Work-Integrated Learning for Mining Engineering Training and the Employability Nexus in Traditional Research Universities: A Case of Selected South Africa Universities

Paul Othusitse Dipitso[1*]

[1]*University of the Western Cape, RSA*

[*]Correspondence: othusitsepaul@yahoo.com

Abstract

Globally, employability is increasingly becoming an issue of concern in higher education due to demands from the labour market requiring work-ready graduates. In the Global South, particularly South Africa, universities are on a quest to develop competence and improve student employability. This paper is set to investigate the impact of work-integrated learning on employability for mining engineering undergraduates in South Africa. The research data were collected using the mixed methods approach and a case study design. Experiential learning was used to examine the impact of work-integrated learning on the employability of mining engineering students. The findings provide a description of perspectives for mining engineers, lecturers, and workplace supervisors concerning the enhancement of employability for mining engineering students. The findings revealed that professional associations play a crucial role in the development of professional skills. This article argues for strong partnerships with industry partners to nurture the employability of mining engineering students.

Keywords: South Africa, employability, mining engineering, work-integrated learning, experiential learning

Introduction

Universities are currently under pressure to produce graduates who can meet the demands of an ever-changing labour market. Employers expect graduates to possess technical and behavioural skills that enable them to navigate the complexities of the contemporary workplace. The expectation is that

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upon exiting the university, graduates should be able to adapt to the work environment. Thus, it is worthwhile for universities to design a curriculum recognising skills and competencies. In this regard, universities have adopted work-integrated learning as a strategy to shape and nurture work readiness. As a result, this study investigates the enhancement of employability skills for mining engineering students through their involvement in work-integrated learning.

Review of Literature

This study is situated within the South African higher education context. It examines the role of work-integrated learning and its contribution to the employability of mining engineering undergraduates at selected mining schools. Work-integrated learning is conceptualised as an applied learning strategy involving a structured educational program that combines productive, relevant work experience with academic studies (Du Pre, 2010). According to Jackson (2015), work-integrated learning is considered instrumental in equipping students with the required employability skills, which empower them to function productively in a work environment. Similarly, Hall, Pascoe and Charity (2017) argue that it provides students with an opportunity to apply acquired knowledge and skills in a practical setting while under supervision. Various scholars argue that the work-integrated learning approach aligns academic and workplace practices of the mutual purpose for the spaces of employment and ultimately improve disciplinary skills and knowledge (Freudenberg, Brimble and Cameron, 2011; Whelan, 2017).

The South African higher education sector has provisions on work-integrated learning embedded in policy documents such as the Higher Education Qualifications Framework (Winberg et al., 2011). Ironically, traditional universities often take less consideration of the career trajectories of graduates and issues of employability (Winberg et al., 2011). However, existing literature indicates that work-integrated learning serves to bridge the gap between skills acquired by graduates and labour market requirements (Tamin, Plooy, Solms, Meyer & Member, 2019). In the context of this study,

professional engineering associations provide guidance on the good practice of teaching and learning (Winberg et al., 2011). As a result, universities are required to affiliate to professional accrediting bodies and award credit for work-integrated learning as part of the academic qualification, which is the case for a mining engineering degree.

Various studies recognise the importance of implementing work-integrated learning within universities (Tamin et al., 2019; Long and Fynn, 2018; Maseko, 2018). Pop and Barkhuizen (2010) conducted a qualitative study to determine the contribution of work-integrated learning towards employability for information and technology of interns. Their findings revealed that it is crucial to have a well-structured work-integrated learning programme, which supports mentorship and contributes to the integration of soft and technical skills. This significance is recognised in other studies, which also identify the approach as critical in universities. Dwesini (2017) argues that it is the responsibility of higher education institutions to equip learners with a knowledge base and generic employability skills, which are necessary for the workplace. It is to this effect that Maseko (2018) explored work placement in four mining schools in all universities offering mining engineering. However, this current study takes a different approach, which is that of examining work-integrated learning concerning the employability of mining engineering students. This study recognises the observation that South Africa needs a competitive environment of higher education, which emphasises the need for innovative ways of work-integrated learning to respond to increasing employer demand for work-ready employees made by (Jacobs & Dzansi, 2015; Nicolaides, 2012; Wessels, 2014). The above-noted studies recognised that work-integrated learning is a powerful tool, which has the potential to empower students with employability capacities hence this study.

Some of the literature focuses explicitly on the various work-integrated learning models and approaches adopted by universities (Govender & Taylor, 2015; Reinhard and Pogrzeba, 2016). The approaches include; work-directed theoretical learning, problem-based learning, project-based learning

and workplace learning (Govender & Taylor, 2015). In their study, Govender and Taylor (2015) found out that the students, industry and academia support the implementation of work-integrated learning. In addition, Reinhard and Pogrzeba (2016) made a distinction based on the context of Germany that this model is referred to as cooperative education, whereby universities work closely with companies to allow students to alternate between classes and working in the industry. However, the lack of workplace readiness and experience is often the key constraint, which is why organisations offer work-integrated learning programmes as part of the students' tertiary education. To this end, Wardle (2012) laments that contemporary discussions on graduate employability bemoan the lack of general job skills and practical industry-specific competences. Thus, the above arguments suggest that universities need to incorporate work-integrated learning into the curriculum to empower students for the realities of the work environment.

Furthermore, Patrick et al., (2008) argue that curriculum design should incorporate work-integrated learning activities to accommodate diversity in learning. In this case, designing mining engineering in the curriculum should take into account the contemporary skills required by the mining industry. Resultantly, Gu, Zhao, and Wu (2018) claim that universities should integrate employability skills into the curriculum to encourage learning experiences. In light of the above, the literature suggests that curriculum design for work-integrated learning can foster and develop skills that enhance work-readiness. Lugoma (2017) calls for a rethinking of the current curriculum owing to the changing profile of students enrolling for mining-related qualifications. Nonetheless, the present study responds to the above call by investigating the current implementation of work-integrated learning in mining engineering degree about the mining industry labour needs. The students under study often enrol for the mining engineering programme in year one directly from high school with no prior industrial experience. Thus, why it is essential for the curriculum to incorporate practice-based programmes to enhance learning experiences. Notably, there is little evidence documented concerning the way work-

integrated learning shapes the employability of mining engineering students, particularly from the viewpoint of lecturers and industry experts who are implementation partners. Overall, there is scant literature, which focuses on how work-integrated learning influences the employability of mining engineering students.

Theoretical Framework

This study seeks to analyse work-integrated learning implemented by mining schools in selected universities using the lens of experiential learning theory. Kolb (1984) identifies experience as the source of learning and development. At the same time, the experiential learning theory emphasizes key stages, which are abstract conceptualisation, active experimentation, concrete experience and reflective observation. The theory is appropriate for the study since its central tenets rest upon the notion that direct involvement in actual work tasks enhances learning. This theory explains the process of transforming experience into learning and reliable knowledge (Kolb, 2015). The study employed the constructs of experience and reflection to undertake an in-depth analysis of the adaptation of experiential learning in work-integrated learning for mining engineering students. The assumption is that mining engineering students derive experience from their ability to reflect on knowledge and skills acquired during their work placement in mining contexts. The implication is that mining engineering students develop their experience from being directly in touch with the realities of the mining field. Consequently, this article explores the use of the relevance of using experiential learning as a unit of analysis that expands our understanding of the impact of work-integrated learning on employability for mining engineering students.

Research Questions

Main Question

How do mining schools integrate, develop, and teach employability skills to enhance work-readiness of undergraduates for mining engineering undergraduate degree programme?

Sub Questions

1. What is the current practice of work-integrated learning for a mining engineering programme at selected universities?
2. What are the required professional skills for the mining sector that undergraduates are supposed to attain?
3. To what extent do mining and engineering undergraduates perceive to have acquired work-readiness skills on completion of their studies?

Significance of the Study

The literature review revealed that there is scant information regarding the actual contribution of work-integrated learning for mining engineering. This makes it imperative to add new knowledge to the field, which strengthens the lack of studies related to work-integrated learning and employability. In this way, the study seeks to provide an understanding of how mining engineering students connect theory and practice in a meaningful way during their work placement period. Thus, the pragmatic mixed-method approach employed in this study discussed below sought to provide tangible results to support real-world context problems. In addition, the study results are valuable to higher education researchers who want to gain an in-depth understanding of work-integrated learning and its contribution towards graduate employability in the context of South Africa. Finally, the researcher is an international student who is researching South Africa, which is a context different from his own country and thus, the report illuminates a comparative element based on the position of the researcher following the mode of international higher education. In effect, the ideas and arguments on work-integrated learning are shaped by international comparison.

Methodology

The methodological approach employed by this research is mixed-methods. This study employed a case study method to study work-integrated learning for mining engineering in the context

of South Africa (Thomas, 2011). Multiple case studies draw on multiple sources of qualitative and quantitative data (Yin, 2018). In light of this, Lucas et al., (2018) support the use of a case study in work-integrated learning because it is flexible to answer a wide range of questions. The study explored how to embed employability skills in the curriculum to enhance work-readiness for mining engineering undergraduates at two selected universities in Gauteng Province, South Africa. The target population of the research study comprised eight academic staff within the Mining Engineering Department. In addition, five mining engineers and five workplace supervisors were purposively selected from mining companies. Interviews were utilised to gather in-depth data about the perspectives of lecturers and mining engineers regarding the implementation of work-integrated learning.

To facilitate data reduction, Atlasti was used for reducing data into manageable themes namely, conception of work-integrated learning, procedures for curriculum design in mining engineering, the implementation of work-integrated learning, employability skills and challenges associated with the implementation of work-integrated learning. The population size for the survey selected (n=94) final year students in mining engineering who were randomly chosen from both universities. A questionnaire was employed to collect data aimed towards measuring the work readiness level of these students. Data were captured using SPSS software, and analysis sought to follow the appropriate statistics for a descriptive design. Pallant (2001) asserts that relevant statistical techniques should be employed to perform a correct interpretation of statistics. It is also worthwhile to highlight that permission to conduct the study was granted by the Humanities and Social Sciences Research Ethics Committee within the institution and the study complied with the issues of consent, confidentiality and anonymity (Yin, 2018).

Results

The data presented shows the perception of interview participants from both universities and mining companies. Participants conceptualised work-integrated learning as learning which incorporates

practical elements into theory. Thus, the findings suggest that work-integrated learning is conceptualised as a learning strategy developed for bridging the gap between theory and practice. The participants also articulated the valuable benefits of the programme experienced in their learning contexts. For instance, one of the lecturers highlighted that "so this basically refers to the application of the theory in the practical environment and in our case it would be in mines".

Work-integrated learning is viewed as a process that facilitates the acquisition of practical experience from the mining context. The findings reveal that work-integrated learning provides students with an opportunity to reflect on the experiences that they would have acquired and hence create new knowledge and skills. As one of the lecturers acknowledged, "it is important for students especially in the first year and third year because they are exposed to the mine environment so that when we teach in class, they have an idea of what we are talking about in relation to the mine techniques". Whilst the other lecturer asserted that "this type of exposure helps them to appreciate the practical environment, hence use the knowledge for their mine the design project.

The findings revealed that the process of designing mining engineering curriculum includes mining engineering staff, service departments, educational stakeholders, regulatory bodies that include Engineering Council of South Africa (ECSA), and the advisory board from the mining industry. It has been established that ECSA plays an instrumental role in the development of professional skills. There are 11 ECSA exit level outcomes, which are used to guide the mining engineering modules. In support of this, the following participants noted that, "the ECSA requirements are followed when designing the curriculum and besides the university credits at different cognizance levels we comply with ECSA". In addition, one participant revealed that "ECSA and SAQA (South African Qualifications Authority) credit points should be met and the qualification should comply with the university requirements". As one of the lecturers mentioned "ECSA level outcomes are highly considered when designing course modules

and are very critical and for specific assignments, we design them in such a way that they help students to achieve these outcomes."

Furthermore, participants alluded to the fact that the implementation of work-integrated learning involves the placement of students in mining companies during vacation for a minimum of eight weeks. Students are assigned a supervisor who is a professional mining engineer during this period. They are consigned to do a project to work on, which mainly involves identifying a technical problem with the work environment and coming up with a solution for it. Upon completion, they are expected to produce a technical report, which will be graded by their university. The following participant pointed out that, "it is important for them to apply what they have learnt in the work environment and some of the projects that they are given in the mine helps them to apply the concepts they have learnt throughout the years." Crucially, one lecturer asserted "we normally encourage the students to go to mines with proper training facilities so that they can get adequate training which will be beneficial to them because in mines they are given a supervisor who oversees their work during the period of placement."

The study made an observation on the participants' views on employability skills. The participants expressed that there are two broad categories, which are generic and professional skills. Some of the identified skills include communication skills, computing and information literacy, financial planning, leadership, people management and conflict resolution. The data indicates that there appears to be a consensus between lecturers, mining engineers and workplace supervisors concerning the provision of technical and people skills. The findings suggests that employability is directly associated with work-readiness. In addition, work-readiness is here concerned with organisational acumen, work competence, social intelligence, ability to gain employment and development of personal characteristics. One of the mining engineers stated that "students learn to manage the workforce and to give instructions which helps in improving their communication skills". Additionally, one engineer

expressed that “students apply their systems thinking to develop solutions for the existing problems using the necessary requirements and guidelines.” Lastly, another participant pointed out that mining engineering students “are prepared to become entrepreneurs by evaluating the mine as a business.”

The participants also identified various challenges and barriers associated with the implementation of work-integrated learning in the context of South Africa. These challenges relate to the lack of adequate time, which consequently limits students’ exposure to the work environment and lack of placement opportunities in mining companies, which hinders students from getting a fair chance of participating in practicals as part of their vacation work. In support of this, one engineer expressed that “the period in which they go for their vacation work is not enough and during placement if a student is exposed to a project that deals with blasting, they spend time on the blasting section but when they start working, they might be placed in ventilation.” In addition, another one lecturer highlighted that “the mining companies have not been absorbing all students because of the large pool of students from universities, which offer the same programme and that the mines have been undergoing through some challenges.” The identified challenges also extend to a lack of financial resources that support the work-integrated learning programme. For example, one of the lecturers alluded that “funding has always been a challenge and we are gearing to find sustainable continuous funding.”

Discussion

The research examined shows the implementation of work-integrated learning for a mining engineering degree. As such, the findings indicate that work-integrated learning is conceptualised as a learning strategy, which supports the integration of the theory into practical contexts. In this case, the university and mining companies which are recognised as learning sites. Effective integration supports work experience, and this implies that integration of conceptual and practical knowledge aims to achieve learning outcomes for mining engineering students. This shows that students are engaged in

some form of mining engineering-related tasks, which enable them to reflect on their knowledge and formulate new experiences (Maseko, 2018). This demonstrates that mining engineering students transform experiences from the mining context into valid knowledge as per the principle of experiential learning (Kolb, 2015). Thus, curriculum design should be studied to understand how knowledge and employability skills can be embedded and in such a way that enhances the relevance of work-integrated learning.

The findings reveal that it is crucial to comply with professional associations such as ECSA when designing mining engineering curriculum. This is aligned with Klassen and Sa (2020) who argue that accreditation by an external professional body is done at individual degree programmes. These findings suggest that ECSA exit level outcomes guide the teaching and learning process. In addition, the findings indicate that mining engineering students are expected to undergo some form of placement in mining companies as part of the curriculum requirements and form part of the work-integrated learning programme. The findings further illustrate that these students are assigned projects whereby they utilise their knowledge to develop solutions for engineering problems that they encounter. In this manner, they apply theoretical concepts into practice. This also means that students engage on a reflection process, which allows them to learn a new set of employability skills. These skills are considered vital, and they ensure that students become successful in mining engineering tasks required in a professional field. Thus, reflection enables students to critically appraise what has been experienced through practice (Heyler, 2015).

Moreover, in line with these findings, Khampirat, Pop and Bandaranaike (2019) argue that work-integrated learning experiences play a significant role that empowers students to acquire both generic and technical skills relevant for their profession. The most commonly identified skills include communication skills, teamwork, and problem solving and conflict and people management. The findings are in line with the study by Taylor and Govender (2017) who found out that work-integrated

learning contributes to increasing employability and enables graduates to enter the workplace confidently. Furthermore, a critical analysis suggests that the mining work environment has the potential to promote the development of appropriate employability skills and work readiness.

Besides, the findings show that there are challenges associated with work-integrated learning. The data shows that students spend limited time in mines during their placement. This means that they are not fully exposed to most of the sections, and this limits their capacity to learn other new skills. In addition, participants articulated that financial constraints hinder the implementation of the programme and this limits student placement in mining companies. Consequent to this, there is a reduction concerning the level of acquiring employability skills by mining engineering students. As a result, it is crucial for the mining department to devise appropriate strategies for raising funds as a practical solution to mitigate the challenges encountered in relation to the implementation of work-integrated learning.

Conclusion

It is crucial to highlight that the findings make a theoretical and methodological contribution in the area of research on work-integrated learning and employability. Concisely, work-integrated learning provides great potential for enhancing employability skills for mining engineering students. The findings show that the mining school conforms to the requirements of ECSA to support the development of professional skills. This allows mining students to engage in complex engineering problems in the real work context while placed in mining companies' prescribed knowledge. This approach demonstrates that experiential learning focuses on the premise that learners acquire new knowledge through direct interaction with reality, thus facilitating an understanding and an explanation of work-integrated learning. Further, contemporary employer's value rests in the mining industry and upon graduates who would have attained a certain level of employability skills and thus improved their work-readiness.

Therefore, universities should facilitate and build sustainable partnerships with mining companies, which will enable the nurturing of employability skills through work-integrated learning.

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Author Note

Paul Othusitse Dipitso is a Ph.D candidate at Institute of Post School Studies, at the University of the Western Cape. His research project focuses on Work Integrated Learning and employability in Africa with a major focus in South Africa.

References

du Pre, R. (2010). Universities of technology in the context of the South African higher education landscape. In Council on Higher Education (Ed.), Universities of Technology-Deepening the Debate 7, 1-202.

Dwesini, N. F. (2017). The role of work-integrated learning in enhancing employability skills: Graduate perspectives. *African Journal of Hospitality, Tourism and Leisure*, *6*(2), 1-9.

Freudenberg, B., Brimble, M., & Cameron, C. (2011). WIL and generic skill development: The development of business students' generic skills through work- integrated learning. *Asia Pacific Journal of Cooperative Education*, *12*(2), 79-93.

Garraway, J., & Volbrecht, T. (2011). Theorising experiential learning. *South African Journal of Higher Education*, *25*(6), 1091-1102.

Govender, M. C., & Taylor, S. (2015). A work-integrated learning partnership model for higher education graduates to gain employment. *South African Review of Sociology*, *46*(2), 43-59.

Gu, J., Zhao, D., & Wu, J. (2018). Can curriculum help career success? An empirical research on the perceived employability of students. *Higher Education Research and Development*, *37*(5), 966-983.

Hall, M., Pascoe, D., & Megan, C. (2017). The impact of work-integrated learning experiences on attaining graduate attributes for exercise and sports science students. *Asia-Pacific Journal of Cooperative Education*, *18*(2), 101-113.

Heyler, R. (2015). Learning through reflection: The critical role of reflection in work-based learning (WBL). *Journal of Work-Applied Management*, *7*(1), 15-27.

Jackson, D. (2015). Employability skill development in work-integrated learning: Barriers and best practice. *Studies in Higher Education*, *40*(2), 350-367.

Jacobs, S. H., & Dzansi, Y. D. (2015). Finding a work-integrated learning strategy that enhances the employability of graduates of South African Universities of Technology: A research agenda. *Journal of Economics*, *6*(2), 102-109.

Khampirat, B., Pop, C., & Bandaranaike, S. (2019). The effectiveness of work-integrated learning in developing student work skills: A case study of Thailand. *International Journal of Work-Integrated Learning*, *20*(2), 127-146.

Klassen, M., & Creso, S. (2020). Do global norms matter? The new logics of engineering accreditation in Canadian universities. *Higher Education*, *79*(1), 159-174.

Kolb, A. D. (1984). *Experiential learning: Experience as the Source of Learning and Development*. Prentice Hall.

Kolb, A. D. (2015). *Experiential Learning: Experience as the Source of Learning and Development* (2nd ed.). Pearson Education.

Long, E., & Fynn, A. (2018). Postgraduate student experiences of workplace learning for a professional psychology qualification in the South African context. *Industry and Higher Education*, *32*(5), 341-350.

Lucas, P., Fleming, J., & Bhosale, J. (2018). The utility of case study as a methodology for work-integrated learning research. *International Journal of Work-Integrated Learning*, *19*(3), 215-222.

Lugoma, M. F. (2017). On-campus mine surveying practicals: Their contribution in training mining engineering students in an open distance-learning context. *The Journal of the Southern African Institute of Mining and Metallurgy*, *117*(3), 207-214.

Maseko, A. L. (2018). A review of work-integrated learning in South African mining engineering universities. *The Journal of the Southern African Institute of Mining and Metallurgy*, *118*(12), 1315-1323.

Nicolaides, A. (2012). Work-integrated learning for the culturally diverse hospitality industry in South Africa and the example of Germany. *African Journal of Hospitality, Tourism and Leisure*, *4*(1), 1-3.

Pallant, J. (2001). *SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS*. McGraw.

Patrick, C-joy., Peach, D., & Pocknee, C. (2008). The WIL [Work Integrated Learning report: A national scoping study [Australian Learning and Teaching Council (ATLC) Final report]. Brisbane.

Pop, C., & Barkhuizen, N. (2010). The relationship between skills training and retention of graduate interns in a South Africa information, communication and technology company. *Literacy Information and Computer Education Journal*, *1*(2), 75-83.

Reinhard, K., & Pogrzeba, A. (2016). Comparative cooperative education: Evaluating Thai models on work-integrated learning, using the German Duale Hochschule Baden-Wuerttemberg model as a benchmark. *Asia-Pacific Journal of Cooperative Education*, *17*(3), 227-247.

Taylor, S., & Govender, C. M. (2017). Increasing employability by implementing a work-integrated learning partnership model in South Africa - A student perspective. *Africa Education Review*, *14*(1), 105-119.

Tamin, M. D., Du P, M, D., Solms, V, S., & Meyer, J. (2019). A proposed modular work integrated learning framework for South Africa. *IEEE Access* 7, 2559-2566.

Thomas, G. (2011). A typology for the case study in social science following a review of definition, discourse, and structure. *Qualitative Inquiry*, *17*(6), 511-52.

Wardle, M. K. (2012). Work-integrated learning for tertiary hospitality education. In Australian Collaborative Education Network (ACEN) National Conference. Geelong.

Wessels, M. (2014). Cooperative education at the Tshwane University of Technology: A new direction for work-integrated learning and employability. *The African Work Based Learning Journal*, *2*(2), 1-16.

Whelan, B. M. (2017). Academic work-integrated learning (WIL): Reengaging teaching- focused academics with industry. *Journal of Teaching and Learning for Graduate Employability*, *8*(1), 172-187.

Winberg, C., Garraway, J., Engel-Hills, P., & Jacobs, C. (2011). Work-integrated learning: Good practice guide. Council on Higher Education.

Yin, R. K. (2018). *Case Study Research and Application: Design and Methods*. Sage Publications.