understanding of how to manage their digital talents.

Once again, the nature of the workplace impacted the levels of independence experienced by the participants. Those in remote and hybrid internships were more quickly thrust into independence-related experiences than their workplace colleagues. This is supported by Dean and Campbell (2020), who highlight the impact of the changing workplace which requires new and relevant skills. Zegwaard et al. (2017) emphasise that transitioning into remote and hybrid roles requires even greater intern support.

The independent reviewer “somewhat supported” this conception. From experience, he believed independence was offered far too quickly in internships, usually because of a lack of structured supervision or operating pressures, leading to poor outcomes and disillusioned interns. Equally, he believed micromanagement also led to a high degree of inefficiency. In his opinion, structured supervision was vital to achieving successful, productive independence, as contemplated in this conception.

5.4. A comparison to Kolb and Kolb's principles

With its African context, this research study has developed a set of seven conceptions of internship experiences, which have been set out and discussed above. It is relevant to compare these conceptions with Kolb and Kolb’s (2005) existing principles for successful experiential learning spaces, through which they suggest that the “learning space concept emphasises that learning is not one universal process but a map of learning territories, a frame of reference within which many different ways of learning can flourish and interrelate. It is a holistic framework that orientates the many different ways of learning to one another” (p. 200).

Table 7: A comparison of Kolb and Kolb's (2005) principles and the research study's conceptions

Kolb and Kolb (2005) Principles		Research Study Conceptions
Develop a learning space	√	Overall experience:
	x	Intern preparedness
Respect for learners and their experience	√	Managing expectations
Begin with the learner’s experience in mind	√	Company readiness
Create and hold a hospitable space for:		During internship:
	x	Structured supervision
Conversational learning	√	Team inclusion
Development of expertise	√	Workspace skills
Action and reflecting	√	Company readiness
Feeling and thinking	√	Independent working
Inside out learning	x	
To take charge of one’s own learning	√	Independent working

For the benefit of this study's discussion, Kolb and Kolb's (2005) principles and the research study conceptions are compared in Table 7.

This research study's findings have highlighted the need for a preparatory phase before internships begin. A significant theme for all participants was their collective experience that the industry partners had not prepared themselves for the internship. This is supported by Kolb and Kolb (2005), who cover this point with two principles: respect for learners and their experiences and the importance of beginning with the learner's experience in mind. However, this research study's findings suggest that a more structured preparation by learners themselves is essential to ensure a hospitable workspace within the preparatory phase. This would include, at the least, knowledge of the learning space and an understanding of expectations.

Although this research study supports Kolb and Kolb's (2005) suggestion that developing implementation requires "a holistic program of institutional development" (p.209), the participants' conceptions highlight the importance of structured supervision to support learning in the hospitable space, in particular to facilitate the learners' actions and reflections. It should not be left to the learner alone to build the experiential learning opportunity but, instead, the industry partner should provide guidance towards a more meaningful outcome.

Therefore, and with the exception of Kolb and Kolb's (2005) inside-out learning which is discussed below, their principles and this research study's conceptions are comparable. Their "conversational learning" principle, alluding to more than spontaneous discussion, is reflected in this research study's findings as the need to include team discussions between learners, colleagues and supervisors on a semi-structured and regular basis. The importance of the "development of expertise" principle in the learning space is also highlighted. Developing skills in the workspace, notably behavioural skills, is integral to the future of work. The challenge, as has been discussed, is that the creation of a hospitable space requires the explicit recognition of the need for such supportive procedures.

This research study endorsed the important principles of "acting and reflecting" and "feeling and thinking". However, and as a point of departure from Kolb and Kolb (2005), successful outcomes require more than a "hospitable space". Although, intuitively, learners may tend towards this priority, the research findings reported here show that participants only recognised these principles through assessments and mentorship. Where the learning space provided guidance and support for them, an enhanced experience resulted. To be hospitable, workspaces must also be structured.

The conceptions derived from the findings did not support Kolb and Kolb's (2005) principle of "inside-out" learning, which seeks to build "self-authorship". While they had a broad wish for industry experience, none of the participants in this study had an expanded understanding of their perceived learning in their workspaces. For Boyatzis (1994) and Kegan (1994) curricula should be developed around learners' more explicit expectations, and the findings of this research study rather support "outside-in" learning, always seeing issues from multiple perspectives.

Overall, the conceptions identified in this research study support Kolb and Kolb's (2005) principles. However it is suggested that more of an emphasis should be placed on creating a "*structured* hospitable space" for learners, recognising that, without structure and as reflected in the experiences of this participant group, the full benefits of internships will be lost.

5.5. Connecting this study's conceptions to the experiential learning literature

Leading on from the comparison of this study's conceptions to Kolb and Kolb's (2005) principles, a more generalised comparison can be made with the direction taken by recent experiential learning research, in particular the development of experiential workplace situational awareness in building knowledge.

Kolb's (1984) experiential learning theory centered around knowledge creation being the result of grasping (feeling and thinking) and transforming (watching and doing) experiences. All four learning modes were required for learning, although there is debate whether they should take place sequentially (Stirling et al., 2016). Largely, Kolb believed experiential learning is a structured process and that knowledge creation is grounded in the actions of learners.

As covered in the literature review chapter, subsequent experiential learning theories introduced situational factors, creating a far more complex paradigm for knowledge creation than Kolb had contemplated. Engestrom (1987) introduced the interplay of unpredictability into activities. Mezirow (1997) believed that critical reflection and active discourse were necessary for learning, and this was taken further by Lave and Wenger (1991), who argued that both should occur in like-minded communities. These further theoretical contributions support the situational outcomes impacting the learner's ability to create experiential knowledge. Kolb supported this development of situational awareness direction in his later work (Kolb and Kolb 2005).

This study's findings support the situational direction of recent research theories. The conceptions of managing expectations, structured supervision and team inclusion were situational learnings in keeping with the participants' unpredictable and uncertain internship environments. Understanding this complex dynamic will become increasingly important in developing work-

integrated learning programs to develop and maintain skills and knowledge in the accelerating future of work.

5.6. Summary

This chapter has presented a discussion of the conceptions derived from the analysis of the participants' interviews. Seven conceptions have been presented, supporting enhanced experiential outcomes in workspace internships. Before an internship starts it is important to manage interns' expectations and preparedness, as well as company readiness. During the internship, structured supervision with regular assessments will be necessary, as well as workspace-required software tools and behavioural skills training. It is also important to ensure mentorship, teamwork and regular communication skills, and to build interns' effectiveness through independence.

These conceptions were then compared to Kolb and Kolb's (2015) principles for creating successful, hospitable learning spaces in an effort to try and arrive at a more useful model that will be applicable across African countries. A case has been presented by this study for the implementation of more structured internship arrangements.

6. CONCLUSIONS

6.1. Introduction

This study set out to research how work-integrated learning is adapting to the changing nature of work and employability in the digital economy through a phenomenographic study sample of twenty African graduate mathematicians' internship experiences across eight countries. The conclusions are set out below, together with the study's limitations, followed by recommendations for further research and the researcher's reflections.

6.2. Conclusions from this study

This study set out to explore the research question: "How is work-integrated learning adapting to the future of work and employability? A phenomenographic study of graduate mathematicians' internship experiences across African countries". This was framed as a set of key sub-questions. What is the future of work and employability? What and how is work-integrated learning adapting to the change underway? Finally, and most importantly, what were the African graduate mathematicians' collective experiences or conceptions during their internships and were there learnings which could be implied in developing a future, and improved, work-integrated internship program?

6.3. The future of work

In answering the primary question, the study began by exploring the future of work. The world is well into the fourth industrial revolution, which has seen the exponential growth of knowledge economies as reflected in the expansion of the internet and other digital networks, the development and implementation of ever-more advanced software and the explosion of online connectivity worldwide. The fourth industrial revolution has also had a material impact on the world of work and its future. Furthermore, Mourtzis (2021) suggests the world may have already embarked on the next wave of innovation, the fifth industrial revolution, a sustainability-driven one, linked mainly to the development of big data and the acceptance of artificial intelligence as an enabler of human creativity

African and Study Context

Africa is a continent of fifty-four nations and, as part of the "Global South" (UNCTAD, 2018, p.1), is regarded as having a relatively low level of economic and industrial development. However, the young demographic of the continent, with youth expected to account for 60% of Africa's population by 2030 (Goldman Sachs Research, 2020), presents opportunities for countries

on the continent to leapfrog to greater prosperity on the back of emerging digital technologies, provided that required labour skills, digital infrastructure and state governance are in place (Cilliers, 2018; Quibria 2002).

6.4. The changing nature of employability

The changing nature of work arising from the fourth industrial revolution will continue to impact employability to a significant extent. The changes underway have been exacerbated by the Covid-19 pandemic, which has accelerated the adoption of digitalisation. The World Economic Forum (2020) states that there is a strong possibility that up to 50% of all existing employees worldwide will require reskilling by 2025. What is more difficult to predict is the number of new jobs that will be created in this age of digitalisation, but Microsoft has predicted 149 million new jobs will be added to the technology sector by 2025 (Microsoft Pulse, 2021).

Linked to the changing nature of employability are the skill sets required to operate in this new world order of work. Three key themes come through in the review of the relevant literature. Firstly, there is an increasing gap between the outcomes of Higher Education institutions and the skills required in the workplace, leading to apprenticeships and work-integrated learning programs becoming more essential to bridge this divide. Secondly, because of the rapidly changing nature of employment roles and responsibilities, behavioural skills are becoming increasingly important, particularly those linked to problem-solving, self-management and social influence. Thirdly, there is a recognition of continuous lifelong upskilling in the workplace, with a strong emphasis on digital skills. This has impacted the role of human resources and talent management units in businesses, requiring them to be more agile and developing individualised and fit-for-purpose solutions.

The sample of participants selected for this study were all mathematics graduates in their home countries and postgraduates from the African Institute for Mathematical Sciences (AIMS). All sought to enter employment in data analytics-related roles, but none felt they were prepared for the workplace, which was confirmed in this study's findings. This raises the importance of educating science, technology, engineering and mathematics (STEM) graduates in the additional business and behavioural skills relevant to the changing nature of employability and the skills demands of the workplace.

6.5. The changing workplace

A significant consequence of the changing nature of work and employability arising from the fourth industrial revolution has been the evolution of the workplace, from traditionally onsite work at employers' premises, to hybrid and remote working in what are better described as “workspaces”. Goldman Sachs, in their post-pandemic future of work report, predicts that hybrid and remote working models will become the new normal for about half of the US workforce (Goldman Sachs Research, 2021). This has been more forcefully stated by Erik Brynjolfsson in his interview with Goldman Sachs: "The pandemic compressed about 20 years of change into 20 weeks, marking the biggest shift in the way people work since WWII" (Goldman Sachs Research, 2021, p.4).

These significant shifts in working conditions and requirements are in their infancy, and much research will be required to better understand and to optimise these new workspaces. Two particular challenges remain in implementing the ‘new normal’: technology connectivity and social engagement. Technology connectivity in the Global North has accelerated exponentially with sophisticated free-to-use platforms such as Google Meet and Microsoft Teams. This is not the case for the Global South, where technology inequality is a significant concern. Social engagement is also important to maintain a healthy workforce. Here, hybrid solutions, where employees spend part of their working week at the office and then the balance at home, appear to be becoming more acceptable. Several material consequences of the hybrid model are still being addressed, including management practices, talent management, security and employee well-being (World Economic Forum, 2023).

Considered in this context, Africa's countries exhibit a diverse range of technology infrastructure and delivery, significantly impacting the style of workspace adopted in each country. Egypt, Ghana, Kenya, Rwanda and South Africa are some of the countries that have embraced technology allowing hybrid and remote workspaces to flourish. In other countries, where this is not the case, there is no option but to work from centralised workplaces. This inequality in preparedness for the fourth industrial revolution threatens the development of a consistent digital economy development across the continent.

The participants in this study were spread across all three forms of workspaces. Most of the internships took place in the physical workplace, driven more by data security issues than connectivity opportunities. Interns in hybrid workspaces benefit both from the advantages of a physical location and the opportunities of connectivity. Only interns in remote internships felt that

their experiences were reduced by location, principally due to the inability to connect with colleagues informally.

6.6. Work-integrated learning in the changing world of work

To better understand the work-integrated learning framework, constructivism and experiential learning concepts were explored by reviewing the theories of Dewey, Lewin and Piaget, three leading educational reformers. All supported complementary approaches, suggesting that effective learning can only be converted into knowledge through practical, social and emotional experiential connectivity. Kolb, in 1984, produced his seminal work, “Experiential Learning Theory”, which sought to build a pedagogical framework for experiential learning in the workplace and this continues to be the basis for modern work-integrated education and co-operative learning programs.

Subsequent scholars - Vygotsky, Engestrom, Lave and Wenger - have placed greater emphasis on intangible and indirect social experiential interactions, all the more relevant to digital workplace learning, where the importance of developing behavioural skills and knowledge is increasing.

Together, this body of literature suggests that work-integrated learning is adapting to the future of work. Dean and Campbell (2020) and Winchester-Seeto and Piggott (2020) indicate that work-integrated education will be increasingly important in bridging the growing skills gap between studies at Higher Education institutions, which are essential to the learning journey, and skills that are learned and applied in the workspaces of the future.

6.7. The Conceptions

Phenomenography is a qualitative research method that is applied in analysing collective experiences, called “conceptions”, and is well-suited for exploring experiential learning. In this study, the conceptions were derived from the experiences of African graduate mathematicians' internships. Variation across the interviews is important (Åkerlind, 2012), and a purposeful sample of twenty participants was selected, comprising eleven females and nine males, and representing nine African countries. The internships were split into eleven workplace locations, five remote workspaces and four hybrid workspaces.

Seven distinct conceptions were derived from these research findings:

1. Overall, the majority of the participants experienced successful workplace internships, which they believed were learning experiences. This was a very encouraging study

conception. It underpins the study's major question positively showing that work-integrated learning is adapting to the future of work and employability as experienced by data analytic talents entering African workplaces. This is all the more important from a digital economy viewpoint in that the workplaces fall into the definition of being "Global South" ones, and therefore less advanced to more industrialised economies. From this supportive foundation, further studies, as discussed below, can seek to improve and further the learning process.

2. However, the participants felt that their expectations should have been better managed and that they could have been better prepared going into their internships. This conception, that was consistent throughout the participant group, expressed the need for greater preparation (although the independent reviewer only "somewhat agreed") ahead of internships. To understand this better, it should be recognised that the bulk of graduates in Ghana and similar countries typically come from rural backgrounds and their first encounter with industry, the workplace and formal employment is entry into internships. What was more positive from this study, was the participants' recognition of this necessity for further pre-preparation to enhance the learning experience.
3. Through their experiences, interns also felt that the companies could have been better prepared, mainly as they were arriving with purposeful data analytical skills, which in several instances, were new to the companies, and they were not entirely sure how to best implement and utilise these digital skills in the businesses. This conception was an important graduate experiential finding and underpins the study's recommendation of developing structured hospitable learning spaces for African workspaces. This follows from two intersecting outcomes. Firstly, the background of the graduates entering the workplaces, as discussed, and secondly, the less digitally developed nature of the companies themselves. Digital business practices are still very much in their infancy in many African workplaces, as evidenced in the findings of this study. In as much as entering the workplace was a challenge for the graduate interns, so was receiving them by supervisors and existing employees for many of whom the digital skillset is new and possibly outside of prevailing operational practices and policies.
4. The majority of the participants experienced a lack of structured supervision. Again because of their particular digital skills, they believed the companies did not entirely know how to supervise their activities and preferred, instead, to let them get on with

their tasks or projects alone. This, though, lessened the internship experience in their opinion, because the workplace, supervision, reporting and team-based participation were very new experiences for most of them. Again, the graduates' experiences implicitly recognise the predicament of operational issues facing supervisors in delivering on their roles, not only in the workplace but in the work-integrated learning outcomes expected by the interns. It reinforces this study's recommendation for ongoing technology upskilling policies to be introduced across organisations.

5. The participants collectively experienced that their mathematical skills did not always translate into workplace skills. This came as a surprise to many and reinforced the conception that they should have been better prepared for their internships. This was an important insight from the participants. It reinforced to them that the full extent of their graduate mathematical studies was not necessarily required in the workplace. A more detailed practical understanding of lesser technical workplace software packages or company-specific software solutions was required. Furthermore, behavioural and presentation skills were highlighted as being important too.
6. Team inclusion was a challenging experience for many. The participants were all postgraduate mathematicians, and they felt a certain discrimination by company employees, who either did not understand how their digital skills would contribute to operations or that, in some way, their own full-time roles would be challenged. This was exacerbated for the female graduate internships. They experienced instances of gender discrimination, which they believed were because their older male managers felt threatened by their presence.
7. Finally, independent working was a positive learning experience for the participants. Not only did it convey a sense of support to them by their supervisors, but it reinforced their learnings. However, several participants believed their independence was granted more as a result of their supervisors and colleagues not understanding their data analytical skills than being comfortable with them working unsupervised. Independence was also challenged by the independent reviewer who, from experience, believed independence given too early led to internship inefficiencies and should be judiciously granted. However, developing independent working abilities in the new era of employability where there is an increasing move towards remote and hybrid workplaces,

was supported by the participants' experiences in those situations during their internships.

The study's conceptions were then compared to the learning space principles of Kolb and Kolb (2005). The aim was, firstly, to discover whether their principles set out in 2005 still held firm in 2023 and, secondly, whether the African context, as part of the Global South, elicited any notable differences.

With regard to the first aim, this study's conceptions were found to be very similar to those of Kolb and Kolb, with only two of their nine principles not matching. Kolb and Kolb (2005) argued that a "hospitable space" was necessary to encourage learning, whereas, in this study, the comparable conception was defined as "structured hospitable spaces". Secondly, this study did not derive a conception matching Kolb and Kolb's (2005) inside-out learning. It is encouraging that the majority of Kolb and Kolb's principles have remained relevant over time.

With regard to the second aim, it was found that African graduates and workplaces were less well prepared for work-integrated learning. In most cases, the participants had never encountered any form of business, and they believed there was a greater need for structure in their internship to enhance their experiential learning outcomes.

Finally, the conceptions arising from this study supported the evolving direction of experiential learning teaching and learning approaches that were identified in the literature review. Other than the workplace skills conception, all the conceptions identified from the analysis of the interviews with interns were behavioral, such as preparation, supervision and team skills experiences. This supports the situation developmental theories of Vygotsky, Lave and Wenger.

6.8. Recommendations for further research

Given the limitations of this study, the researcher recommends further studies to deepen the understanding of work-integrated education in Africa's emerging digital economies:

1. Undertake a comparable phenomenographic study into the collective experiences of the industry partners hosting the postgraduate internships explored in this study;
2. Look into the collective workplace experiences of STEM graduate groups in fields other than Mathematics and compare the outcomes to this study for a more robust set of conclusions;
3. Research work-integrated learning experiences in specific countries across the digital divide in Africa to better understand the prospect of Africa leapfrogging into the fourth

industrial revolution, and whether the fourth industrial revolution will exacerbate the digital divide across Africa's economies;

4. Compare the African learnings to marginalised but significant communities in the Global North, providing possibly a model to enhance work-integrated learning for these communities;
5. Research the experiences of African graduates employed by international companies in carrying out remote projects; and finally
6. Compare the employment progression of similar graduates who did not benefit from structured work-integrated learning programs.

6.9. Researcher's personal reflections

As a former program leader and now a researcher, I feel blessed to have been afforded the opportunity to develop my professional passions in a structured academic journey. As I move to conclude, I wish to set down some personal reflections.

We live in an unprecedented time in history where the changing nature of work and employability, as we know it, is accelerating at a pace which I think of as 'acceleration-squared', or 'change-upon-change'. The future is increasingly uncertain, and skills learnt early in life will require ongoing and more demanding upskilling to remain relevant and useful. The best we can do is prepare ourselves for a life of learning and change.

This brings me to the increasing impact of artificial intelligence on learning and education. It would be incongruous to conclude this research study journey without acknowledging the advent of the artificial intelligence application, ChatGBT in November 2022, nine months before the conclusion of the project set out in this report. Even in the early days since its launch, ChatGBT has had a profound impact as it responds to increasingly complex prompts and composes advanced responses, including articles, social media posts, essays, emails, graphics and videos (TechTarget, 2024). ChatGBT provides stark evidence of the potential of artificial intelligence to disrupt life as we know it and at an unprecedented pace, more starkly described by Yuval Noah Harari as the "hacking of the operating system of the human civilization" (Yuval, 2023, p.1). Ray Kurzweil suggests that we will reach a "technological singularity" in the next few decades, which he defines as a "period during which the pace of technological change will be so rapid, its impact so deep, that human life will be irreversibly transformed." (Kurzweil, 2014, p.393). Education and learning as we know it, will have changed forever.

Finally, I wish to shout out for my continent, represented in its rich diversity of histories, cultures, aspirations and ambition of youth, supporting the declaration by Kuyoro and Leke (2023, p.1)

"Young, innovative, and resource rich: Africa is poised for the reimagining of its economic opportunity – to the benefit of the continent and the world at large"

7. THE PRAXIS MODEL: THE GHANA1000 INITIATIVE

7.1. Introduction

This researcher has enjoyed the privilege and benefit of incorporating his Masters research journey over the past two years into his advisory role and the conceptions, particularly those related to company readiness and structured internships, being introduced into the delivery of internship programs, with which he is involved. In particular, the outcomes of this research are being incorporated into a national African internship program seeking to scale science, technology, engineering and mathematics (STEM) graduate employability, described more fully below.

7.2. The Ghana1000 Initiative

In February 2023, a team on behalf of Industry Immersion Africa (iiAfrica), including this researcher, concluded an agreement with the Ghana Ministry of Education, through its National Service Scheme (NSS), to select and train 1,000 STEM graduates in a virtual and expanded Industry Immersion Program (IIP) in October and November 2023 (the Ghana1000). The graduates, on completion, would then enter their compulsory twelve-month national service internships with Ghana industry partners. This program seeks to enhance the employment prospects of these STEM graduates transitioning into data analysis and business intelligence roles in industry and supporting the Government of Ghana's stated adoption of the fourth industrial revolution to develop its digital economy.

The Ghana1000 Initiative has set a target of graduating 10,000 STEM graduates through the program over four years. Key performance indicators include 70% of the student cohort being female and 80% transitioning from their internships into meaningful employment.

The Ghana1000 brings together several academic partners partnering with iiAfrica, including ESMT Berlin, the University of Toronto's Rotman School of Management and the University of Victoria's Peter B Gustavson School of Business. The technology platform delivering the business and behavioural skills will be provided by Insendi, an “online learning platform designed with learning experiences in mind” (Insendi, 2024, para. 1). Funding is being sought from educational foundations, for example, the Mastercard Foundation (Mastercard Foundation, 2024) and sponsorship from local industry partners.

7.3. The Industry Engagement Program

Arising out of this research study, several of the conceptions discussed will be adopted into practice for the Ghana1000 project and will become the basis for the Industry Engagement

Program. To ensure a successful transition for graduates participating in the Ghana1000 and increase the chances of creating a pipeline of talents into companies, the Industry Engagement Program will aim to train and prepare human resource managers and data analytics managers from participating industry partners around their preparedness for the internships, set out on greater detail below.

7.3.1. Graduate pre-internship preparedness

All graduates that are signed up for the Ghana1000 project will be introduced to their appointed internship companies and their proposed roles during the program skills course. They will be given a project to research and then present to their nominated supervisors, including:

1. An overview of the company;
2. The nature of their internship role; and
3. An understanding the expected technology tools they will have to deploy.

The aim of this project is to give both intern and supervisor a first opportunity to meet and understand one another and give input into a more effective orientation on arrival at the start of the internship.

7.3.2. Company pre-internship preparedness

What is evident from research carried out for this dissertation is that many African companies, particularly, small to medium sized ones, are not sufficiently prepared for internships. The World Economic Forum (2022) in its “Why Africa’s youth hold the key to its development potential” report states this includes a lack of understanding that:

1. Successful internships are a two-way relationship;
2. Structure is required in the internship role;
3. Supervision and mentorship are essential;
4. Team and colleague support are necessary; and
5. Two-way assessments are required.

It is proposed that all internship industry partners' chief executive officers, human resource leads and supervisors will be invited to workshop conferences introducing them to work-integrated internships. After that, companies will be requested to:

1. Nominate an internship supervisor;
2. Describe the internship role and tech platform to support delivery; and
3. Set out their expectations.

There will be follow-up workshops in smaller groups to discuss the above during the internships.

7.3.3. Internship delivery

Following the completion of the skills course, all the graduates will enter their compulsory twelve-month national service with selected industry partners, as prescribed under the Government's National Service Scheme. The internship delivery program will be tailored to meet the dynamic and focused requirements of individual companies and industries, following the insights from the set of seven conceptions identified in this report. The following overall objectives will be implemented:

1. Orientation. The first two days of the internship will be devoted to orientation, during which time, interns will be introduced to the company, the internship role, the team, and fellow employees. The company's policies and procedures will also be outlined (linked to this research study's conceptions: managing expectations and company readiness)
2. Supervision. Interns will work under a designated supervisor providing day-to-day guidance and support. Supervisors will meet with interns regularly to discuss progress, challenges, and goals (linked to this research study conception: structured supervision)
3. Mentorship. Each intern will be paired with a mentor who will guide them throughout the internship. Mentors will provide regular feedback, help interns develop new skills, and answer any questions they may have (linked to this study's research conception: team inclusion);
4. Skills training. Interns will receive workplace training in relevant skills and technologies. Additionally, they will participate in behavioural skills training, including communication, time management, and problem-solving (linked to this study's research conception: workplace skills);
5. Project work. Interns will work on projects that align with their skills and interests. Projects will be designed to challenge interns and help them develop new skills. Regular check-ins will be held to ensure progress and alignment with company goals (linked to this study's research conception: independent working);
6. Networking. Interns will network with employees, including attending social events and team-building activities. Additionally, they will be encouraged to participate in relevant industry events and conferences (linked to this study's research conception: team inclusion); and finally

7. Career development. Towards the end of the internship, interns will participate in career development workshops focused on resume building, interviewing, and job searching. The company will also provide feedback and support for those seeking future employment opportunities.

7.3.4. Internship assessments

The quarterly internship assessments are critical to the success of the Ghana1000 and the national internship program in seeking to enhance the prospects of subsequent employability.

They will be compulsory and will seek to measure the following:

1. Overall success of the internship experiences;
2. Progress of the intern's work-integrated learning outcome;
3. Progress of the internship project delivery for the company;
4. Interns' strengths and weaknesses; and
5. Likelihood of employability.

7.3.5. Employment preparedness

In the last quarter of the internship, preparations will begin towards the interns' employment.

These will include:

1. Discussions with the intern's company as to possible employment opportunities;
2. Preparing online curriculum vitae for each intern; and
3. Setting up a recruitment matching system between possible employers and completing interns.

7.4. STEM Women in Business

In addition to the industry engagement program, Ghana1000 has developed two more innovative programs aligned with the core program: STEM Women in Business (SWIB) and work-integrated research aimed at Global South lower-income countries.

The SWIB program has set an ambitious target of recruiting up to 70% of the program as women. This aligns with government and international development organisations' policies to promote women's inclusion in industry. More so, and recognising the challenges women face breaking into in the workplace, the Ghana1000 will support the female graduates in two further respects:

1. Creating a community of practice and mentoring and providing personal development opportunities. This will be achieved by building the social network platform to allow direct curated connectivity between the SWIB graduates in the workplace to solve immediate challenges encountered and social support. The Ghana1000 will enhance this community by persuading leading women in Ghana industry and academia to join the SWIB community as mentors and guest leaders; and
2. Awarding the top 2% of SWIB graduates the opportunity to enroll in online Masters in Business Administration programs at renowned business schools such as ESMT (Berlin), focusing on the industries in which they seek careers in Ghana. The objective is to build the management skills required of the SWIB graduates to jump to senior industry levels, becoming the core of an ever-strengthening women's group influencing industry and policy in Ghana.

7.5. The Agritech Innovation Hub

The second program aligned to Ghana1000 is the Agritech Innovation Hub partnership with the Ghana National Service Scheme focussing on developing value-added agriculture employment services. Agriculture plays a vital role in the economic growth of the Ghanaian economy and is an essential contributor to various sectors, employing over 50% of the population in Ghana. In 2019, the value of Ghana's Agriculture sector was US\$11.5 billion and comprised 54% of the country's GDP (World Bank in Ghana, 2023, para. 1)

The National Service Scheme has the mandate to establish a project with the objective of training 48,000 agri-preneurs and 12,000 professionals in the agriculture-adjacent sectors. The project's core is allocating 200,000 acres of arable farmlands across the country, purposefully designated as model farms for training and development in the agriculture and agriculture-adjacent sectors. Ghana1000 will be the lead training program in supporting graduates' transition to work in the agribusiness value chain, from farm to consumer, including:

1. Skill units for each level of the farming output value-chain led by female graduates from international business schools, specialising in the relevant farming management skills;
 2. With supporting data analytics and business intelligence, including crop analytics, logistics systems, credit and finance; and
 3. Supported by mentorship arrangements with industry partners.
- leading to the development of revenue-generating streams and a self-sustaining ecosystems.

7.6. Work-integrated learning research

Finally, discussions are underway with the research aligned foundations, for example, the International Development Research Centre (IDRC) and other international higher education institutions, to fund the formation of a research unit to deliver high-quality research responding to work-integrated learning challenges in Africa. For example, one project call for funding is “How can the impact of promising or proven innovations for data systems and data use be scaled to support transformative change in education systems in lower-income partner countries?” (International Development Research Centre (IDRC), 2023, para. 1).

If funding is secured, it is the intention to recruit a pilot research team in Ghana in 2024, with strong local and international higher education research advisory links. During this first year, data collection will take place parallel to the Ghana1000 internships underway, and in 2025, the first set of preliminary findings will be concluded and published. If this research pilot project meets its objectives, the intention would be to establish a permanent research facility focused on work-integrated research programs across the continent.

7.7. Summary

The Ghana1000 project is the culmination of endeavours by a partnership of African and international educational institutions and industry partners to enhance graduate youth employability. Ironically, the Covid-19 pandemic forced the partnership to adopt virtual and hybrid practices to continue its journey, and in so doing, lay the blueprint for scaling workplace-integrated learning solutions. Ghana1000 will be the national pilot of this scaled outcome in 2023 and 2024 and, if successful as is expected, will provide a work-integrated education model to export to other African countries in the years ahead to assist digital economies leapfrog into an enhanced future.

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APPENDICES

Appendix A: Extract from African Development Bank Group Study (AfDB) Study Report: Unlocking the potential of the fourth industrial revolution to transform Africa

(African Development Bank Group, 2019, p13-17)

INTRODUCTION

“In the past, Africa was unable to benefit and capitalise on the opportunities brought about by previous industrial revolutions. This weakened its position in relation to international competitors. In light of the benefits and challenges posed by the fourth industrial revolution (4IR), Africa cannot afford to, nor does it have to, miss out on the opportunities brought about by the Fourth Industrial Revolution². This report provides a first blueprint for Africa to capitalise on its strengths and mitigate its weaknesses and grasp the opportunities afforded by the 4IR” (African Development Bank Group, 2019, p.13).

UNLOCKING THE POTENTIAL

“With a growing number of business users and end consumers, the 4IR is starting to become a reality in Africa. Studies dating back to 2015 projected high growth in African start-up technological entrepreneurs, identifying 3,500 new technology-related ventures and an anticipated \$1 billion in venture capital by 2018³. In 2019, this study reveals that reality has surpassed projections, as approximately 6,500 technology start-ups were identified on the continent, among which about 10% develop 4IR applications (712 start-ups). They received \$210 million in venture capital investments of the overall \$2.27 billion investments in technology start-ups. Not all of these startups by any means are focused on the 4IR (many are in the realm of digitisation) but the basis for Africa’s growth into 4IR is already there”.

“On the supply side, Africa cannot as of today be characterised as a producer of 4IR technologies, but rather as an adopter of existing technologies produced and developed elsewhere in the world. These products and services are often developed by foreign corporations or start-ups (e.g. Thales, Airbus, Zipline) but also by African corporations or start-ups to meet African demand”.

“Africa’s large population, which is expected to double by 2050 to 2.4 billion, presents both a source of data to feed innovation in 4IR technologies as well as a dormant valuable market.

According to the present analysis, there is margin for growth on the supply side as proposed products and services in Africa stand way below estimated demand levels”.

“While there is no data available on the turnover of companies proposing 4IR applications, looking at the current level of capital investments is a first step to approximate the current supply levels. For their part, Internet of Things (IoT) applications are steadily emerging in Africa. More than \$100 million of venture capital was invested in African IoT start-ups by 2019, making it by far the most attractive 4IR technology for investors on the continent⁴. The IoT market is projected to reach a value of \$12.6 billion by 2021 in Africa and the Middle East, with high potential for growth for producers of IoT applications on the continent. Concerning Big Data, it is estimated that \$9.5 million worth of capital investments will have financed Big Data start-ups on the African continent in 2019. In Kenya and Nigeria, IBM estimates that up to 40% of businesses are in the planning stages of Big Data projects”.

“Additive Manufacturing (AM), including 3D printing, is the second promising 4IR technology on the continent. About \$47 million was invested in additive manufacturing in Africa by 2019, according to Crunchbase (Crunchbase, 2019). On the demand side, Africa’s market represented \$300 million in 2016 and is estimated to reach \$1.3 billion by 2022”.

“The volume of business for African markets relating to artificial AI, drones and Blockchain is not yet known. However, \$17.5 million worth of capital was invested in African AI start-ups by 2019 (Crunchbase) while studies estimate that global economic activity linked to AI will increase by 16% by 2030 compared to 2018⁵. In addition, \$7.9 million was injected into African start-ups developing drone applications by 2019 while the global market will be worth \$100 billion by 2020. Finally, \$14.9 million was injected into African start-ups working with Blockchain in 2019 (Crunchbase) in a global market which is expected to grow by 62.1% between 2015 and 2025. By then, it is estimated that the market would be worth \$16.3 billion” (African Development Bank Group, 2019, p.16)

However, countries face key challenges which need to be tackled to unlock the 4IR in Africa, including:

“Human capital initial training and retraining.

Entrepreneurs in Africa often lack technical and managerial skills in terms of how to develop successful business models and how to run a business and usually experience shortcomings in the soft skills needed to effectively pitch to investors. There is a need for more targeted capacity building (e.g. through mentors, Angel investors). Gender imbalance is another issue. Additionally,

unlocking the potential of the 4IR will include relying on data that can inform the design of sound policies in the field of human capital development. However, there is an overall scarcity of data for long-term planning and reform” (African Development Bank Group, 2019, p.16).

“Governance, policy and regulations.

Overall, lack of awareness and uninformed public opinion, uneven digital inclusion, obsolete governance systems not adapted to spatial and temporal issues posed by the 4IR, as well as competition and digital privacy encroachment represent the biggest challenges standing in the way of the adoption and absorption of emerging 4IR technologies on the African continent” (African Development Bank Group, 2019, p.17).

“Information and communication technology (ICT) markets.

On the supply side, the reduced extent and speed of the internet on the continent is hindering the take-up of 4IR technologies. On the demand side, however, a large number of individuals and households do not use, or do not have devices to access, the internet. In fact, potential consumers are mainly the working poor and operate in the informal sector. This may hinder large-scale and widespread adoption of 4IR technologies unless the applications are designed accordingly (i.e. cheap, easy, simple to access) to meet the specific needs of this consumer base. Importantly, if people are not connected then the data they could otherwise produce cannot be captured leading to possibly distorted analyses and conclusions” (African Development Bank Group, 2019, p.17).

“Entrepreneurial and innovation support systems.

Africa shows a limited ability to absorb external knowledge while it is at an early stage in terms of closing the technology gap. Universities are still too focused on publication and admit that there is a gap in terms of their capacity to transfer knowledge. Elsewhere, public funding is suboptimal. Technology transfer systems are weak and there is a global lack of research & development investment. Technology hubs, incubators and networks of mentors have not yet reached a professional and critical mass level and thus do not fully play their role as catalysts in the African start-up scene” (African Development Bank Group, 2019, p.17).

“Access and diversity of financing.

African businesses, in particular micro, small and medium enterprises (MSMEs), face problems accessing debt or equity financing. On the demand side, there are still significant

obstacles facing people working in the informal sector in their efforts to access finance.“ (African Development Bank Group, 2019, p.17).

RECOMMENDATIONS

“Essentially, there are three scenarios that Africa might consider in the 4IR context:

1. the first would be to maintain the status quo and miss out on the revolution, as Africa did for the three previous industrial revolutions. The study’s analysis discards this scenario. To do so would be neither beneficial for Africa’s development nor rational given its ability to participate in the 4IR;

2. the second would be to bypass other stages of development and leapfrog directly to the 4IR. Even though this path is paved with challenges to be overcome, Africa has more to benefit than to lose from taking the necessary steps to unlock the 4IR. However, it will inevitably have to pass through the third, digital, industrial revolution to ensure it has the digital infrastructure to support the 4IR;

3. the third would be for Africa to become a producer of 4IR technologies. This path is, perhaps, too ambitious for Africa as a whole and not foreseeable in the medium term (i.e. within five years). It would require a significant human capital gap to be bridged, which would require longer to achieve. This scenario, however, is not out of the question for some ambitious African countries, but they would need to start to build their human capital now.”
(African Development Bank Group, 2019, p.17)

Appendix B: Participant demographics

No	Country	Internship	Industry Services	Gender
1	Cameroon	Workplace	Consulting	Male
2	Cameroon	Workplace	Agricultural	Male
3	Cameroon	Workplace	Engineering	Male
4	Ghana	Workplace	Financial	Male
5	Ghana	Workplace	Financial	Male
6	Ghana	Workplace	Financial	Male
7	Ghana	Workplace	Technology	Female
8	Ghana	Workplace	Government agency	Female
9	Ghana	Hybrid	NGO agency	Female
10	Ghana	Remote	NGO agency	Female
11	Kenya	Workplace	Financial	Male
12	Kenya	Remote	Technology	Male
13	Kenya	Remote	Property	Female
14	Kenya	Remote	Technology	Female
15	Kenya	Remote	Consulting	Female
16	Lesotho	Hybrid	Financial	Female
17	Morocco	Workplace	Engineering	Female
18	Nigeria	Hybrid	Education	Female
19	Uganda	Hybrid	Technology	Male
20	Zambia	Workplace	Education	Female

Appendix C: Ethics clearance letter



Graduate School
of **BUSINESS**
UNIVERSITY OF CAPE TOWN

MPhil

INTERVIEW CONSENT FORM:

Participant name.....

I volunteer to participate in a research project conducted by **Mark Heerden** as partial fulfilment of the requirements for the MPhil Degree at the Graduate School of Business. I understand that the research is designed to gather information about **my internship experiences** and that I will be one of approximately 20 participants being interviewed for this research.

Background and purpose of the research

Work-integrated learning has long been a key strategy in enhancing graduate youth employability. How is work-integrated learning adapting to the changing nature of work and blended learning? A phenomenographic study of internship experiences across selected African countries.

Ethics approval

Ethical consent for the study has been approved by the UCT Commerce Faculty Ethics in Research Committee.

Participation and confidentiality

I understand that my participation in this research is voluntary, that I will not be compensated and that I may withdraw at any time.

The interview will take approximately 45 - 60 minutes to complete and will be audio recorded

I understand that I will not be identified by name in any reports using information obtained from this interview and that my confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.

Consent

I consent to participate in this interview, based on the terms outlined above and subject to the following additional condition of my own (if any)

Own Conditions.....

.....

Signed by participant

.....

Date

.....

Signed by Student

.....

Date

