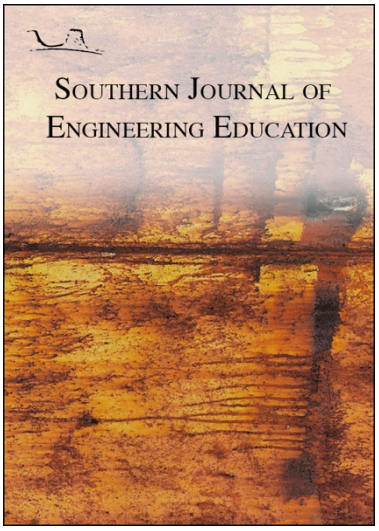

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Employers' perspectives on employability skills and attributes of mining engineering undergraduates in South Africa

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There is an increasing demand for universities to produce work-ready graduates in the mining sector. Universities and industry therefore acknowledge the need to support graduate employability through various strategies that focus on theory-practice integration. Mining engineering undergraduate programmes offered in South Africa furnish students with knowledge and skills that enable them to effectively transition to the workplace. This signifies the valuable employability skills and attributes which are highly sought after in the workplace. This article presents data based on interviews with employers in the mining industry. The paper draws from Kolb's experiential learning theory which provided an analytical lens for the study. The article presents findings on the following themes: development of reflective learning experiences; enhancing workplace experience through work-integrated learning (WIL); development of employability skills; and university and mining company partnerships. In conclusion, this qualitative study on employers' perceptions regarding the attributes of mining engineering undergraduates may play a significant role in understanding the mining sector's contribution to fostering employability among students.

Keywords: competencies; employability skills; attributes; mining engineering; work-integrated learning

Introduction

Education providers, industry and governments have embraced the concept of employability as a solution to labour market changes. Employability is considered a crucial aspect that enables graduates to transition into the workplace. As Clarke (2018) highlights, universities are pressured to equip graduates sufficiently with employability skills to enable them to be marketable. The competitive labour market values graduates possessing relevant work experience. Employability skills and competencies form capital that is necessary for employment prospects (Fajaryati & Akhyar, 2020). Tomlinson and Anderson (2021) assert that human and social capital are significant in understanding and explaining employability outcomes.

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Employers constantly demand skilled graduates capable of meeting the needs of the competitive labour market. Universities are challenged in the sense that employers often require graduates with a comprehensive set of soft skills and attributes (Wald & Harland, 2019). Personal competencies are key to expanding the capabilities of graduates to adapt to workplace complexities. There have been persistent concerns from employers regarding the employability of graduates exiting universities (Fajaryati & Akhyar, 2020; Matsouka & Mihail, 2016). In response, universities continue to engage in initiatives that improve graduate attributes and employability skills and that address policy and market pressures (Healy, 2023), thus becoming responsive to the needs of the employment system (Cai, 2013). Due to the heightened focus on employability and the successful transition of graduates to the labour market, universities play a crucial role in developing work-ready graduates (Orr et al., 2023). Work-ready students possess knowledge, skills and abilities that enable them to transition from university into professional practice or employment (Smith & Worsfold, 2015).

Academics in universities interpret employability skills from a theoretical knowledge perspective while employers are concerned with practical knowledge. Academics at universities of technology are more likely to focus on applied/practical skills, whereas at traditional research universities, they may focus more on theoretical knowledge. Typically, universities of technology focus on vocationally oriented programmes while universities focus on foundational degrees (Griesel & Parker, 2009). Nonetheless, there has been a shift concerning the development of graduate employability, which entails the integration of theory and practice into learning. However, employers in the mining field often provide limited workplace learning opportunities to nurture students' employability while they are still at university.

The paper analyses an empirical case study in a South African context, investigating the perspectives of employers regarding the employability skills of mining engineering undergraduates. The paper first provides an overview of the literature, followed by the theoretical framework, and then the methodological approach adopted for data collection and analysis. An analytical tool to understand and interpret employability skills and graduate attributes in workplace settings is drawn from experiential learning theory (Kolb, 1984). Further, the article presents the findings and subsequently a detailed discussion. The implications of the results on graduate employability and employability policies in the industry

are also discussed. Finally, conclusions are drawn from the discussion and areas for further research are suggested.

Context of the research

The South African economy is linked to mining and mineral resources owing to an abundance of mineral wealth (Cameron & Drennan, 2017). Despite recent systemic challenges, the mining sector seems to be robust and remains a leader in wealth and employment creation (Minerals Council South Africa, 2019). Crucially, a free-market economic paradigm influences the expansion of the mining industry. According to Van Der Merwe (2011), the mining sector has contributed immensely to the country's economic and political development.

The mining sector supports the training of students and lecturers in academic and technical institutions. The South African mining industry remains vulnerable to a skills shortage (Musingwini et al., 2013). Consequently, universities continue to produce a skilled workforce for the mining sector, thus contributing to the expansion of the sector. The linkages between mining companies and universities set the ground for the acquisition of knowledge and transferable skills. The curricular focus on mining engineering tends to introduce students to and offers them a firm foundation in key theoretical and practical mining concepts.

Professional bodies contribute significantly to the engineering profession in South Africa (Kloot & Rouvrais, 2017). In this manner, for university qualifications to be recognised, accreditation must be obtained from the Engineering Council of South Africa (ECSA). In addition, practising engineers with relevant qualifications are expected to register as professional engineers and receive a certificate of competency. Van der Merwe (2011) asserts that compulsory professional registration of mining engineers would enforce professional development.

It is worth highlighting that the mining industry essentially supports the development of student employability through work-integrated learning (WIL). Undergraduate students complete a period of vacation work in mining companies doing individual projects as negotiated by students and workplace supervisors. Placement in mining companies enables students to navigate the dynamics associated with theory-practice integration. This link demonstrates that university–industry partnerships contribute to nurturing skills and competencies. Maseko (2018) argues that WIL in mining engineering shapes professional skills for mining engineering undergraduates.

Reviewed literature on approaches to developing student employability

Employability is considered a critical aspect of university teaching and the quality of learning outcomes. Developing employable graduates is viewed as a means whereby universities produce graduates who can navigate the complexities of the contemporary labour market through WIL (Björck, 2021). It is an increasing trend that employers demand graduates possessing skill sets and attitudes relevant to the workplace (Clarke, 2008). As such, the relevance of graduate attributes has been prioritised within employability discourses. Wald and Harland (2019) emphasise that graduate attributes are a dominant feature of university missions and objectives as articulated to various stakeholders.

The current mining workplace demands for work ready graduates

The disruptive impact of technology has adverse implications for the labour market. In light of this, the current labour market constantly requires employable graduates with relevant skills that could enable them to perform jobs effectively. Clarke (2008) argues that it is crucial to align higher education with the necessary work skills required by employers by including graduate attributes in the curriculum. The focus is on developing knowledge, skills and attitudes that contribute to effective performance in the labour market (Römgens et al., 2021). Job-related competencies include a set of personal resources that allow individuals to perform a job while generic competencies extend to transferable job-related competencies required for making job transitions, thus being valuable to employability in terms of obtaining new employment (Peeters et al., 2019). Competence-based approaches to employability involve learning in the workplace (Clarke, 2008).

Graduating with undeveloped employability skills subjects graduates to criticism from potential employers (Cavanagh et al., 2015). Employers often bemoan the graduates' lack of relevant skills required in professional contexts (Sarkar et al., 2021). In light of this, Thebuwana et al. (2016) assert that there is an existing disconnection between university education and its application in the workplace. This could be attributed to the lack of relevant practical experience required by potential employers. Despite the outcry by employers, Clarke (2008) observed that many employers seem reluctant to offer generic skills development.

The significance of WIL in mining engineering programmes

WIL focuses on the integration of practical and theoretical activities aligned with the workplace to enhance graduate employability (Dimenas, 2010). Smith and Worsfold (2015) emphasise that a dialectic involving theory and practice serves as a pedagogical process that facilitates theory-practice integration. The importance of WIL in nurturing employability for the future of work has been demonstrated by various studies (see Jackson & Bridgstock, 2021; Jackson et al., 2022; Palmer et al., 2018; Ramnund-Mansingh & Reddy (2021). These studies reveal that the WIL approach strengthens the development of generic and technical skills required from graduates to enter the labour market (Clarke, 2008; Jackson & Dean, 2022).

A learning environment prioritising graduate employability allows students to develop work-readiness skills from experiential learning activities (Orr et al., 2023). WIL potentially improves employability, thus leading to the development of employable graduates (Palmer et al., 2018). The forms of knowledge to be acquired in learning contexts should be clearly articulated to students as they develop employability skills. Students often learn in contexts that are not related to practice, which ultimately influences how they develop conceptual and practical knowledge. Panther and Montfort (2017) argue that understanding how students categorise knowledge seems to provide insights into their ability to apply it in different contexts, thereby preparing them for engineering practice. Students obtain knowledge from academic subjects and often experience challenges in understanding the relevance of disciplinary knowledge, especially transferring it to the workplace (Winberg et al., 2011).

To date, a commonly explored indicator of employability is discipline-based and professional skill development (Jackson & Bridgstock, 2021). In their study, Sarkar et al. (2020) emphasise the importance of inquiry-based and problem-based learning which allows students to engage in challenging problems that enhance knowledge, skills and competencies desired for the workplace. As such, embedding learning activities is useful for skills development and gaining work experience (Jackson & Bridgstock, 2021). Similarly, Beagon et al. (2019) argue that embedding professional skills into engineering programmes could potentially improve students' technical and non-technical skills. Exposure to authentic work environments to develop knowledge and skills seems to support students' perceived employability (Jackson & Dean, 2022). However, potential host organisations often indicate that workload leads to a shortage of staff to oversee students during work placement. It is also

worth noting that the lack of student placement in the industry manifests as a problem for mining engineering (Maseko, 2018).

University industry partnerships in mining engineering

University–industry partnerships form part of the engineering ecosystem in South Africa. Establishing these partnerships significantly contributes to raising awareness and developing employability. The university–industry partnerships create a conducive environment for WIL, which supports reflective learning. Maseko (2018) asserts that effective partnerships are necessary for improving WIL.

Mining engineering programmes have increasingly included courses that support the development of graduate attributes and employability. This approach is central to the practice-based application of knowledge in real work contexts. The emphasis here is on the ability to adapt to complex labour market changes. Wald and Harland (2019) argue that it is essential to prioritise powerful knowledge in the curriculum which adequately structures the knowledge, attributes and skills desired by employers. A study conducted by Ishengoma and Vaaland (2016) shows that effective university–industry linkages involve activities that enhance employability, such as joint student–industry projects, internships, and an active role of industry in curriculum development.

Accreditation of mining engineering programmes by ECSA

The ECSA exit-level outcomes provide standards for shaping graduate attributes and employability. Mining schools across universities have mapped the ECSA exit-level outcomes into the mining engineering curricula to facilitate the acquisition of knowledge and skills (ECSA, 2018). These standards are essential for guiding the assessment process to foster and ensure the acquisition of knowledge and skills. Accreditation legitimises university-housed programmes since it carries the judgement of the external professional body (Klassen & Sá, 2019). The core idea is based on facilitating an effective evaluation and measurement of student learning to improve learning outcomes and enhance graduate employability. ECSA accreditation requirements do not focus only on the curriculum structure, but rather extend to the quality of teaching and learning, and the programme aims and outcomes (Oladirana et al., 2012).

Accreditation enables universities to translate the exit learning outcomes by aligning them with specific modules in a degree programme. The challenge is that ECSA originally required knowledge-based outcomes, and then shifted to graduate attributes as outcomes. However, lecturers are trained to work on theoretical knowledge, but they have limited capacity to develop students with learning experiences required in practical contexts. Above all, accreditation helps to determine the expected levels of proficiency and standards of achievement for each learning outcome (Crawley et al., 2014).

Drawing from the existing literature, evidence confirms the importance of developing skills and attributes for mining engineering undergraduates. WIL enhances employability skills required for the mining field. Wald and Harland (2019) argue that instead of frequently changing education to address contemporary demands, universities should focus on strengthening the quality of foundational knowledge and skills. This article examined the perspectives of employers concerning the desired employability skills and graduate attributes required for mining engineering practice. Employer perceptions are crucial in understanding the transitions from university to the workplace (Cai, 2013).

Theoretical framework

Experiential learning theory, coined by David Kolb, provided an analytical lens for this study. The endorsement of the theory stems from studies that used experiential learning to demonstrate the development of employability in the workplace (Jackson & Dean, 2022; Reid et al., 2021; Villarroel et al., 2020). Experiential learning theory is based on the assumption that the learning that students such as mining engineering undergraduates acquire emerges from directly engaging with the realities of what is being studied (Kolb, 2015). The theory describes learning in a cycle characterised by the following stages: concrete experiences, observation and reflection, formation of abstract concepts and generalisations, and testing the implications of concepts in new situations (Kolb, 1984). Using the cycle to examine ways in which learning emerges from experience reveals that a mining engineering learner engages with an experience, observes and reflects from the experience, utilises analytical skills to integrate concepts and ideas from observations, and then applies the new concepts in practice (Reid et al., 2021).

Kolb's analytic frame identified reflection and experience as key elements of experiential learning theory which provide an account of how students transform experiences to construct new knowledge. The learning cycle is underpinned by an integration of action and reflection

as well as experience and concept, suggesting that the reflective process enhances the development of employability skills (Kolb & Kolb, 2017). Within experiential learning theory, attention is given to the logical sequence that experience occurs first, then knowledge is the latter product of experience acted upon by the process of reasoning (Michelson, 1996). Concrete experience enables learners to utilise their experiences by being involved in specific situations, while abstract conceptualisation involves giving meaning to the experience encountered by students.

Transformation of experience occurs through experience involving the practical application of knowledge in the real world, as in mining (Kolb, 1984). Reflective observation entails reflecting on previous stages to consolidate the integration of lessons acquired from all the experiences (Kolb, 2015). These principles are relevant to demonstrate how mining engineering undergraduates learn from their experiences to enhance employability skills. This draws attention to what the employers' perceptions reveal about how the learning process allows students to improve employability skills required by the labour market.

The relevance of experiential learning theory to employability is that it recognises students' reflections on the work experience gained during work placement in mining companies. This theory defines learning as a process of human adaptation involving the whole person in the formal classroom and the workplace (Kolb & Kolb, 2017). In essence, the workplace significantly enables employers to observe learners' acquired knowledge and employability skills developed. Specifically, in this study employers revealed how mining engineering learners reflect on acquired experiences to develop the desired employability skills and attributes relevant to mining engineering. Fenwick (2006) asserts that power relations structure hierarchies of knowledge and skills, thus determining who gets to judge skills such as in the mining workplaces.

This article therefore used experiential learning theory to explain employers' interpretations of how mining engineering learners cultivated their employability skills in the workplace. Specifically, the theory emphasises the transformation of knowledge to form employability skills. Importantly, this signals that employers could interpret the desirable skills possessed by mining undergraduates upon completing work placement. However, an observed limitation of the learning cycle lies in the assumption that it does not depict the socio-emotional aspects that influence student learning in the workplace. Highlighting another limitation of the

theory is that in some instances learners would not directly learn from direct experience but rather from the experience of other people within their context (Vince, 1998).

Methods

This article explored employers' perceptions regarding key factors that are necessary for preparing aspiring mining engineers to be prepared for the workplace. It sought to understand the level of competencies of mining engineering undergraduates by reflecting on the perspectives of mining engineers and workplace supervisors. Fundamental questions guiding the study were: (1) what are the perceptions/perspectives of employers regarding the employability skills of mining engineering undergraduates? (2) To what extent do mining engineering undergraduates develop employability skills in the workplace?

The article reports on empirical research conducted from June 2018 – April 2019 as part of a PhD project. This research employed a qualitative case study which included semi-structured interviews. Approval to conduct the study was gained from the University of the Western Cape Humanities and Social Science Research Ethics Committee (Ethics Reference Number: HS18/2/7) before commencing with data collection. Data was generated through semi-structured interviews conducted in three selected mining companies located in the Gauteng Province in South Africa. The selected five mining engineers and five workplace supervisors from the respective mining companies participated in this study. Purposive sampling aided in selecting the participants. The article draws on the responses from the ten participants who consented to participate in the study. The participants were selected based on their position and substantive responsibility of supporting students during work placement. In addition, the mining engineers were ECSA-registered. In mining companies, students are governed by workplace learning policies developed by the human resource office.

The interviews were considered appropriate for this study since they allowed the participants to voice in-depth insights concerning the employability of mining engineering undergraduates. The interview questions were developed using insights drawn from the literature. The interviews generated rich insights and allowed the interviewer to probe and seek clarity whenever ambiguities emerged. Although there were variations noted across the mining companies, enough uniformity allowed data coding and analysis. The data were transcribed, anonymised, coded and analysed using ATLAS.ti data analysis software. The thematic categories captured the meaning from interviews and supported data to be presented according

to the emerging themes and patterns (Braun & Clarke, 2006). The empirical data aided in understanding and interpreting the perceptions of employers regarding the employability skills of mining engineering undergraduates.

Analysing the results based on Kolb's Model

The qualitative data obtained from the interviews was coded and the analysis revealed the following themes: enhancing workplace experience through WIL, development of reflective learning experiences, development of employability skills, and university and mining company partnerships. Through the cycle of Kolb's model, employers revealed their perceptions and how the workplace fosters employability learning. The results are therefore presented in the light of how they relate to the four-stage cycle of experiential learning.

Concrete experience

Enhanced workplace skills and applied knowledge is used as an indicator of analysed concrete experience. Kolb indicates that knowledge develops from testing out the experiences of learners. The participants' perceptions are anchored on the basis that WIL is essential for developing work experience through work placement which is concrete. They hold the view that an institutionally endorsed WIL programme is ideally tailored to strengthen direct practical experience through engaging in new tasks. The participants emphasised the need to engage students in a process that best enhanced their acquisition of practical experience. The findings suggest that continuity of experiences occurs across different learning contexts whereby students actively experiment with concepts. On this basis, mining engineers and workplace supervisors appear to link theoretical knowledge to its application in practical settings. A key aspect of practical experience lies in fostering the process of reflective observation. This signals a commitment to problem-solving in mining companies, thus effectively transforming the acquired experience. Essentially, students reflect on the hands-on activities undertaken during placement in mining companies. Participant ZK3 expressed the following: 'Practical experience gives the student's knowledge of how the work environment functions so that they can know what to expect in mining contexts.'

The mining engineers reported that WIL focuses on developing competence, employability, and knowledge acquisition, thus fostering experience. The participants revealed that the work environment is a learning space that allows students to develop a clearer picture of mining

operations in mining contexts. A common view amongst the participants was that placement of students in mines strengthens their ability to understand how to apply theory in the work environment. As one interviewee (participant LKC 9) said: 'Students come to the mine to learn about the sections in the mine and they understand what they have learnt from school. They are oriented by the shift sections and shift miners who supervise them.'

Abstract conceptualisation

The development of an employability skill set is used as an indicator for analysing abstract conceptualisation. Abstract conceptualisation is concerned with thinking, reflecting and acting on intellectual knowledge derived from concepts and theories. The participants echoed that through ECSA exit learning outcomes, the abstract concepts are embedded into the curriculum to strengthen the relevant standards that address the educational requirements of a mining engineering role. ECSA learning outcomes emphasise the abstract conception of subject matter content. It is worth noting that interviewees stated that the development of an employability skill set and competencies for mining engineering undergraduates is necessary for improving employability as per the curricula outcomes. Generic and technical skills are regarded as crucial in the learning process of mining engineering students, as well as a means of promoting the real-world connection between learning and the application of content. In this case, generic skills refer to skills that have potentially broad applications to a range of disciplines and situations (Freudenberg et al., 2011). Job-specific skills were referred to as technical skills. Both the mining engineers and workplace supervisors reported that learners develop employability skills through forming and re-forming experience. The table below shows the employability skills that were identified by employers in this study.

Table 1: *Employability skills identified by employers*

Response theme for sub-categories	**Skills coded from the employers' responses**
Generic skills	People skills & communication Leadership & teamwork Problem solving & adaptability Accountability Honesty and integrity Emotional intelligence & resilient thinking
Technical skills	Project management & financial planning Mine planning & production

Table 1 (Cont.): *Employability skills identified by employers*

	Engineering management & business acumen
	Surveying & geotechnical skills
	Computer literacy
	Compliance with regulations/legislation

It is worth noting that the identified employability skills were evident in the responses given by both mining engineers and workplace supervisors. This implies that employers regard them as the most desirable competencies required for the mining engineering profession.

Reflective observation

The reflective observation stage was analysed using an indicator focusing on developing a reflective learning experience. This stage involves observing and reflecting on experiences in contextualised settings, thus allowing deep learning and retention of information. The participants noted that students developed their competencies through developing a firm understanding of practical strategies that enabled them to navigate the work environment which ultimately resulted in the acquisition of experience. Mining engineers and workplace supervisors reported that involving students in mining systems and structures contributed to developing their organisational acumen, based on their learning to adapt to the workplace. In this case, students reflected on their acquired knowledge from various perspectives, thus forming new experiences. All the employers mentioned that within the mining companies, students developed work competence, thus improving skills that enabled them to remain productive when performing mining engineering-related tasks. For instance, Participant ZK4 explained that: 'Work competence allows students to demonstrate the application of basic knowledge in the workspace.'

The participants mentioned that reflective activities enabled students to understand social and human dynamics leading to new learning experiences in workplace settings. This indicates that social and emotional intelligence is a necessity in mining contexts, given the frequent student–employer interactions designed to foster a higher level of reflection. Some participants argued that academic and workplace contexts constitute distinctive activities and this often poses adaptation challenges to students during their transition to the workplace.

Active experimentation

Mining sites provide a context for constructing new knowledge through experimentation, thus contributing to improving competencies for mining engineering learners. The findings revealed an agreement between mining engineers and workplace supervisors concerning the significance of university–industry partnerships. The participants reported that the university and mining partnerships focused on providing workplace learning and experiential learning opportunities.

The participants echoed that the collaboration between mining schools and companies provided formalised internships, an environment which is necessary for nurturing employability. It was reported that during the work placement period that occurs in the third year, students are assigned an engineering project. This form of the student–industry project facilitates experiential learning, thus leading to knowledge retention in the workplace.

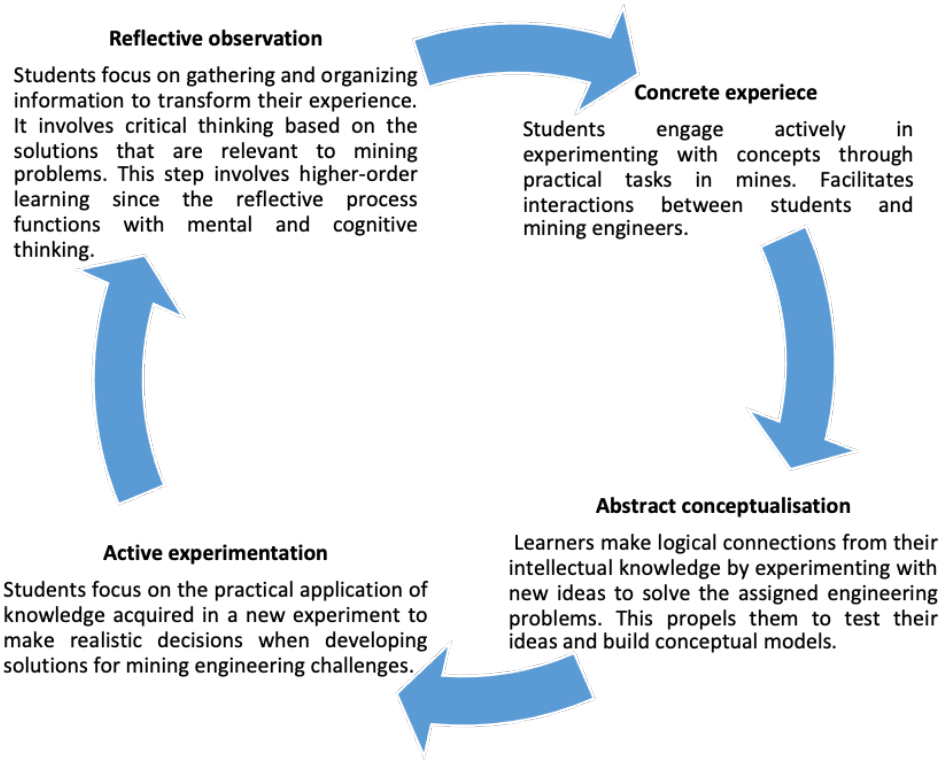

Figure 1: *Experiential learning cycle demonstrating formation of experience*

The phases of the experiential learning theory described above suggest that new knowledge and skills emerge from grasping and transforming experience. The figure above demonstrates how mining engineering undergraduates develop knowledge and experience during the

workplace learning period. Each step is not a discrete event leading to the other; rather a student might move through and between the stages.

Returning to the theme of active experimentation, the participants stated that mining engineering professionals are often invited to offer guest lectures to contribute to sustaining these collaborations. The participants reported that these partnerships are essential for influencing knowledge incorporated into the mining engineering curriculum. The findings reflect a mutual understanding between universities and mining companies, regardless of their differences in organisational mandates as well as approaches to learning. This suggests that engaging in a variety of activities would be useful for developing graduate attributes required in mining engineering.

Discussion

The findings indicated that the ECSA exit level outcomes play a pivotal role in the development of student employability as well as graduate attributes. The standardised exit-level outcomes essentially guide universities to develop courses incorporating knowledge required in the mining field. Translating knowledge and skills into learning outcomes and facilitating the attainment of expected proficiencies require customisation at the curriculum design phase (Crawley et al., 2014). The employers were inclined to perceive the ECSA guidelines (ECSA, 2014) as useful in providing a substantive role in developing the employability skills of future mining engineers. To this end, the findings show that the inclusion of the ECSA exit-level outcomes strengthens the development of employability skills and subject-related competencies.

The findings illustrate that the mining engineers and workplace supervisors regard WIL as crucial in developing the employability of mining engineering students. The analysis demonstrates that employers recognise the importance of work exposure offered to mine engineering students. Through the lens of experiential learning theory, mining engineering undergraduates learn from active engagements and practical activities which facilitate the application of theoretical knowledge and reflection on experiences to inform future learning (Kolb, 1984). The findings suggest that mining engineering learners who undergo WIL placement are highly likely to improve their employability skills by being at the centre of the experiential context. This suggests the perspectives of mining engineers and workplace supervisors strongly endorse the value placed on practical knowledge in strengthening mining-related skills for learners.

Experiential learning manifests itself in the aspects of WIL. One is the focus on reflection which is perceived to be paramount in assisting students to develop relevant experiences. Aligned with the reflective practice of experiential learning, students develop abstract concepts while in the classroom; upon reaching the mining field they observe and reflect in order to cultivate concrete experiences from specific mining engineering situations. Kolb (1984) argues that knowledge is tested on the experiences of the learner by transforming experiences into action. This approach promotes student-centred learning, thus empowering students to think critically while engaged practically by solving mining engineering problems. This finding supports a previous study by Garwe (2020) which established that performance character leverages job knowledge, hands-on skills, practical orientation and work-related competencies.

Another aspect of experiential learning is work experience. Work experience encompasses essential skills such as creativity, problem-solving, decision making and flexibility. The data illustrates that adaptation to the workplace allows mining engineering students to accumulate work experience by thinking about it as well as acting and reflecting (Kolb, 1984). The reflective exercise between students and their workplace supervisors, emerging from debriefing sessions, allows them to be mindful of their improvement. Purposeful reflection processes support students in learning from experiences that facilitate employability development in varied workplace contexts (Reid et al., 2021). Predominantly, learning occurs from directly applying knowledge to solve complex engineering problems. Experiential learning empowers learners to adapt to the physical environment (Kolb, 1984). In this case, mining engineering learners adapt to functioning in a practical mining context. Consequently, these processes shape their professional expertise due to interaction with mining specialists. The capacity of students to acquire relevant work experience therefore rests on their ability to develop employability skills and strengthen their desirability in the mining engineering field.

The findings suggest that through collaboration, experienced mining engineers mentor and guide students during work placement as well as encourage reflection. This process exposes students to industry-focused learning which enhances their employability skills, since they learn by doing. The findings are consistent with Martin et al. (2019), who found that supervising can take the form of mentoring. In this case, the students are allocated mentors to support them in learning how to navigate the mining field; however in contexts where engineers have extreme workloads, dedicating time to advise students remains a challenge. This obstacle deters mining engineering learners from securing an opportunity to learn from experts on how

to contextualise engineering knowledge in the workplace. Leveraging university–industry partnerships, however, reflects the strategic intent to enhance employability skills.

The employers reported that students possessed the necessary employability skills but still need to strengthen their practical skills as expected in their respective workplaces. The identified generic and technical skills are developed from the critically reflective process of experiential learning. The nature of these employability skills suggests that experiential learning is a valuable tool that allows mining engineering students to contextualise their knowledge in practical settings, signalling reflective observation. The employer's perceptions indicate that generic skills are integral to disciplinary knowledge infusing and enabling academic knowledge and learning (Crawley et al., 2014). The findings are consistent with those of Fajaryati and Akhyar (2020), who assert that according to the employers' demands, communication, teamwork, problem-solving and technical skills are required to enhance employee productivity in the workplace.

The results show that employers value and acknowledge that transferable skills are necessary for facilitating a seamless transition into the workplace. The emphasis is placed on the ability to develop concrete experiences to enhance work readiness. Mining engineering learners need a diverse set of knowledge and skills that enables them to process information which is necessary for solving complex problems that they will encounter in the workplace (Haupt & Webber-Youngman, 2018). These results matched those observed by Jackson et al. (2022), which affirm that critical thinking, fostering innovative behaviour, building confidence, and communication skills are necessary for preparing learners for future work. In this manner, students interact with disciplinary knowledge through the application, changing and translating knowledge and in turn shaping their experiences (Crawley et al., 2014). These findings are consistent with Behle's (2021) argument that subject-related skills and competencies are an important outcome and require clear pathways for transferability to the labour market. The findings reveal that industry-wide skills and professional skills are developed through engaging in both theoretical and practical knowledge, which signals the application of concrete experiences as noted by Kolb.

Drawing from the analysis above, employers acknowledge that fostering collaborations with mining companies contributes to the co-development of employability skills both in the classroom and the workplace. Course advisory panels allow mining industry representatives to contribute to programme development, thus legitimising the activities undertaken in a mining

engineering programme (Kullberg & Paulin, 2019). These results match those observed in a study by Kvilhaugsvik (2022) which confirms that advisory board panels can be understood as layers of established cooperation with the world of work. These findings agree with the results of Sambell et al. (2020), Ramnund-Mansingh and Reddy (2021) and Cai (2013), who found that purposeful industry engagement builds impactful partnerships that cement the design of consistent graduate attributes and relevant employability skills. A study by Ishengoma and Vaaland (2016) on activities within university–industry linkages concluded that internships and joint student industry projects enhance students' employability. Universities should form close interactions with employers and participate in diverse employer networks (Cai, 2013).

Experiential learning has been shown as a powerful activity that influences the development of employability skills for mining engineering undergraduates. The employers view WIL as an effective strategy to enhance employability skills for mining engineering undergraduates. Evidence suggests that forming stronger relationships between mining companies, universities and professional associations could potentially nurture students' competencies. Ultimately the acquired knowledge and skills are translated into employability, thus fitting the needs of employers in mining engineering. The employers' perceptions noted in this study shed light on understanding how mining engineering could be supported to develop employability skills in the workplace. Clarke (2008) argues that promoting individual employability proves to be a powerful tool for creating sustainable competitive advantage in the labour market.

Practical implications of the study

The engineering field is constantly in need of contemporary skills, thus understanding employers' perceptions seems to be useful both at a theoretical and practical level. This study has significant implications for mining schools to strengthen the initiatives that support the enhancement of employability skills and graduate attributes. The study highlights employers' views that the employability skills of mining engineering undergraduates are linked to skills development in engineering. This finding raises awareness of the importance of creating a conducive environment that promotes university–mining industry collaboration. Focusing on university–industry linkages would contribute to building knowledge on how the mining schools can align their programmes with the labour market needs**.** Employers' critical perspectives contribute to curriculum review and course redesign, which links to the development of employable graduates. This could be achieved by integrating employability

skills into the curriculum. Hence, this reflects the notion of undergraduate teaching as a component of the engineering ecosystem.

Limitations and suggestions for future research

The limitations of this study are evident in the limited sample size, given that only ten employers were interviewed. The extent to which these participants represent mining employers might be limited. Further studies could increase interview participants across the mining industry. Employers are often not trained in how to assist students to translate knowledge to the workplace, and this challenges skills transfer. A further study with a focus on empowering employers to facilitate skills transfer for learners is suggested. It would also be useful for future research to examine the perspectives of mining engineering learners and investigate how they maximise their learning experiences to strengthen their competencies during work placement.

Conclusion

The findings showed that the competitive labour market requires mining engineers to possess relevant employability skills. The employers emphasised the value of skills, abilities, intellectual and practical knowledge. The core argument highlights that mining engineering learners are likely to improve their employability by directly engaging in mining-related activities that allow reflection and acquisition of work experience. The study concludes that it is essential for universities to strengthen employability initiatives such as WIL to enhance the employability skills and attributes of mining engineering learners. This study argues that to enhance students' skills transfer in the workplace, mining engineers and workplace supervisors should receive adequate training on assessment and supervision. In essence, this would provide clarity regarding the transfer of knowledge and skills in the workplace.

The employers recognised that the ECSA exit level outcomes play a pivotal role in framing the development of employability skills for mining engineering undergraduates, which concurs with global competency needs. Given that employers observed a deficiency in some of the necessary skills in mining engineering undergraduates, it would be beneficial for them to rethink how to design and implement initiatives that foster graduate employability in the workplace. The implication is that policymakers should acknowledge that developing graduate attributes should be a collaborative effort between the industry and universities. Overall, the study outcomes highlight the interconnectedness of the mining industry, ECSA, and mining

schools, and their joint contributions to developing employability skills and graduate attributes for mining engineering undergraduates.

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