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Industry perceptions of employability skills for agricultural graduates in the fourth industrial revolution

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Orientation: Graduate unemployment remains a pressing economic challenge across Africa. The rapid advancements in technology, machine learning and artificial intelligence have further reduced job opportunities for young graduates, including those in agriculture.

Research purpose: This study explores industry perceptions of employability skills required for agricultural graduates in the Fourth Industrial Revolution (4IR) era in South Africa.

Motivation for the study: The 4IR era is transforming the agricultural sector, requiring graduates to develop skills that align with technological advancements. Understanding employer expectations can help higher education institutions adapt curricula to meet workforce demands.

Research approach/design and method: A mixed-method approach was used, combining qualitative and quantitative data. The study employed a cross-sectional research design, with semi-structured questionnaires administered to 150 employers in the Cape Winelands District, Western Cape. Descriptive statistics and multiple regression analysis were applied to examine employability determinants, while thematic analysis was used for qualitative insights.

Main findings: Graduate employability is strongly linked to gender, multilingual abilities, academic performance, and soft and hard skills. Employers emphasised the importance of practical experience, communication and digital proficiency in modern agricultural techniques.

Practical/managerial implications: The misalignment between industry needs and academic curricula contributes to graduate unemployment. Strengthening collaborations between universities and employers can bridge this gap, offering students hands-on experience and job opportunities to improve employability.

Contribution/value-add: This study highlights the importance of industry participation in curriculum development, ensuring agricultural graduates acquire essential skills for success in the evolving 4IR-driven sector.

Keywords: agricultural graduates; employability; higher education institutions; industry perceptions; multilingual skills; soft skills; data analytics skills.

Introduction

Youth unemployment is one of the most devastating economic challenges facing developing countries such as South Africa (SA) (Mncayi & Meyer, 2022). Unemployment threatens the country's social stability and economic growth. South Africa's general unemployment rate was around 25% – 29% between 2008 and 2018, and the coronavirus disease 2019 (COVID-19) pandemic increased it to about 35.3% by the end of 2021 (World Bank, 2017). According to MacGinty (2024), graduate-specific unemployment rates were 11.9% of unemployed bachelor's degree or equivalent and higher degree holders and 26.5% unemployment of post-matric qualifications lower than a bachelor's degree in the first quarter of 2023. These values had increased by 22.03% and 23.02%, respectively, from the first quarter of 2019. In the second quarter of 2024, SA experienced a general unemployment rate of 33.5%, resulting in 8.4 million unemployed individuals (Statistics SA, 2024). This value included individuals with qualifications less than matric, non-working jobseekers who have actively looked for jobs in the past month including the discouraged economically active individuals who have given up on finding jobs.

The unemployment rates seem to discourage the youth from participating in self-development and investing in higher education, although the values of trained individuals seem to be higher than those of untrained individuals with minimal education levels, seen by a higher unemployment rate of untrained individuals (MacGinty, 2024). Nevertheless, when it comes to first-time employment even young and fresh graduate professionals experience huge challenges and this is a global trend (Matsouka & Mihail, 2016). The move from academia to the labour market is characterised by integration into company culture, application of one's potential, career development, new social networks, and independence. These experiences are significant milestones in young people's lives, although they can also become sensitive challenges for individuals who are not adequately prepared (Geirdal et al., 2019).

In addition to these the fourth industrial revolution is also continuously changing the landscape of the labour market. In this context, institutions of higher education are expected to attract, educate and train a new generation of industry-ready learners who can assist their respective organisations achieve company strategic goals, and improve their livelihoods and the country through skills transfer and development. This will aid in the acceleration of organisations in accomplishing their set of goals and objectives (Hosain et al., 2023). It is assumed that most young graduates in developing countries such as SA, will look for suitable entry-level jobs within and outside of their discipline or major areas. According to Hosain et al. (2023), students tend to pay focus to employment prospects when selecting institutions of higher learning to enrol in. However, it remains unclear what constitutes employability, and the employability attributes required within the agricultural value chain (Harry et al., 2018). It is, however, clear that graduates and institutions of higher learning need to adopt newer and improved and/or innovative skills and techniques to properly facilitate the production of graduates who are prepared and willing to engage in agricultural-related enterprises (Hosain et al., 2023). Adoption of new skills and techniques into higher learning institution curricula for agricultural training institutions needs to be industry needs-driven, such that institutions produce employable graduates who will experience fewer challenges when transitioning from academia to the labour market (Lange et al., 2020).

Against this background, literature findings reveal that plenty of studies on this topic have focused on assessing learners' perceptions of graduate employability, with very little to no insights from stakeholders within the agricultural industry (Harry et al., 2018; Knobloch et al., 2007; Ninh, 2021). At present, there is a fundamental and escalating requirement for conducting empirical studies to investigate the skill sets required by employers from young graduates in the era of the fourth industrial revolution.

Literature review

Defining and conceptualising employability

Employability is a multifaceted concept influenced by various factors, including prospective employers, educational content, context, and the characteristics of the candidate. Employability refers to a series of accomplishments that include skills, understanding and personal attributes that contribute to an individual's probability to secure employment and become successful in their chosen field, to the benefit of the individual, the workforce, and their community (Mabunda & Frick, 2020). Cheng et al. (2022) defined employability as a full set of skills that can improve graduates in furthering their career development, these include a series of skills, technical knowledge, and personality attributes.

Mainga et al. (2022) conceptualises employability as a set of skills such as complex problem-solving, effective communication, critical thinking, and the ability to work in diverse teams. This implies that quality employable graduates should not only possess subject-related knowledge but also have soft skills and the ability to apply what they have learned in the educational process (Jonck, 2017). Related literature defines employability in numerous ways, however, the constant agreement in the definitions is that employability is the ability to obtain sustainable employment that is in line with one's qualifications and acquired set of soft skills. In the work of Mncayi and Meyer (2022), they found that many students from South African rural universities perceived employability to be influenced by the socioeconomic status of the student, the education system and curriculum that the student was provided, the choice of higher education institution and social connections to which the student belongs to. However, a study conducted by Ruiz-Talavera et al. (2023), found that work-related technical skills, professional knowledge, control over language and communication, and work experience are the four main contributors to employability among university students.

Essential employability skills and attributes required in the fourth industrial revolution era

Mainga et al. (2022) conceptualise employability as a set of skills such as complex problem-solving, effective communication, critical thinking, and the ability to work in diverse teams. This implies that quality employable graduates should not only possess subject-related knowledge but also have soft skills and the ability to apply what they have learned in the educational process (Jonck, 2017). In addition, the 4IR is reshaping the agricultural sector, necessitating a new set of skills and abilities for its workforce. To thrive in this digital age, agricultural graduates must possess a blend of technical and soft skills, and these skills include digital literacy, data analysis and interpretation, Artificial intelligence and machine learning, Robotics and automation, working experience, communication skills and wok-related technical skills (Kana & Letaba, 2024; Mokhtar et al., 2022).

In the era of the 4IR and generative AI, some of the job skills highlighted above might be replaced by modern technology. The agricultural sector is evolving rapidly to keep pace with the growing demand for food. Farmers are increasingly adopting modern technology and AI to enhance productivity

and reduce costs. For example, a study by Wanyama et al. (2024) found that farmers use robots, drones, and sensors to monitor soil moisture and automatically adjust irrigation systems, improving water use efficiency. Similarly, Satapathy et al. (2024) observed that drones are being used for precision seed sowing through specialised containers equipped with controlled dispersal systems, ensuring seeds are released accurately from the air to the ground. Satapathy et al. (2024) further noticed that using drones can reduce planting costs by up to 85%, while achieving a 90% seed emergence rate. To thrive in the Fourth Industrial Revolution (4IR) era, individuals must possess a distinct set of employability skills and attributes, including digital literacy, quantitative literacy and data-driven decision-making skill, artificial intelligence and machine learning, work experience, effective communication skills and work-related technical skills.

Digital literacy

Mokhtar et al. (2022) asserts that digital literacy is like information literacy, which includes the use of critical thinking and skills in the process of finding and consuming information. However, understanding digital technologies and utilising them in cooperative, communicative ways through social interaction constitute digital literacy. Kana and Letaba (2024) conducted a study on the reshaping of curriculum transformation to address the 21st-century skill sets and employment prospects during the Fourth Industrial Revolution era. Their study found that Technical and Vocational Education and Training (TVET) students need to be prepared to operate in the digital and technological landscape because South African enterprises have mainly adopted the 4IR. This entails possessing abilities such as critical thinking, problem-solving, creativity, communication, digital literacy, and teamwork (Kana & Letaba, 2024).

Quantitative literacy and data-driven decision-making skills

Coetzee and Goede (2024) revealed that the rapid digitisation of the global economy, which is coupled with a significant increase in internet and social media usage, has led to an unprecedented influx of data. Hence, an estimated 328.77 million terabytes of data are generated every day, resulting in a phenomenon known as data overkill. But data are meaningless in and of themselves (Coetzee & Goede, 2024). Agricultural graduates must be able to gather, evaluate, and interpret data from a variety of sources, including sensors, drones, and satellite imaging, to convert them into information that may help decision makers (Coetzee & Goede, 2024). Another study conducted by Segbenya et al. (2023) on demographic characteristics and employability skills among tertiary graduates in Ghana revealed that employers ranked numeracy/processing and understanding numerical data as the second most important employability skill, while tertiary graduates placed it third in the study area.

Artificial intelligence and machine learning

Rickardo and Meiriele (2023) defines the term artificial intelligence as the collection of methods and algorithms that enable machines to learn from information and experiences and carry out activities that previously needed human intelligence is known as artificial intelligence. A study conducted by Giwa and Ngepah (2024) artificial intelligence and skilled employment in South Africa. Their findings reveal that employees with skills that complement robotic investments are more likely to experience employment benefits and have better job prospects compared to those with skills that are less complementary. The degree of complementarity between employee skills and robotic investments is a key factor influencing these employment outcomes (Giwa & Ngepah, 2024). Learning these AI-based technologies will help agricultural graduates to improve efficiency in managing problems faced by the agricultural sectors such as crop yield, irrigation, soil content sensing, crop-monitoring, weeding and crop establishment.

Work experience

Ninh (2021) found that work experience from work-based learning or work-integrated learning (WIL), which university students generally obtain from partaking in internships, part-time jobs, and volunteer work during their studies, may assist graduates in integrating classroom-based knowledge with practical work in a professional environment. Research by Lange et al. (2020) supports the idea that combining theoretical knowledge with practical experience leads to improved technical skills and a deeper understanding of the workplace culture, expectations, and requirements, which leads to graduates who can easily adapt to different environments. In this regard, employers seek highly skilled and experienced individuals as they consider inexperienced graduates as risky investments (Mgaiwa, 2021).

Communication skills

Communication skills can be observed or monitored through the individual's ability to effectively send and receive information (Hosain et al., 2023). In the workplace this is performed through face-to-face interactions, using online platforms or emailing between colleagues. Rukuni et al. (2018) postulates that poor communication skills in both written and oral communication were a major barrier to South African graduates obtaining employment. These skills allow efficiency in organisational processes, which include employee relations, customer relations, public relations, negotiation with stakeholders and strategic planning (Bosibori, 2018). Similarly, the study by Fajaryati et al. (2020) found that the lowest-rated employability skill was written communication among agricultural college graduates. In the study, oral communication was rated higher than written communication, possibly because the agricultural labour force is composed of minimally educated society members. In addition, most of the tasks involved in agriculture require more verbal communication, especially on the technical end.

Work-related technical skills

Work-related technical skills and professional knowledge are some of the attributes that students acquire from WIL

(Gbollie & Keamu, 2017; Lim et al., 2016; Makouezi & Ngobila, 2022). Technical skills are also interlinked with curriculum design as such it is important that Higher Education Institutions (HEIs) supply graduates with the necessary technical skills that are demanded by the job market (Misni et al., 2020). It is, therefore, imperative that institutions understand the skills that employers seek to avoid a mismatch between what is demanded and supplied. According to Leibbrandt and Woolard (2010), both HEIs and organisations should be aware that relevant employability skills involve more than just finding a job, this entails the development of individual techniques, qualities, and experience. Moreover, the gap between the supply of overall employability skills and the corresponding demand for relevant skills is a main concern as institutions persist in developing more graduates than can be absorbed by the job industry.

A study conducted by Abdel-Rahman and David (2014) on the impact of academic performance on the employability of graduates in Egypt highlighted that a higher score in academic studies resulted in increased employment opportunities. About 74% of participants who scored more than 60% in their last graduation were employed by companies (Abdel-Rahman & David 2014). From an agricultural perspective, good course grades may be linked to a better understanding of course content and therefore may imply better technical skills. The need for technical competency was also highlighted in the study by Misni et al., (2020) who found that employers seek technical skills over organisational skills when considering the employment of graduates.

Agriculture in the context of the fourth industrial revolution

In the era of the 4IR and generative artificial intelligence, some of the job skills highlighted above might be replaced by modern technology. The agricultural sector is evolving rapidly to keep pace with the growing demand for food. Farmers are increasingly adopting modern technology and AI to enhance productivity and reduce costs. For example, a study by Wanyama et al. (2024) found that farmers use robots, drones, and sensors to monitor soil moisture and automatically adjust irrigation systems, improving water use efficiency. Similarly, Satapathy et al. (2024) observed that drones are being used for precision seed sowing through specialised containers equipped with controlled dispersal systems, ensuring that seeds are released accurately from the air to the ground. Satapathy et al. (2024) further noticed that using drones can reduce planting costs by up to 85%, while achieving a 90% seed emergence rate. Therefore, this study seeks to explore the current and future skills in high demand among employers in the agricultural sector, as technology continues to reshape the industry.

Research design

The research study utilised a cross-sectional design, which is suitable for capturing data at a specific point in time, allowing for the examination of relationships between various factors influencing graduate employability (Levin, 2006). For the quantitative aspect, structured questionnaires were developed to gather data on various employability attributes and demographic variables. The qualitative aspect of the analysis was explored through semi-structured interviews to gain deeper insights into the perspectives of farm managers regarding the skills and attributes they value in young graduates (Creswell & Poth, 2018). Purposive sampling was selected for both quantitative and qualitative components to ensure participants had direct experience with hiring agricultural graduates. The same participants were involved in both phases to maintain continuity and to facilitate triangulation of data.

Research methodology

This study employed a mixed-methods approach, integrating both qualitative and quantitative research methodologies. These approaches were deemed appropriate as they allow for a comprehensive exploration of the employability attributes required by employers in the agricultural sector for young graduates. The combination of methods enhances the robustness of the findings by providing both numerical data and rich descriptive insights (Creswell & Clark, 2017). The quantitative component utilised a survey-based approach, while the qualitative aspect focused on in-depth interviews.

Research participants

The study population comprised of active farmers registered with the Department of Agriculture in the Western Cape Province, with specific focus on those operating within the Cape Winelands District. To ensure a highly relevant participant pool, a purposive sampling, strategy was employed, targeting 230 registered farmers who demonstrated an active involvement in hiring young graduates (Palinkas et al., 2015). To enhance participation, potential respondents were initially contacted through official Department of Agriculture records, industry networks, and farmer associations. Invitations were sent via email and follow-up phone calls were made to confirm eligibility and willingness to participate. Clear inclusion criteria were communicated, ensuring that only farm managers with direct experience in graduate employment were considered. From this targeted outreach 150 farm managers consented to and completed the questionnaires, and an additional 20 farm managers participated in the semi-structured interviews. The purposive sampling technique was specifically chosen to target individuals with the most relevant experience and knowledge, ensuring that the data collected would be rich and relevant.

Quantitative data collection

The primary instrument for quantitative data collection was a structured questionnaire designed to assess various dimensions of graduate employability, including technical

skills, soft skills, and academic performance. The questionnaire consisted of both closed-ended questions, which facilitated statistical analysis, and open-ended questions that provided respondents with an opportunity to elaborate on their perspectives (Yin, 2023).

The structured questionnaire included Likert-scale questions such as: 'Rate the importance of communication skills for graduates on a scale from 1 to 5'. This approach ensured that responses could be systematically analysed to identify trends and correlations in industry perceptions of employability skills.

To enhance the validity and reliability of the instrument, a pilot study was conducted before the full-scale data collection. The pilot study helped to refine the questionnaire by identifying ambiguities, improving question clarity, and ensuring that the response format effectively captured the intended data. Feedback from the pilot study led to minor modifications, ensuring that the final questionnaire was both comprehensive and easy to interpret.

Qualitative data collection

The qualitative component of the study involved semi-structured interviews with farm managers and recruiters. These interviews provided deeper insights into employer expectations beyond what could be captured through numerical data. Conducted face-to-face, the semi-structured format allowed for more engaging and dynamic discussions, enabling respondents to elaborate on key factors influencing graduate employability.

The interviews were audio-recorded with participants' consent, transcribed verbatim, and analysed using thematic analysis (Braun & Clarke, 2006). This method allowed for the identification of recurring themes and patterns in employer perceptions of essential skills. Sample interview questions included: *What skills are crucial for graduates to succeed in modern agricultural environments? What key employability skills do you look for when hiring agricultural graduates? How do you assess graduates' ability to adapt to technological advancements in agriculture?*

Thematic analysis

To gain deeper insights into industry perceptions of employability skills, qualitative data from the interviews were analysed using thematic analysis. The analysis followed Braun and Clarke's (2006) six-step approach, ensuring a systematic exploration of the data. Firstly, the interview recordings were transcribed verbatim and repeatedly reviewed to ensure familiarity with the content. This step allowed for a deeper understanding of the data before proceeding to the next phase.

Secondly, initial coding was performed by identifying key phrases and concepts related to employability skills. These codes captured meaningful data segments and were essential in organising the information. Once the codes were established, they were grouped into broader themes, such as *communication skills*, *adaptability*, and *work experience.* This thematic categorisation helped to structure the findings in a way that reflected industry expectations.

After identifying potential themes, they were reviewed to ensure coherence and relevance to the study's objectives. This step involved refining and merging overlapping themes while ensuring that each theme accurately represented the underlying data. Once finalised, the themes were clearly defined and named, providing a comprehensive understanding of the key employability attributes sought by employers.

Finally, the findings were synthesised into a coherent narrative, integrating direct quotes from participants to support the interpretation of results.

Statistical analysis

For the quantitative data analysis, Statistical Package for Social Sciences (SPSS) version 29 was employed. Descriptive statistics was used to provide a summary of key variables of the study into frequency tables (Kaliyadan & Kulkarni, 2019). A multiple regression model was employed to examine the relationship between graduate employability and selected variables of interest. One of the main benefits of using a multiple regression analysis is that it can convey complex and diverse nature of real-world events (Poston et al., 2023). The model specification in matrix notation is estimated by:

$$\gamma = \beta_0 X_1 + X_2\beta_2 + \ldots + X_{10}\beta_{10} + \varepsilon \quad \text{[Eqn 1]}$$

Equation 1 was then linearised by taking the natural logarithm, which yielded the following equation:

$$Ln\ Y = \beta_0 + \beta_2\, lnX_2 + \ldots\ldots\ldots\ldots + \beta_{10}\, lnX_{10} + \varepsilon \quad \text{[Eqn 2]}$$

where:

γ = Graduate Employability; X_1 = *Gender*; X_2 = *Age*; X_3 = *Race*; X_4 = *Computer skills*; X_5 = *Multilingual*; X_6 = *Academic perfomance*; X_7 = *Ethnicity*; X_8 = *Soft Skills*; X_9 = *Technical skills*; X_{10} = *Academic Perfomance*; X_{11} = *Curriculumn development* β_0 = *Constant term*; β_1 = *coefficients of the regression model*; L_n = *natural Logarithm, and* ε = *error term.*

A summary description of all variables used in the model are listed in Table 1.

Ethical considerations

Ethical clearance to conduct this study was obtained from the Cape Peninsula University of Technology, Faculty of Science Research Ethics Committee. (No. [30105214/04/2024]). Written informed consent was obtained for all interviews ensuring participants' anonymity and the confidentiality of their responses. Participants were informed about the study's objectives, procedures, and their right to withdraw at any time. Participants were assured that their responses would only be used for research purposes.

Results

This section presents and analyses primary data collected from the sample of participants in Cape Winelands District, SA. Findings were analysed and interpreted in relation to the research objective. Data are presented according to key themes underpinning this study's key issues, such as company profile, relevance of soft and hard and key factors influencing employability. Table 2 presents the demographic characteristics of the participants in the study area. The results indicate that 62% of the respondents were females between the ages of 31–50 years. It was also revealed that 45% of the participants occupied line management positions and 30% of the participants were human resources officers.

The results of the descriptive statistics revealed that the survey shows a broad representation of the agricultural industry, with most respondents (45%) being line managers, followed by HR managers or officers (30%), primarily working on mid-sized farms employing 51–100 workers (50%). The frequent hiring of graduates, with 50% of respondents hiring every 6 months and 30% annually, reflects the industry's ongoing need for fresh talent, especially as it adapts to technological advancements such as AI and automation.

The impact of employability skills on employability

The impact of employability skills on the job prospects of fresh graduates was investigated by asking employers the following question: Which factor(s) from the table do you consider most important for students to secure an internship or WIL placement at your company? (Please rank in order of importance, i.e., 1–14 with 1 = most important). Table 3 shows the ranked employability skill results as per employers in the agricultural industry ranking, from most ranked to least ranked. The study employed mean scores to rank the most important skills that recruiters perceive as important when hiring fresh agriculture graduates. As depicted in Table 3, communication skills, time management skills, positive attitudes and behaviours, and adaptability skills were ranked as the top four most important employability skills sought after by employers.

TABLE 1: Description of variables used in the model.

Variable	Notation	Expected outcome
Graduate employability	Y_0	-
Gender	X_1	±
Age	X_2	±
Race	X_3	-
Computer skills	X_4	+
Multilingual	X_5	+
Academic performance	X_6	-
Ethnicity	X_7	±
Soft skills	X_8	+
Technical skills	X_9	+
University's reputation	X_{10}	-

Relative importance of academic-related skills

The purpose of this section was to provide evidence of the importance of academic skills in securing employment. Employers were asked to rank the importance of academic-related skills, teamwork and personal management skills in securing graduate placement. Specifically, employers were asked: *Which of the following skills do you think fresh*

TABLE 2: Demographic characteristics of survey respondents.

Variables	Coding	Frequency (N = 150)	%
Gender			
Male	0	57	38
Female	1	93	62
Age (years)			
< 30	0	8	5
31–40	1	60	40
41–50	2	23	15
51–60	3	38	25
> 60	4	23	15
Position			
HR manager or officer	0	45	30
Line manager	1	70	45
CEO	2	30	20
Supervisor	4	5	5
Years in industry			
Packhouses	0	45	30
Pome and stone fruit	1	75	50
Dried fruit	2	30	20
Grape and wine	3	0	0
Hiring of graduates			
Yes	0	150	100
No	1	0	0
Frequency of hiring			
Every 6 months	0	75	50
Annually	1	45	30
Quarterly	2	15	10
Needs basis	3	15	10
Farm size (workers)			
0–50	0	38	25
51–100	1	75	50
101–150	2	30	20
> 151	3	8	5

CEO, Chief Executive Officer; HR, Human Resource.

TABLE 3: Important employability skills.

Skill type	Mean*	SD	Rank
Communication skills	7.36	3.54	1
Time management skills	6.92	3.79	2
Positive attitudes and behaviours	6.82	3.47	3
Adaptability skills	6.14	3.71	4
Interpersonal skills	5.77	3.19	5
Learning skills	5.49	2.30	6
Teamwork skills	4.78	3.03	7
Self-management skills	4.67	2.87	8
Problem-solving skills	3.58	3.12	9
Networking	3.32	5.05	10
experience	1.87	3.32	11
Working with diversity	1.32	3.25	12
Leadership skills	1.21	3.22	13

SD, standard deviation.

*, The mean difference is significant at the 0.05 level.

graduates must have before entering the job market (please indicate whether you agree or disagree with statements given below. (Please rank in order of importance, i.e., 1–14 with 1 = most important).

Participants were asked to rank the soft and hard skills most important for performing tasks better in the agricultural sector. The results presented in Table 4 show that proficiency in languages such as Afrikaans, English and isiXhosa plays an important role in securing a graduate placement in the Western Cape province. Adaptability, teamwork and innovative skills also came top of the list, with employers confirming the importance of these skills in securing job placement.

Factors affecting fresh graduates' employability

The study carried out a multiple regression analysis to determine the relationship between the dependent variable (graduate employability) and the independent variables (age, gender, computer skills, multilingual skills, academic performance, ethnicity, soft skills, technical skills, institutions reputation). Table 5 presents the results of the model.

The results of the multiple regression analysis presented in Table 5 revealed several factors significantly influenced the employability of graduates in South Africa. The significant variables were graduates' gender, multilingual skills, academic performance, soft skills, and hard skills. In terms of gender, the regression results revealed a positive and statically significant at the 5% confidence level. While multilingual skills were found to be positively significant at a 5% confidence level.

TABLE 4: Presents the hard and soft skills.

Skill type	Mean	SD	Rank
Language (fluency and type of language spoken)	7.36	3.54	1
Adaptability skills	6.92	3.79	2
Teamwork skills	6.82	3.47	3
Innovative and creative skill	6.14	3.71	4
Recognition and respect for diversity and individual differences	5.77	3.19	5
Accountability (i.e., responsible for your actions and the actions of your group, etc.)	5.49	2.30	6
Self-awareness (i.e., aware of strengths, weaknesses, etc.)	4.78	3.03	7
Positive attitude (i.e., 'can do' approach, show initiative, etc.)	4.67	2.87	8
Self-confidence	3.58	3.12	9

i.e., in essence; etc, etcetera; SD, standard deviation.

TABLE 5: Multiple regression analysis results.

Variables	Notations	Marginal effect	SE	*t*
Graduate's gender	X_1	0.0039*	0.0115	0.95
Graduate's age	X_2	0.3592	0.1958	1.83
Graduate's race	X_3	0.1967	0.2437	-0.81
Computer skills	X_4	0.2550	0.2017	-1.27
Multilingual skills	X_5	0.0064*	0.0293	3.54
Academic performance	X_6	0.0218*	0.2127	0.10
Ethnicity	X_7	-0.0540	0.0586	-0.92
Soft skills	X_8	0.0109*	0.0053	2.08
Hard skills	X_9	0.0456*	0.0197	3.32
Institution's reputation	X_{10}	-0.5480	-	0.85
Log-likelihood	-	-67.5600	-	-
Pseudo R^2	-	0.7740	-	-
Adjusted R^2	-	0.6870	-	-

Note: Sample size, $N = 150$. $R = 0.880$; $R^2 = 0.774$; adjusted $R^2 = 0.687$. Log-likelihood = -67.5600.
SE, standard error.
*, Coefficient is significant at the 0.05 level (2-tailed).

Themes and sub-themes from thematic analysis

Thematic analysis revealed key themes and sub-themes related to the employability skills expected from agricultural graduates in the 4IR era. Three main themes emerged: technical skills, soft skills, and adaptability to technology.

Technical skills

Employers emphasized the importance of hands-on agricultural expertise, including precision farming and data-driven decision-making. One participant opined,

> *"Graduates must understand modern farming techniques, not just theory but practical application in real-world scenarios."* (Employer 1)

Another employer explained,

> *"We need individuals who can interpret soil data and use precision agriculture tools effectively to optimize yields."* (Agronomist 2)

A farm manager added,

> *"Knowledge of mechanization and irrigation systems is essential. Graduates should be comfortable operating and maintaining advanced agricultural equipment."* (Farm Manager 3)

One respondent highlighted,

> *"It is not just about knowing how to plant and harvest; understanding sustainable farming practices and soil management is equally important."* (Sustainability Specialist 4)

Another employer remarked,

> *"Graduates must be able to integrate technology into traditional farming methods to improve productivity."* (Agricultural Consultant 5)

Soft skills

Communication, teamwork, and problem-solving were identified as crucial attributes. A recruiter highlighted,

> *"We need graduates who can communicate effectively, collaborate with teams, and think critically to solve unexpected challenges in the field."* (Recruiter 6)

One farm owner emphasized,

> *"The ability to lead a team and work harmoniously with employees from different backgrounds is crucial in a farm setting."* (Farm Owner 7)

A respondent observed,

> *"We often face unpredictable situations in farming – graduates must be problem solvers who can make quick and informed decisions."* (Operations Manager 8)

Another participant stated,

> *"Employers value individuals who show initiative and can work independently without constant supervision."* (HR Specialist 9)

One hiring manager explained,

> *"It is not just about having knowledge; being able to articulate ideas and present solutions to farm challenges is a highly desirable skill."* (Hiring Manager 10)

Adaptability to technology

The increasing role of digital tools in agriculture required graduates to be tech-savvy and open to innovation. One employer stated,

> *"With the rise of smart farming, graduates must be comfortable using new technology and continuously upgrading their skills."* (Tech-Savvy Employer 11)

A farm manager observed,

> *"Automation is becoming more prevalent – graduates should understand drone technology and GPS-based farming techniques."* (Farm Manager 12)

One participant emphasized,

> *"The ability to interpret data from digital sensors and adjust farming practices accordingly is a key requirement."* (Data Analyst 13)

A hiring officer added,

> *"Technology is reshaping agriculture, and we need graduates who are eager to embrace new tools instead of resisting change."* (Hiring Officer 14)

Another respondent mentioned,

> *"We use farm management software for tracking crops, and graduates should be proficient in data entry and analysis."* (Agricultural Technology Specialist 15)

These findings highlight industry expectations, and the evolving skill set required for agricultural graduates to thrive in the 4IR era.

Discussion

The following section presents the quantitative results derived from the study, providing an overview of respondent demographics and hiring trends in the agricultural industry. This is followed by an analysis of the qualitative findings, which explore employer perspectives on the skills and competencies required for graduates in the 4IR era.

The impact of employability skills on employability

The study used mean scores to rank the most important employability skills perceived by recruiters, and this approach is in line with previous studies that have employed similar methods (Abbasi et al., 2018; König & Ribarić, 2019; Mainga et al., 2022; Strong et al., 2020). Communication emerged as one of the top soft skills, critical for interacting with colleagues, farmers, and clients in the agricultural sector. AgriSETA SA (2021) also identifies communication, along with conflict management and production coordination, as essential skills sought by agricultural recruiters. Pitan and Muller (2023) further highlight that 60.6% of employed university graduates lacked communication skills, indicating a significant mismatch. This suggests that communication training should be a greater focus within agricultural education to better prepare graduates for the workforce.

TABLE 6: Academic skills, teamwork and personal skills.

Skill type	Mean	SD	Rank
Academic performance (i.e. overall grades)	7.36	3.54	1
Good numeracy skills	6.92	3.79	2
Data analytics skills	6.82	3.47	3
IT literacy skills (i.e., use of technology, programmes and information systems effectively)	6.14	3.71	4
Critical and analytical thinking skills	5.77	3.19	5
Competence in specialised subject area	5.49	2.30	6
Problem-solving skills involving mathematics (i.e., numeracy skills)	4.78	3.03	7
Self-management skills	4.67	2.87	8
Well-written curriculum vitae	3.58	3.12	9

i.e., in essence; IT, information technology; SD, standard deviation.

Relative importance of academic-related performance numeracy and language skills

This study evaluated the significance of academic skills in the agricultural industry labour market by utilising a mean score approach, consistent with methods employed in similar research studies (Healy, 2023; Leibbrandt & Woolard, 2010; Mainga et al., 2022; Misni et al., 2020; Mgaiwa, 2021; Römgens et al., 2020). The findings (Table 6) show that academic performance, specifically overall grades, is considered the most important factor by recruiters when hiring fresh graduates and WIL students. This emphasis on high grades may be attributed to the association between good academic performance and qualities such as hard work, discipline, and self-motivation (Kidane & Worth, 2012). Similarly, Harry et al. (2018) found that good academic grades are highly valued for improving job prospects in the agricultural sector. Despite the importance of academic performance, Makhaya (2014) cautioned that relying too heavily on grades as a determinant of employability may overlook technically skilled individuals.

Another key finding in this study is the importance of numeracy skills. These skills are crucial for farming activities such as stock-taking, unit conversions, planting schedules, and irrigation scheduling. Strong numeracy ensures that these tasks are carried out efficiently, making it a priority for recruiters in the sector. In addition, data analytics and IT skills are increasingly in demand because of the growing use of AI, drones, and sophisticated machinery in agriculture (Ruiz-Talavera et al., 2023). These technologies require employees to manage and analyse data quickly and accurately.

Finally, language fluency emerged as an important factor for employability. In the Western Cape of SA, the main languages spoken on farms are Afrikaans, English, and IsiXhosa (Banda & Peck, 2016). Language fluency is vital for communication, particularly given the diverse workforce comprising individuals from various linguistic backgrounds,

such as farm workers from the Eastern Cape or Cape Coloureds native to the Western Cape (Van der Waal, 2022). Emuze and James (2013) also identified that language and cultural diversity can create communication barriers in the workplace, further emphasising the need for effective language skills in agricultural employment.

Factors affecting fresh graduate's employability

The results of the multiple regression model presented in Table 5, highlight variables that are statistically significant at the 5% confidence level, including gender, computer skills, multilingual skills, academic performance, soft skills, and hard skills, all of which are significant at the 0.005 confidence level. The model's multiple correlation coefficient (R) is 0.880, indicating a strong relationship between the dependent and independent variables. Furthermore, the R-squared value of 0.774 suggests that 77.4% of the variability in the dependent variable is explained by the regression model, which is considered a strong fit.

The gender of the graduate was found to be statistically significant with a p-value of 0.010, confirming that gender plays a role in the recruitment process. This could be attributed to the physical demands of certain agricultural tasks that may require more manpower; therefore, employers may favour male candidates for specific roles that involve physically intensive work (Stenbacka, 2019). Multilingual skills were also statistically significant ($p = 0.064$), underscoring the importance of language proficiency in the recruitment process. Participants highlighted the key languages Afrikaans, English, and IsiXhosa that offer a competitive advantage to young graduates seeking employment in the agricultural sector. This finding contradicts claims circulating on social media, and the observation by Dyers (2008) suggesting that farms in the Western Cape predominantly employ candidates fluent only in Afrikaans. Our study, however, reveals that employers prioritise proficiency in any of the three languages Afrikaans, English, or Xhosa. Employers found that over 90% of their workforce speaks one of these languages, which enhances communication and productivity at the farm level.

Academic performance, as measured by students' grades across various subjects, emerged as a statistically significant variable with a p-value of 0.012. Graduates with higher academic achievements were viewed more favourably during recruitment, as employers often associate good grades with strong work ethics, discipline, and the ability to perform under pressure. These findings align with previous research, which indicates that academic performance is an important determinant in the recruitment of graduates (Ramnund-Mansingh & Reddy, 2021).

Both soft skills ($p = 0.010$) and hard skills ($p = 0.046$) were statistically significant, underlining their importance in the recruitment process. Soft skills, which include leadership, communication, and time management, are essential for effective collaboration and productivity in the workplace (Hamid & Younus, 2022). Employers prioritise these skills because they are critical to managing teams, solving problems, and ensuring smooth day-to-day operations. On the other hand, hard skills were found to be statistically significant with a p-value of 0.0456, indicating that they are an important factor in the recruitment process. This suggests that technical knowledge and specialised training related to specific agricultural roles play a significant role in employers' hiring decisions (Sima et al., 2020).

Thematic analysis findings

The thematic analysis findings align with the study's objective of assessing industry perceptions of employability skills for agricultural graduates in the 4IR era. Employers emphasised technical skills, highlighting the need for graduates to apply modern farming techniques, such as precision agriculture, in real-world scenarios (Mahaney et al., 2021). This reinforces the importance of experiential learning in bridging the gap between education and industry needs (Andrade-Silva et al., 2023). In addition, soft skills, including communication, teamwork, and problem-solving were identified as essential for workplace adaptability (Mahmud & Wong, 2022). Employers stressed that technical competence alone is insufficient, and graduates must demonstrate strong interpersonal abilities to succeed. Another key theme was adaptability to technology, reflecting the increasing role of digital tools in agriculture. As automation and data analytics reshape the sector, graduates must continuously update their skills and embrace technological advancements (Oke & Fernandes, 2020). This finding suggests that higher education institutions should integrate digital literacy and emerging technologies into their programmes to enhance graduate employability. Overall, the results highlight the need for a well-rounded skill set that combines technical expertise, soft skills, and technological adaptability to meet the evolving demands of the agricultural sector.

The combination of qualitative and quantitative findings provides a comprehensive understanding of industry perceptions of employability skills for agricultural graduates in the 4IR era. The quantitative results from the structured questionnaire revealed that employers highly prioritise technical skills, soft skills, and technological adaptability. These findings were reinforced by qualitative insights, where employers elaborated on the importance of practical experience, communication abilities, and digital proficiency in modern agriculture. The qualitative data further explained and deepened the quantitative findings by providing contextual details on why these skills matter (Creswell & Plano Clark, 2018). For instance, while the survey data showed a high rating for communication skills, interviews revealed that employers value not only verbal communication but also the ability to convey technical information effectively. Furthermore, both datasets confirmed the growing role of technology, with qualitative interviews highlighting specific challenges employers face in training graduates on new digital tools. This alignment between qualitative and quantitative results strengthens the study's conclusions, demonstrating that both technical expertise and soft skills are crucial for graduate employability in the evolving agricultural sector.

Limitations of the study

Geographical scope: the first limitation of this study was that the study focused on employers and recruiters who are based in the Cape Winelands District in Eastern Cape, which may not be representative of the entire South African agricultural industry. Therefore, studies that are going to be conducted in the future can expand and explore other regions to increase generalisability. Sample size and response rate: Although there were 150 employers and recruiters participated in the study, the response rate and sample size may not be sufficient to capture the full range of perspectives and experiences within the industry, therefore future studies can expand the sample size.

Limited representation of small-scale farmers: The study may not have adequately represented the perspectives of small-scale farmers, who are critical stakeholders in the South African agricultural industry. Focus on employer perceptions: While the study provides valuable insights into industry perceptions, the study does not capture the perspectives of agricultural graduates themselves. Therefore, future studies could explore the alignment between employer expectations and graduate perceptions.

Theoretical implications and future research recommendations

This study contributes to the existing body of knowledge on graduate employability by integrating industry perspectives on the essential skills required for agricultural graduates in the 4IR era. The findings extend employability theory by demonstrating that traditional models emphasising academic performance and technical expertise are insufficient in a rapidly evolving labour market. Instead, the study supports an expanded employability framework that incorporates soft skills, digital literacy, and adaptability to technological advancements. Furthermore, this research reinforces Human Capital Theory, which posits that investments in education and skills enhance employability and economic productivity. The study highlights that beyond formal education, industry-relevant competencies such as problem-solving, communication, and data-driven decision-making are key determinants of employability. This suggests that higher education institutions must shift from a purely knowledge-transfer model to a competency-based learning approach that aligns with industry demands.

Additionally, the study engages with Signalling Theory, which explains how job seekers use qualifications and skills to signal their value to potential employers. The findings suggest that graduates who possess a diverse skill set including multilingual capabilities and WIL experiences are more favourably perceived by employers. This expands the theory's application to the agricultural sector by emphasising the importance of non-traditional signals, such as digital proficiency and adaptability to automation. Finally, this study aligns with Constructivist Learning Theory, which emphasises learning through experience and interaction. The results demonstrate that practical exposure to industry settings through internships and WIL significantly enhances employability. Thus, the study suggests that constructivist learning approaches should be more deeply embedded in agricultural curricula to improve graduate readiness for the workforce.

These theoretical contributions provide a foundation for further research on curriculum development, employer expectations, and the role of emerging technologies in shaping graduate employability within the agricultural sector. As a result, the authors suggest that future research should look at the longitudinal study by conducting a study to examine how industry perceptions of employability skills evolve and how agricultural graduates' skills adapt to changing agricultural industry demands. Furthermore, a comparative study can be conducted to examine the differences in industry perceptions of employability skills across various regions, industries, or countries. Lastly, a look at the graduate perspectives would be to investigate the perspectives of agricultural graduates on employability skills, which may explore the alignment between graduate perceptions and industry expectations.

Practical implications for the agricultural sector and farm managers

The findings of this study have several practical implications for both the agricultural sector and farm managers. Agricultural companies and farm managers should invest in training programmes that focus on developing computer skills, multilingual skills, soft skills, and hard skills to enhance the employability and productivity of agricultural graduates in SA. Additionally, they should prioritise hiring graduates with strong academic performance, computer skills, and soft skills, and focus on retaining talent by providing opportunities for growth and development. Furthermore, they should embrace diversity and inclusion by providing equal opportunities for employment and development, regardless of gender or language proficiency. Lastly, collaboration with educational institutions is also crucial, this will help to develop curricula that align with industry needs and provide students with practical experience and job opportunities. By implementing these strategies, the agricultural sector and farm managers can enhance employability, productivity, and competitiveness in the 4IR era.

Conclusion

This study aimed to investigate the perceived factors influencing the employability of agricultural graduates in SA. The findings of this study support the importance of skills such as computer skills, multilingual skills, and soft skills in the 4IR era, which validates the relevance of the 4IR skills framework in the agricultural sector in South Africa. This study further highlights the significance of employability skills such as hard skills, soft skills, and academic performance, in the 4IR era, which emphasises the need for agricultural graduates to possess a variety of skills

to remain competitive in the agricultural industry. In addition, the study reveals the importance of collaboration between industry stakeholders and educational institutions to ensure that agricultural graduates are equipped with the necessary skills to meet industry demands for them to remain competitive.

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Authors' contributions

T.M.S. and O.A.S. conceptualised the study; T.M.S. and A.N. constructed the methodology; O.A.S. conducted the formal analysis; O.A.S. and A.N. wrote and prepared the original draft. A.N. and O.A.S. wrote, reviewed and edited the manuscript. All authors have read and agreed to the published version of the manuscript.

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Data availability

The data that support the findings of this study are available from the corresponding author, T.M.S. upon reasonable request.

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