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WORK-INTEGRATED LEARNING CHALLENGES OF ENGINEERING DIPLOMA STUDENTS AT SELECT SOUTH AFRICAN UNIVERSITIES OF TECHNOLOGY

ПРОБЛЕМИ ІНТЕГРОВАНОГО З РОБОТОЮ НАВЧАННЯ СТУДЕНТІВ ІНЖЕНЕРНИХ СПЕЦІАЛЬНОСТЕЙ В ОКРЕМИХ ТЕХНОЛОГІЧНИХ УНІВЕРСИТЕТАХ ПІВДЕННОЇ АФРИКИ

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ABSTRACT

Purpose. *The study aimed to identify the challenges experienced by select universities of technology, industry mentors, and engineering diploma students regarding the work-integrated learning (WIL) component of the study programme.*

Мета. *Дослідження має на меті виявлення труднощів, з якими стикаються окремі технологічні університети, галузеві ментори та студенти інженерних спеціальностей щодо компонента навчальної програми «інтегроване з роботою навчання» (WIL).*

Methodology. *A concurrent mixed-methods approach was used, which included a survey and focus group interviews. Both purposive and convenient sampling processes were used to select the sample. The survey sample comprised 25 university of technology employees, 28 industry mentors, and 165 learners. The focus group was comprised of six members selected based on their involvement and expertise with WIL issues, including a placement officer, a training manager, a WIL facilitator, senior technicians, and a corporate director.*

Results. *The most significant challenge was the long waiting period for learners to find suitable placements, which impacted their completion and graduation. Learners lacked the relevant computer literacy skills required by the industry, as well as communication skills. Learners also faced challenges working with industrial drawings and documentation, and could not manage projects in the workplace. The inability to work in teams, and having the correct attitude to work were also highlighted as challenges. The responsibilities outlined in the logbooks did not always correspond with those in the workplace either. The learners also complained about infrequent visits from university staff to monitor their performance in the workplace. It also became apparent that the academic institutions did not adequately prepare the learners for the world of work.*

Conclusions. *The study highlighted the many challenges encountered by the learners, the academic staff involved in WIL activities and the industry mentors, implying the need for a strategic overview, and overhaul of the relevant WIL programme, including policies and processes. Recommendations are made on how all the players could address the challenges.*

Keywords: *engineering technicians, industry mentor, monitoring visits, waiting time, work readiness, workplace resources.*

Методологія. *Одночасно використовувався змішаний підхід, який включав опитування та фокус-групові інтерв'ю. Для відбору зразка використовувалися як цілеспрямовані, так і прості процеси відбору. Вибірка опитування складалася з 25 співробітників технологічного університету, 28 галузевих менторів та 165 студентів. Фокус-група складалася з шести представників, відібраних на основі їхньої участі та досвіду роботи з питаннями інтегрованого з роботою навчання, включаючи фахівця з працевлаштування, менеджера з навчання, фасилітатора, старших технічних співробітників та корпоративного директора.*

Результати. *Найсуттєвішою проблемою був тривалий період очікування для студентів, щоб знайти відповідне місце працевлаштування, що вплинуло на закінчення програми та випуск з університету. Студентам не вистачало відповідних навичок володіння комп'ютером, необхідних у галузі, а також навичок спілкування. Студенти також стикалися з труднощами, працюючи з промисловими кресленнями та документацією, і не могли керувати проектами на робочому місці. Серед труднощів також було відзначено невміння працювати в команді та ставлення до роботи. Обов'язки, зазначені в журналах місця роботи, теж не завжди відповідали службовим. Студенти також скаржилися на нечасті візити співробітників університету для контролю їхньої праці на робочому місці. Також стало очевидним, що заклади вищої освіти недостатньо підготували студентів до роботи.*

Висновки. *У дослідженні підкреслено багато проблем, з якими стикаються студенти, викладачі, залучені до діяльності інтегрованого з роботою навчання, і галузеві ментори, що вказує на необхідність стратегічного огляду та перегляду відповідної програми, включаючи лінію поведінки учасників та окреслені процеси. Надано рекомендації щодо того, як усі учасники можуть подолати ці виклики.*

Ключові слова: *інженерно-технічний персонал, галузеві ментори, моніторингові візити, час очікування, готовність до роботи, ресурси робочого місця.*

INTRODUCTION

The demand for work-ready graduates who are familiar with organizational practices in the workplace is increasing. Thus, the need for more significant work-integrated learning (WIL) is a growing concern in education (Campbell et al., 2019). WIL entails integrating

classroom learning and its application in the workplace. Some researchers (Berndtsson et al., 2020) argue that WIL is broad, complicated, and unique, requiring substantial thought in design and implementation.

Sovilla and Varty (2011) argue that the overall benefits of WIL outweigh the limitations since workplaces provide particular kinds of experiences that support student learning in ways that may not be present in other circumstances.

Thus, there is strong support for applying classroom learning in the workplace because WIL transfers valuable knowledge, various skills, and attitudes through participation, observation, reflection, discussion, research, and other learning modes in the work environment (Smith, et al., 2019; Dean & Campbell, 2020).

Jackson and Greenwood (2017) assert that employers are reluctant to participate in WIL programs, even though the program may be beneficial to them. Thus, Rook (2017) relates extended delays in learners graduating on time to a lack of industry interest in providing. Lloyd et al. (2018) highlight that the modern workplace has many challenges.

Thus, workplaces require learners to be able to work in teams, interacting, engaging, and cooperating with others of different ages, skills, personalities, and backgrounds while delivering on common company objectives (Winborg & Hagg, 2022).

Several researchers (Khampirat & McRae, 2016; Kiriri, 2019) concur that securing placements and other resources becomes difficult as WIL becomes more widespread, and the throughput of the National Diploma in Engineering of the universities of technology will be most affected.

Thus, this study focuses on the challenges related to the WIL encountered in the National Diploma in Engineering, and related engineering qualifications of the universities of technology (UoTs).

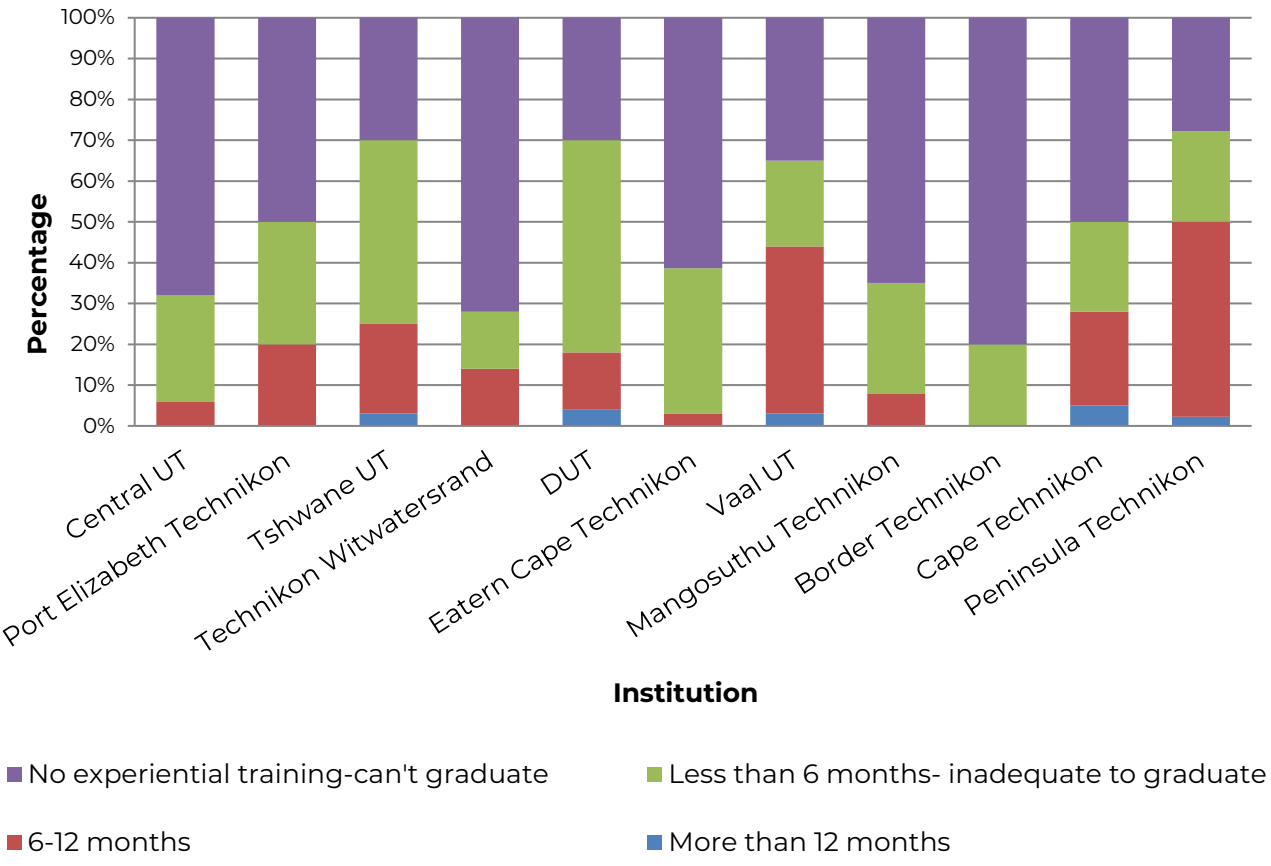
The revised (South African) National Skills Fund Strategic Plan from 2015 to 2020 identifies the partnership between educational institutions and employers as a critical area to promote linkages for work-integrated learning.

The National Skills Fund, therefore, has structured funding mechanisms to reduce the WIL gaps for learners who have completed the theoretical component of their qualifications, but lack the workplace component.

The revised South African National Skills Fund committed to the following in the revised Strategic Plan for 2015 to 2020, namely, to fund and encourage ongoing research in work-integrated learning, facilitate stakeholder relationships to build partnerships between academic institutions and the workplace, through funding mechanisms, and organize and fund initiatives that give students hands-on experience by incorporating WIL into the broader value chain.

The impact of the extended duration of the ND – Engineering programmes attributed to the inability to complete the WIL component of the qualification is depicted in Figure 1.

Figure 1
CESA Experiential Training
Source: *SASCE (2013)*



According to the South African Society for Cooperative Education (SASCE), most academic institutions face the challenge of limited access to suitable workplaces. Consequently, many students do not graduate timeously, thus limiting the supply of much-needed technicians (Southern African Society for Cooperative Education, 2013). This shortage is evident in the National Scarce Skills list of the Top 100 occupations in demand, published by the Department of Higher Education and Training (2009).

Without the WIL component, National Diploma in Engineering students cannot obtain their qualifications and graduate; therefore, their maximum educational attainment would be matriculation, and an incomplete tertiary qualification. Thus, a study investigating the challenges associated with workplace access required by engineering diploma learners may significantly improve the situation.

Identifying the difficulties experienced by academia, the organizations where workplace placement could be located, and the learners can drastically enhance the throughput rates of UoT engineering diploma students, and close the gap between supply and demand for these skills. Thus, this study aims to assess the challenges experienced by a sample of universities of technology, industry mentors and engineering students about the WIL component of the study in terms of its impact on workplace access, and to propose a conceptual framework to assess, and analyse the identified challenges and constraints.

METHODOLOGY

The mixed methods approach was most suitable for the study since it encompasses exploring and identifying various WIL challenges. A survey was conducted using structured questionnaires among UoT employees, WIL students and industry mentors. A separate questionnaire was designed for each of the targeted groups. Concerning the qualitative study, participants could respond without restrictions to a broad, general, open-ended question.

The research participants consisted of university of technology academic staff involved with WIL responsibilities, and WIL learners from the Uo Ts based in the province of KwaZulu Natal (KZN), namely, the Durban University of Technology and the Mangosuthu University of Technology. Mentors from industries based in KZN also participated in the research.

The focus group comprised six carefully selected participants based on their involvement and expertise with WIL issues. The focus group included a placement officer, a training manager, a WIL facilitator, senior technicians, and a corporate director.

All focus group participants worked closely with WIL learners, Uo T faculty, academic staff, industry mentors, and other stakeholders interested in WIL issues.

The focus group discussions centred on themes that would address the research aim. Questions were designed for the interviews, and presented to the members. A healthy discussion ensued as the members engaged, and consequently provided valuable inputs and contributions. The conversation was recorded, transcribed, and organized under themes.

Ethical clearance for the study was obtained from the Da Vinci Institute of Technology, and permission letters were obtained from the selected UoTs in the KZN Province.

FINDINGS

Potential participants in the survey were provided the online link to access the questionnaire, and those without internet access were provided printed hard copies.

As reflected in Table 1, the research questions had a minimal reliability coefficient of 0.87, deemed acceptable by many researchers.

Table 1
Reliability coefficients

Group	Cronbach's Alpha	Internal Consistency
WIL learners	0,938	Excellent
UoT WIL staff	0,952	Excellent
Industry mentors	0.897	Good

Factor analysis was conducted to assess validity; overall, the study was valid.

Table 2 reveals the factor analysis results for industry mentors, which overall are acceptable.

Table 2

Factor analysis – Industry mentors

	Comm.	UoT Placement System	Workplace Resources	Mentorship Training	Attitude
Alpha	.639251	.800137	.485367	.719938	.898673
Omega	.659791	.837512	.523227	.762127	.909391
Omega2	.659791	.837512	.523227	.762127	.909391
Omega3	.663812	.852571	.54535	.770579	.926914
Avevar	.342475	.645482	.18763	.477204	.716699

Table 3 reflects the factor analysis results for the UoT respondents.

Table 3

Factor Analysis – UoT Staff

	UoT resources	Monitoring	Comm.	Industry liaison	Placement	Mentorship Training	Attitude
Alpha	.784001	.752968	.807042	.874589	.835742	.79071	.668724
Omega	.787728	.783707	.793748	.882246	.839611	.801981	.707143
Omega2	.787728	.783707	.793748	.882246	.839611	.801981	.707143
Omega3	.788802	.799047	.738457	.880604	.814652	.803767	.716591
Avevar	.484074	.493362	.346975	.718104	.394749	.512341	.464489

Table 4 reflects the factors derived from the survey questions for the WIL learners.

Table 4

Factor analysis – WIL learners

	UoT resources	Comm.	Placement	Monitoring	Mentorship Training	Attitude	Workplace resources
Alpha	.83061	.867279	.850716	.907539	.822785	.638476	.823181
Omega	.856656	.879157	.855182	.917124	.813864	.670369	.822716
Omega2	.856656	.879157	.855182	.917124	.813864	.670369	.822716
Omega3	.865363	.883673	.859345	.926647	.7907	.68085	.821026
Avevar	.529602	.561927	.544428	.787995	.424714	.417108	.607901

Concerning the gender of the survey respondents, namely, the learner, industry mentor, and UoT staff, it was established that the vast majority (over 50%) were male. Furthermore, most participants were under 30 years old, and 21% of learners were between the ages of 30 and 40.

The learners' waiting period to be placed in the workplace after completing the academic component of the Engineering Diploma varied from one to six months to two years. Only a minority (1%) of the respondents indicated that their waiting period exceeded a year.

Table 5 reflects the participants' perceptions of shortcomings in the current WIL programmes.

Table 5

Gaps in the WIL programmes

	Gaps	Learner	UoT staff	Industry mentor
1.	Theoretical knowledge	13%	8%	48%
2.	Practical skills	29%	42%	56%
3.	Computer skills	12%	13%	11%
4.	Communication skills	36%	38%	26%
5.	Punctuality	32%	33%	19%
6.	Attendance	20%	38%	15%
7.	Interpretation of drawings and documents	12%	17%	30%
8.	Project management skills	22%	25%	26%
9.	Working in a team	22%	25%	33%
10.	Attitude	35 %	46%	19%

It is evident from Table 5 that most UoT staff indicated that learners are equipped with the relevant theoretical knowledge required by the workplace to perform engineering tasks competently. Higher levels of computer skills are required for the current fourth industrial revolution (4IR), and the introduction of 3D printing, robotics, the internet of things, and the extensive use of artificial intelligence for plant processes and various engineering systems (Rotatori et al. 2021).

The analysis also revealed that most learners are confident that they possess sufficient relevant computer skills. The UoT staff also concurred with the learners since only 13% of the UoT staff indicated that the learners lacked the relevant computer skills for the workplace.

Employers require careful listening to instructions, and good verbal communication skills for discussion, explanation, report writing, and presentations (Magogwe & Ntereke, 2014). According to Brink and Costigan (2015), listening skills are a major communication challenge in the workplace. A significant number (36%) of learners acknowledge they do not possess the communication skills required in the workplace. Similarly, 38% of the university staff indicated that learners lacked the relevant communication skills. Furthermore, 26% of industry mentors were dissatisfied with learners' communication skills.

Arriving at work late disrupts planning, scheduling and the timely completion of tasks and projects. Although the majority (56%) of industry mentors also indicated the problem of late arrival at work, only 19% of the learners stated a punctuality problem. Coupled with punctuality is absenteeism since the absenteeism of WIL learners results in various hidden costs to the organizations.

These include the indirect costs of additional staffing, re-scheduling of tasks or delaying projects, re-training of staff absent for a significant time, lost productivity, diminished

morale of colleagues who must carry additional workloads, turnover, and the cost of lost opportunities.

Expertise in engineering-related drawings and documentation is essential for the efficient and effective operation of engineering businesses. A significant percentage (12%) of learners indicated they lacked the necessary skills to interpret drawings and work with documentation. The UoT staff and industry mentors also revealed that learners struggle with drawings and documentation.

Managing projects is a crucial function that engineering technicians and engineers are expected to perform in the workplace. The survey indicates that a significant (22%) number of learners indicated they lacked sufficient and relevant project management skills to perform adequately in the workplace.

The UoT staff further confirmed that the learners experienced challenges in project management, with 25% responding that the learners lacked project management skills required for the workplace. Twenty-six (26%) of the industrial mentors also responded that learners lacked relevant project management skills needed in the workplace.

A combined team effort results in a less stressful work environment, higher levels of job satisfaction, and improved productivity outputs (Williams et al., 2020). Learners must work with other team members on various tasks and projects for their successful completion. A total of 22% of the learners responded that they struggled to work in a team. Similar sentiments were echoed by the UoT staff, and 33% of the industry mentors.

Poor mental health or a bad attitude towards work for various reasons will lead to low performance and non-productivity (Wang & Gorenstein, 2014). Learners are required to have the proper attitude towards their mentors, other work colleagues, and seniors. Most (46%) of the UoT staff responded that the learners lacked the correct attitude.

WIL-related challenges are discussed and debated at Industry Liaison Committee meetings. Most respondents agreed that the Industry Liaison Committee sessions are effective.

Since many students frequently struggle to find appropriate WIL placement (Jackson & Greenwood, 2015), it is expected that UoTs will aggressively canvass businesses to increase the number of workplace opportunities to accommodate learners. A significant number (48.1%) of the industry mentors responded that the canvassing exercises by UoTs were not optimal.

The University of Technology provides logbooks which list various tasks that students in WIL programmes must complete. A total of 40,7% of the industry mentors indicated that the functions listed in the logbooks did not fully correspond with the responsibilities of the specific workplaces.

The majority (40.7%) of the industry mentors indicated that the resources necessary to develop a WIL learner adequately were lacking. In previous research, learners highlighted concerns regarding the lack of university support, and lecturer visits to the workplace (Agwa-Ejon & Pradhan, 2017). This view was also confirmed in the present study since 42.6% of the WIL learners indicated displeasure with the absence of monitoring visits from the UoT staff.

A significant number (38.8%) of the student respondents reported that the academic institutions did not prepare them adequately for the workplace. Despite some academic institutions having established several initiatives to close the gap between the classroom and the workplace, industry mentors also responded that there was a need to focus on learner readiness for the work environment.

Building relationships with businesses to provide access to or promote opportunities for future WIL learners is the primary function of the Cooperative Education Department of the UoT.. However, 31,4% of WIL student respondents were unhappy with how the departments handled learner placements.

University of Technology staff are required to travel to various businesses located around the province of KwaZulu-Natal to secure more workplace opportunities for WIL learners, approve and authorize new workplaces, ensure the workplace has the capacity, capability, and other resources to offer WIL opportunities, monitor the progress of WIL learners and consult with industry mentors.

For these functions to be efficiently carried out, finance is required. Although the (South African) Department of Higher Education advises UoTs to budget adequately for costs associated with WIL (DHET, 2013), a significant percentage (33,4%) of the UoT staff responded that finance for industry visits posed a considerable challenge.

The survey also included several open-ended questions, which allowed respondents to comment on any other aspect of WIL. Their responses were used to develop word clouds since they provide an overview by extracting the most frequent words found in the text.

Figure 2 depicts the word cloud developed from the responses of the UoTs. Learners, management, late, phones, absenteeism, and department are the only words in the word cloud for UoT staff. Attendance, punctuality, and the use of cell phones appear to be issues that UoT staff and management face with learners.

Figure 2

Word Cloud – UoT staff responses

Figure 3 depicts the responses of the WIL learners. The only words that appear in the word cloud of the learners' responses are environment, communication, coordination,

relationship, and visits. Adapting to an entirely new environment at the workplace can be a challenging experience for learners.

Monitoring visits are vital to track learner progress at work. At the same time, skills in communication and relationship-building with all stakeholders, including lecturers, industry mentors, and team members, are required for learners to succeed.

Figure 3

Responses of WIL learners

It is evident from Figure 4 that the only words that appear in the word cloud for industry mentors are negative, technical, ethics, funding, equipment, low and practical. Technical, practical, and equipment are words associated with the workplace, a new environment for learners. Funding for learner stipends is required mainly for transport expenses, without which learners' regular attendance compromises progress.

Figure 4

Word Cloud- Mentor responses

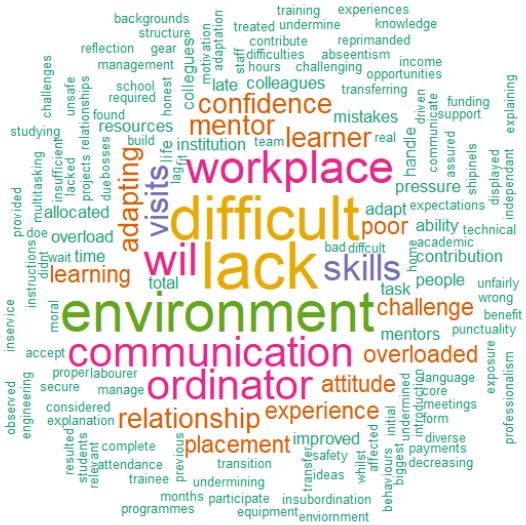


Table 6 below maps the word clouds of all three respondent groups to identify what is shared.

Table 6

Mapping of word clouds

Prominent Words	Learners	UoT Staff	Industry Mentors
Lack	√	√	√
Difficult/Challenge	√	√	
Environment	√		
Communication	√		
Coordinate	√		
Relationship	√		
Placement	√	√	
Attitude	√	√	√
Overloaded/Time	√	√	
Visits	√		
Workplace/Companies	√	√	√
Poor	√	√	√
Skills	√		√
Learning	√		
Confidence	√	√	√
Learners		√	
Management		√	
Late		√	
Phones/Mobile		√	
Absenteeism		√	
Department		√	
Negative			√
Technical			√
Ethics			√
Funding			√
Equipment			√
Low			√
Practical			√

In addition to the word clouds, sentiment analysis was conducted, and the outcome is reflected in Table 7. Sentiment analysis connects or matches sentiments to textual words, phrases or expressions indicating opinions of positivity, neutrality and negativity linked to a particular topic, highlighting any relationships to the subject.

Sentiment analysis is widely used to capture the emotions prevalent in social, political, and marketing events to determine opinions on products and services (Cambria et al., 2017).

Sentiment analysis was conducted using the R data science tool. The responses were cleaned and mapped using a lexicon algorithm through the R "tidyverse" and "tidytext" packages. The context of some words used in the comments and responses to the qualitative question may be neutral, but still trigger sentiments.

Table 7

Sentiments arising from the highlighted words in the word cloud

Words	Sentiments
Honest, limited, bad, disrespect, challenge, distracted, Confidence, moral	Anger
Pay, attendance, result, mobile, depend, efficient, time	Anticipation
Honest	Trust; fear
Change, honesty, difficulty, confidence, bad, challenge, Confidence, afraid	Fear
Honest, pay, respect, confidence, found, resources	Joy
Late, unable, unsuccessful, limited, negative, absent, bad, Overload	Sadness
Management, personal, employ, pay, mentor, respect, team Unreliable, confidence, wear, communication, depend, efficient, Assured resources, morals, school, structure, income, and relevant	Trust

The sentiment of fear and negative emotion emerged as standard from an analysis of the qualitative responses of the WIL learners. Entering a workplace environment for the first time may induce fear among the WIL learners caused by unfamiliarity with the environment, engineering tasks, industry expectations, working with new work team members, and the fear of modern plant equipment, machinery, and hi-tech technology.

Trust is a positive emotion emanating from solid partnerships and relationships between the UoT and industry. Mutual trust is also required between the WIL learners and industry mentors.

Anger resonates with displeasure, annoyance, and hostility, and is considered a negative sentiment. The challenges experienced by WIL learners, UoT staff, and industry mentors may result in behaviour that depicts elements of anger.

Learners who obtain immediate placement opportunities in reputable organizations will express joy since they will fall within a privileged group that transfers from the academic institution to the workplace without delays.

Focus group responses

Participants in the focus group comprised six members, which included industry placement officers, a training manager, facilitators, senior technicians, and a corporate director. All focus group members had worked closely with the WIL learners, UoT staff and industry mentors.

The researcher transcribed, coded, and categorized the data collected from the focus group interviews. The data, reflecting the participants' responses, were captured by the

researcher, and organized into themes and categories as indicated in Table 8. A discussion follows.

Table 8

Themes and categories

Themes	Categories
1. Learners' Challenges	1.1 Placement opportunities
	1.2 Preparation
	1.3 Skill gaps
2. UoT challenges	2.1 Capacity
	2.2 Knowledge gaps
3. Industry mentor challenges	3.1 Difficult learners
	3.2 Lack of resources
	3.3 Mentor qualities
	3.4 Curriculum mismatch
4. Stakeholder engagement	4.1 Communication
5. Relevancy of diploma	5.1 Labour market contribution
	5.2 Socio-economic contribution

Learners' challenges

The group concurred that there existed a shortage of workplace opportunities, and in some cases, learners were requested to perform work unrelated to their qualifications. One participant commented, "The companies willing to offer a place for WIL learners tend to drift away from the core qualification and have learners engaged in irrelevant duties, even admin/office work". Another focus group member said: "Learners find it difficult to find appropriate work placements (companies that are workplace approved by the universities) to complete the practical component of the diploma, and some learners end up not graduating".

The focus group members summarised the impact of delayed placement with the following comment:

"A delay in placing learners in the industry to get practical and on-the-job experience can sometimes result in the learner losing momentum in putting what he has been taught into practice. This may further lead to a sense of demotivation towards the chosen career path and ultimately loss of interest in his academic and professional progress. This delay also creates a sense of not graduating as the timeframe of graduation shifts further away from the goalpost. The delay sometimes forces a learner to quit pursuing this ambition and pushes them into the job market to start (non-career-related Work or look abroad for other academic and professional opportunities. The changing career paths add to the skills shortage in that specific field. The impact of this delay is also felt by the tertiary institutions as they struggle to complete the latter component of the programs, and this affects the placement statistics and success rates".

Learner preparation

All focus group members agreed that the learners were poorly prepared to meet the workplace requirements. More specifically, the Human Resources manager had this to say: “The workplace has become more than a place of reporting for duty; with socio-economic and social media spilling over into the workplace, it has created an environment that divides its focus between hard and soft skills”.

However, another focus group member indicated how the workplace could benefit the learner: “The WIL program plays a significant role in preparing the learners for the workplace. The model is designed to transfer theoretical knowledge into practice, thus enhancing their employability chances and job opportunities”. Many of the learner's concerns focused on lacking cognitive skills, application skills, and confidence. The researcher captured the following catchphrases the focus group used as follows:

“Learners have false expectations of the workplace. They expect to be paid salaries; they expect to be guided, mentored, and supported similarly to at the university. They expect time management to be similar to the university where attendance and punctuality are no serious offences. WIL learners desire an environment that will be nurturing. Learners seek the same treatment they received from the lecturers. Learners must exhibit the proper characteristics and attributes needed in the workplace. Workplace standards include putting in a lot of effort, treating others with respect, being able to work well in a team and under direction, and acting ethically and professionally. Learners struggle to resolve disagreements and conflicting viewpoints. Learners find it difficult to articulate an argument respectfully and constructively. Punctuality, attendance and/or meeting deadlines are critical to the workplace”.

It also became evident that UoTs need to put much more effort into equipping the WIL students with the necessary skills to prepare them for a seamless transition into the workplace. Many focus group participants suggested that the WIL learners’ performance on practical workplace tasks lacked the necessary applicable skills. One focus group member commented: “Learners are not prepared to transfer theoretical knowledge into practice”. Another focus group member argued: "Learners need to gain pivotal work experience that pure theory cannot provide.

Other members of the group mentioned that the learners lack the practical skills required by the workplace. The senior technician contributed with this statement: “In this digital era, a huge emphasis is placed on one's knowledge of technological devices." With the advent of the fourth and fifth industrial revolutions, the nature of the workplace has changed. Modern technology, including robots, artificial intelligence, mechatronics, and other breakthroughs, has overtaken academic institutions. The senior technician in the focus group added, “Learners need to be taught the skills of the real world”. In summary, the findings of the focus group concerning the work-integrated learning challenges for the learner support the findings of the quantitative study.

University of technology challenges

The participants acknowledged the enormous responsibility and dedication required by the UoT staff responsible for WIL. Capacity issues were significant contributors to WIL activities being neglected. The group indicated the lack of funding and resources as critical issues. The WIL placement officer stated that “University of Technology staff do not have the resources to effectively administer and supervise WIL”.

The research participants also agreed that academic staff lacked sufficient awareness of WIL learning, and that depth of expertise was required. The participants stated that these knowledge gaps were noticeable during the monitoring visits. Since many of the UoT staff members were academics first and foremost, it became evident that they lacked a complete understanding of the tasks required to perform at work. A focus group member commented, "The University of Technology staff do not have all the answers".

Industry mentors' challenges

The focus group members asserted that students have negative opinions of the industry mentors. Some learners showed disdain towards the industry mentors, and completely disobeyed any instructions, arrived late, or did not even show up at the workplace, or explain their lateness and/or absence. The following statement was made by one of the focus group participants to sum up this issue: "Learners do not give the industry mentors full commitment, do not work hard, are disrespectful, find it difficult to work in a team or take instructions from the mentor, and fail to demonstrate ethical and professional behaviour".

The focus group members also cited the lack of resources at work as a significant weakness or obstacle in delivering effective mentoring services to the WIL learners. The participants emphasized that providing the learners with enough time and attention was challenging because their mentorship duties were coupled with their already demanding workloads. The focus group participants also emphasized the lack of finance for WIL activities. In addition, they stated that students who depend on stipends often do not show up at the workplace if stipend payments are delayed.

The consensus was that industry mentors should possess skills to help learners change their thinking, and adjust and adapt to workplace expectations and norms. The Human Resources manager asserted that "They are dealing with youthful mindsets that are immature in the workplace and, as a result, confront a range of issues that are not only related to the job".

Industry mentors found it challenging to match workplace activities with the logbook criteria. The WIL placement officer stated: "I believe the existing logbook ought to be revisited as there is no balance or a mismatch between the university curriculum and what the sector wants". This evaluation is necessary due to the industry's recent adoption of new technology, the transition to 4IR, the introduction of robotics, mechatronics, and artificial intelligence, and other factors. It was recommended that the logbook should incorporate elements of soft skills, cognitive skills, and interpersonal skills.

Relevance of the engineering diploma

The WIL placement officer stated: "The WIL program significantly contributes to the learners' workplace readiness. The model is made to help people put their theoretical knowledge into practice, improving their chances of finding employment".

The focus group participants highlighted that due to the demand for skilled technicians, more access to suitable companies would result in learners graduating earlier, and being available for employment as engineering technicians. The participants noted that because the learner population is mainly from disadvantaged backgrounds, there would be an improvement in the socio-economic situation of those previously disadvantaged, along with a significant impact on the national unemployment status.

Stakeholder engagement

There was a standard view that greater collaboration should be encouraged among all the stakeholders involved in WIL. One participant stated, “transparent and open communication is essential for enhancing harmonious relationships among the stakeholders”.

DISCUSSION

Student uncertainty about obtaining the necessary work skills (through WIL) before being certified as having completed the diploma in engineering programme is a significant concern. The long 'waiting' times, as evidenced by this study, could result in students losing their theoretical knowledge and understanding and becoming anxious. Increasing access to more workplaces soon after completing the theoretical modules will allow learners to graduate and gain employment sooner.

Learners ready for placement in the workplace should possess a balanced set of generic and specialized skills to allow for ease of transition into the workplace, and to equip them further to adapt to the fast-changing workplace requirements. The WIL learners require various practical skills to perform adequately in the workplace. Without the relevant knowledge and skills, exposure to unfamiliar industrial plant processes and sophisticated and expensive equipment could risk damage to property or danger to lives.

Fergusson et al. (2021) citing Jiang et al. (2015) took the challenge of further documenting WIL's impact. Jian et al. (2015) analysed 19,093 job placements of engineering students with 4,709 employers in 1,817 cities and 76 countries. The finding was that students performed better at work, and found placements with an increasing emphasis on leadership in their senior years. Senior students specifically acquired non-engineering skills, increasing their abilities for more diversified placements. The study identified the ability to learn and develop interpersonal and problem-solving skills as the most significant characteristics of WIL students.

These attributes suggest the so-called “soft skills” that might be overlooked in strictly technical learning environments (Hornostaieva & Kravchenko, 2021). These data and findings indicate that co-op aims to achieve job preparedness and employability, which results in the development of transferable skills at a higher cognitive level when associated with higher education programs. In today's world, computer skills are widely required, and so is engineering. Computer literacy is included, and highly ranked as a necessary competency in the workplace. Higher levels of computer skills are needed for the current 4IR, and the introduction of 3D printing, robotics, the Internet of Things, and the extensive use of artificial intelligence for plant processes and various engineering systems.

Employers prefer to hire workers with the necessary “soft” and “hard” skills to positively contribute to the organization's effective functioning since, in today’s highly competitive and dynamic global market, practical communication skills are highly valued for fostering relationships with all stakeholders.

Regular attendance is critical to the smooth functioning of any organization. Absenteeism by WIL learners’ results in various hidden costs to organizations, which include the indirect costs of additional staffing, re-scheduling of tasks or delaying projects, re-training of staff who have been absent for a significant time, lost productivity,

diminished morale of colleagues who must carry additional workloads, turnover, and the cost of lost opportunities.

Managing projects is a crucial function that engineering technicians and engineers are expected to perform in the workplace. Therefore, project management skills are critical for completing engineering projects. Teamwork is essential in completing any project since many employees, sometimes from different departments, are involved. The current complex and highly demanding workplace require more harmonious teamwork than ever. Thus, this skill must be taught at the university level through academic projects.

CONCLUSIONS

The expansion of WIL in SA universities of technology has increased competition for WIL opportunities. Thus, innovative WIL approaches are needed to broaden engagement with industry, accommodate growing student numbers, and prepare students for a dynamic and constantly evolving workplace characterized by an increased focus on entrepreneurship and innovation.

The emergence of work-integrated learning as a higher education endeavour has forged a new role for senior leadership and management in higher education institutions. This new role is to provide a vision for significant workplace and community engagement changes with learning institutions to ensure the new agenda delivers full potential benefits to all stakeholders.

Work-integrated learning requires higher education, employers and industry involvement, and all sectors face challenges. The key to successful engagement in either approach includes ongoing communication, flexibility with approaches, committed and skilled lecturers who support students, engaged students, the involvement of intermediary organisations to organise and facilitate activities, and the commitment of business and education leaders to drive work-based learning and work-integrated learning in their communities and companies.

The findings from this study may contribute to improving the WIL programme, offering the graduation of more work-ready graduates. An increase in the pool of skilled engineering technicians will contribute towards alleviating the shortage of such skills in the labour market. The cumulative benefit would be an improved socio-economic sector, and a positive impact on the country's economic growth by reducing graduate unemployment, and an enhanced tax base through more graduates being employed.

WIL practitioners should be appropriately skilled, experienced, and supported to ensure quality WIL experiences and outcomes for students. Appropriate professional development opportunities should be created for WIL practitioners and industry/community partners. In the recasting of WIL in response to the changing nature of work and learning, questions of quality, understanding of purpose, and considerations of relevance must be applied to any emergent practice model. New and emerging models of WIL need to account for what is at the core of quality WIL practice and pedagogy.

WIL is concerned with what students do in both educational and work environments, and how the two are integrated to enrich student learning and organizational outcomes. These structures can be used repeatedly with almost any subject matter, thus making for a transdisciplinary framework or a ‘learning ecosystem’ in which multidisciplinary practices can be accommodated within work-integrated research projects.

CONFLICT OF INTERESTS

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