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How Students' Gender and Age Group Affect the Confidence-Competence Measures related to Work Integrating Learning (WIL) of Engineering Placement Students in an Australian University

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ABSTRACT

CONTEXT

This study explores how gender and age group shape the perception and performance of engineering placement students; through the use of the confidence-competence measures. These measures are based upon innovation, employability, transferable and technical skills development of an engineering undergraduate WIL program cohort in an Australian University. Our research will examine students' experience of 'open-ended real-world projects' in the context of developing healthy confidence-competence self-evaluation and reflection.

PURPOSE OR GOAL

Despite the importance of innovation, employability and technical/transferable skills development; very limited effort has been spent on the self-perception and self-preservation of students undertaking the WIL placement (thus experiencing a dramatic change in their work environment.) This study will try to address the following research question: What are the key factors that influence students' skills development (stemming from an industry-based project) that contributes to the development of healthy confidence and competence from the perspective of students' gender and age group?

APPROACH OR METHODOLOGY/METHODS

Students have been asked to complete a questionnaire that stems from Jackson's (2013) framework, which represents industry skill requirements in new graduates. The framework has been expended by introducing additional skill dimensions related to employability, innovation and enterprise broadening an already established measuring tool. On a scale of zero to ten, participants rated the level which best describes their ability to perform each skill in the workplace environment (ranging from experiences at the beginning, middle and after their work placement.) Using the dyadic perspective, the information requested will identify key factors that are underpinning the students' confidence-competence measures (with an emphasis on the students' gender and age group.)

ACTUAL OR ANTICIPATED OUTCOMES

This study brings more insight into how students' gender and age group impact the students' ability to meaningfully develop the capacity to work creatively, innovatively and harmoniously with their working environment (as well as within themselves.) It also provides a reflection of the different skills development in the different stages of their placements; uncovering possible perceptive shifts in the students' abilities to perform proper self-skills assessment and reflect upon its findings.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The proposed research is significant as it contributes equally to the research literature in: (a) education and (b) innovation/employability/self-perception (particularly related to engineering education and work-integrated learning.)

KEYWORDS

Age, Confidence, Competence, Gender, Reflective Practice, Work Integrating Learning (WIL)

Introduction

It is a known fact that the insight into the self-perception and self-preservation of engineering placement students (as well as the most recent graduates) has been very limitedly explored. However, the recognition and importance of their obtained transferable/technical skills development was widely acknowledged equally by academics and industry leaders/employers (Khoo et al, 2020.)

Using the 'open-ended real-world project approach (as a part of Flinders University Engineering Placement Program) our engineering placement students have been exposed to a sudden change in their learning environment (from in-class/online university-based learning to the real-life industry-based project-driven experience.) The aim is always the same, which is to shift their student perspective from 'engineering student' to a 'student engineer' within just twenty weeks. In order to achieve such a dramatic shift, we embedded detailed pre-practicum preparation and project management-based curriculum that satisfies equally our student cohort and industry-based providers. Although some pilot exploration of the gender inclusivity of engineering placement students has been done by Male and MacNish (2020) using the qualitative data analysis on a very small data sample (less than ten due to the nature of used approach) our work (in contrast) is based on the quantitative data analysis of a much larger data sample. We will explore how students' gender and age group affect the confidence-competence measures related to work integrating learning (WIL) of engineering placement students.

Background and Motivation

The insight into the self-perception and self-preservation of engineering placement students (alongside the most recent graduates) has been very limitedly explored. However, the recognition and importance of their obtained transferable/technical skills development was widely acknowledged equally by academics and industry leaders/employers (Khoo et al, 2020.)

This study uses the transferable skills framework developed by (Jackson, 2013) of which its aim was to broadly recognize typical industry skills/measures in new graduates. This measuring tool was further expanded by Rampersad and Zivotic-Kukolj (2018) and Zivotic-Kukolj, Randhawa and Asgari (2022), by introducing additional skill dimensions related to employability, innovation and enterprise. Such upgraded framework is then used to measure how the self-applied assessment tool can influence a positive perception of students' placement experience and develop healthy-realistic confidence built upon set-up skill-based competencies.

The adequate visual tool called 'the confidence – competence grid' developed by Chamorro-Premuzic (2013) is presented in Figure 1 below, and has been introduced to solve confidence-competence paradigm of the student self-perception.

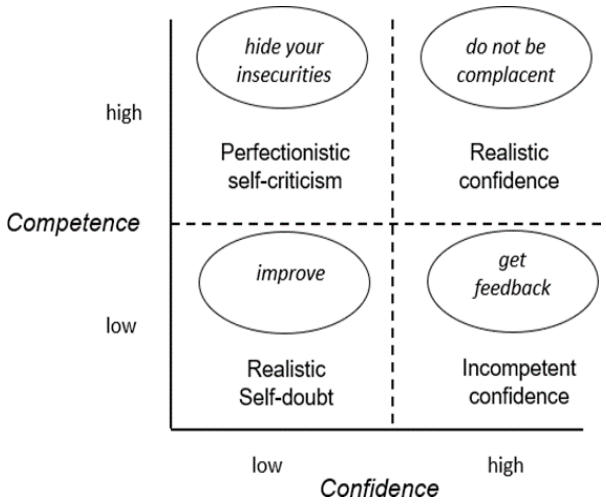


Figure 2: The Confidence – Competence Grid by Chamorro-Premuzic (2013)

Provision of understanding of ‘the confidence – competence grid’ is based on the most common misconception that the key to success in life and business is confidence only. Chamorro-Premuzic challenges this misconception explaining - ‘Confidence is feeling capable,’ while ‘Competence is being capable.’ He rightfully points out that successful people are confident because of their skills and competencies that they can use and demonstrate (not the other way around.) Figure 1 shows that there are four possible confidence-competence categories that could be considered as a measure of confidence: Incompetent confidence, Realistic self-doubt, Perfectionistic self-criticism and Realistic Competence. Each of them occupies a different quadrant in the confidence-competence grid. The following paragraph provides descriptions for each of these categories (as well as the author’s interpretation and instructions on how to use the confidence-competence grid tool.)

The first and most dangerous category is the ‘Incompetent confidence’ (related to high confidence, low competence) which is a product of delusional self-serving biases (rather than actual competence.) People in this category could be dangerous for themselves as well as for others, due to their lack of skills/abilities to perform. The best advice in this situation is for them to seek proper feedback from professionals in the field to change their self-perception. The second category is the ‘Realistic self-doubt’ (related to low confidence and low competence) – when the person is aware of a lack of skills and competencies (therefore feeling insecure.) This awareness results in an increase of motivation to self-improve and is an important stage in the development of required skills and competencies. The third category is the ‘Perfectionistic self-criticism related to low confidence and high competence,’ when an individual (despite high levels of accomplishment) still does not feel “good enough.” This is the characteristic of an individual with perfectionistic tendencies combined with low self-esteem. The only way to deal with such confidence is to hide insecurities and continue to improve skills and competencies. The fourth and final category is the ‘Realistic Competence related to high confidence and high competence.’ This is the quadrant where the person possesses a balance between competencies and confidence. This is where we would like to see our students to be at the end of their placement experience. The only thing that should be considered for a person in this category is that they should not become complacent and still maintain a desire to grow their skills and competencies.

As educators, we are obligated to help our students to become aware of their level of self-confidence and competence by using this tool; thus enabling them to be better emotionally prepared once they leave the educational institution and become a part of the engineering workforce.

Method

This quantitative study involved data collection (using the online Qualtrics survey tool.) It required students to complete a questionnaire on their perceived experience of the specific skills presented in Table 1 (under measures/items.) The survey was conducted across the 3rd year undergraduate student cohort enrolled in the civil, biomedical, electrical and electronic, mechanical and robotics – Flinders University engineering cohorts in twenty weeks of the placement over the last four years (from July 2019 to July 2023.) The survey questionnaire was completed before the placement commencement, in the middle of the placement (week 10) and at the end of placement (week 20). This questionnaire was designed to track each student’s performance (related to educational experiences) in order to determine the possible impact on the confidence-competence level. This questionnaire (as presented in Table 1) was based on multi-item, 11-point Likert scale to not only be an investigation instrument, but also as an assessment tool. Participants rated the level which best described their perception of the specific measures and items used in the survey. Of the 275 participating engineering students enrolled across two placement topics (from July 2019 to July 2023) 211 were male and 54 were female. The age of students ranged from 19-21 years (92), 22-25 years (122) and 26+ years (61).

Questionnaire

Instructions: Please highlight your answer on a scale of 0-10 (for items related to transferable skills competencies: 0=not competent at all,10=highly competent, 5=neither competent nor incompetent; for items related to self-confidence 0=not confident at all and 10=highly confident, 5=neither confident nor unconfident; for the employability skill item 0=not employable at all and 10=highly employable, 5=neither unemployable nor employable) concerning your self-perception about the presented skill statement.

Table 1: Questionnaire Measures and Item Definitions

Measure	Item Definition
TEAMWORK	***Task collaboration**: Complete group tasks through collaborative communication, problem solving, discussion and planning.*
	***Team working**: Operate within and contribute to a respectful, supportive and cooperative group climate.*
	***Social intelligence**: Acknowledge the complex emotions and viewpoints of others and respond sensitively and appropriately.*
	***Cultural and diversity awareness**: Work productively with people from diverse cultures, races, ages, gender, religion and lifestyles.*
	***Influencing others**: Defend and assert rights, interests and needs and convince others of the validity of one's point of view.*
	***Conflict resolution**: Address and resolve contentious issues with key stakeholders.*
COMMUNICATION	***Verbal communication**: Communicate orally in a clear and sensitive manner which is appropriately varied according to different audiences and seniority levels.*
	***Giving and receiving feedback**: Give and receive feedback appropriately and constructively.*
	***Public speaking**: Speak publicly and adjust style according to the nature of the audience.*
	***Meeting participation**: Participate constructively in meetings.*
	***Written communication**: Present knowledge, in a range of written formats in a professional, structured and clear manner.*
CRITICAL THINKING	***Conceptualization**: Recognize patterns in detailed documents and scenarios to understand the 'bigger' picture.*
	***Evaluation**: Recognize, evaluate and retain key points in a range of documents and scenarios.*
PROBLEM SOLVING	***Reasoning**: Use rational and logical reasoning to deduce appropriate and well-reasoned conclusions.*
	***Analysing and diagnosing**: Analyse facts and circumstances and ask the right questions to diagnose problems.*
	***Decision making**: Make appropriate and timely decisions in light of available information in sensitive and complex situations.*
PROFESSIONALISM	***Efficiency**: Achieve prescribed goals and outcomes in a timely and resourceful manner.*
	***Multi-tasking**: Perform more than one task at the same time.*
	***Autonomy**: Complete tasks in a self-directed manner in the absence of supervision.*
	***Quality of work**: Complete work to a high-quality standard aligned to expectations.*
	***Time management**: Manage time to achieve agreed goals.*
	***Commercial awareness**: Aware of commercial viability or cost considerations.*

	***Drive**: Go beyond the call of duty by pitching in, including undertaking menial tasks, as required by the business.*
	***Goal and task management**: Set, maintain and consistently act upon achievable goals, prioritized tasks, plans and realistic schedules.*
INNOVATION AND ENTERPRISE	***Innovation**: Contribute towards the development of new products, services and/or technologies (e.g., software, applications, devices).*
	***Entrepreneurship/Intrapreneurship**: Initiate change and add value by embracing new ideas and showing ingenuity and creativity in addressing challenges and problems.*
	***Lateral thinking/creativity**: Develop a range of solutions using lateral and creative thinking.*
EMPLOYABILITY	*I believe that I am employable.*
SELF-AWARENESS	***Meta-cognition**: Reflect on and evaluate personal practices, strengths and weaknesses in the workplace.*
	***Lifelong learning**: Actively seek, monitor and manage knowledge and sustainable opportunities for learning in the context of employment and life.*
	***Career management**: Develop meaningful and realistic career goals and pathways for achieving them in light of labor market conditions.*
SELF-MANAGEMENT	***Self-efficacy**: Be self-confident in dealing with the challenges that employment and life present.*
	***Stress tolerance**: Persevere and retain effectiveness of well-being and strive to maintain a productive balance of work and life.*
	***Self-regulation**: Reflect on and regulate emotions and demonstrate self-control.*
SOCIAL RESPOSIBILITIES & ACCOUNTABILITY	***Social responsibility**: Behave in a manner which is sustainable and socially responsible (e.g. consistent with company policy and/or broader community values).*
	***Accountability**: Accept responsibility for own decisions, actions and work outcomes.*
	***Personal ethics**: Remain consistently committed to and guided by core values and beliefs such as honesty and integrity.*
	***Organizational awareness**: Recognize organizational structure, operations, culture, systems and adapt behavior and attitudes accordingly.*
SELF-CONFIDENCE (TRANSFERABLE SKILL)	*How good you think you are?*

Please note that the transferable skills competencies and self-confidence (under the development of transferable and technical skills) were measured separately. Also be aware, that online sources treat the technical skills as one of the transferable skills. However, by definition the transferable (also known as a soft skills) are the skills that are learnt through experiences in any type of job and are later applicable/transferable in the any other type of job (irrespectively of job description needs associated to the specific area of expertise.) On the other hand, the technical skills are the skills obtained from the specific educational pathway – requiring specific educational training. They are part of the extremely strict accreditation requirements usually set up by the specific professional

body or association (such as Engineers Australia). They include specific technical knowledge and expertise that are of completely different nature compared to the standard transferable (soft) skills.

It is Important that we provide an in-depth explanation of each skill and sub-skill of Jackson's extended framework during the Pre-placement Preparation topic and introduce an Excel Tool that enables each individual student to produce his/her own transferable skills spider diagram (based on the survey responses before, in the middle and after the placement.) The students would then insert the obtained spider diagrams into the closing section of their final placement reports and reflect upon it. This is how the survey data was integrated into the final placement assessment piece. As the weighting of the reflection was only 7 out of 35 total final report mark, the benefit of teaching students the transferable skills framework was far more beneficial than a possible bias related to data collection. Please note that the total score across all assessments in the topic was 100.

Results

Figure 2 presents the employability, innovation and transferable skills outcome of the survey per measure on the scale from 0 to 10 in relation to gender diversity. It is worth mentioning, that in the survey (under the gender item) there are three possible options to choose: male, female and other. So far there was no response other reported, however it does not mean that in the future students will not choose it.

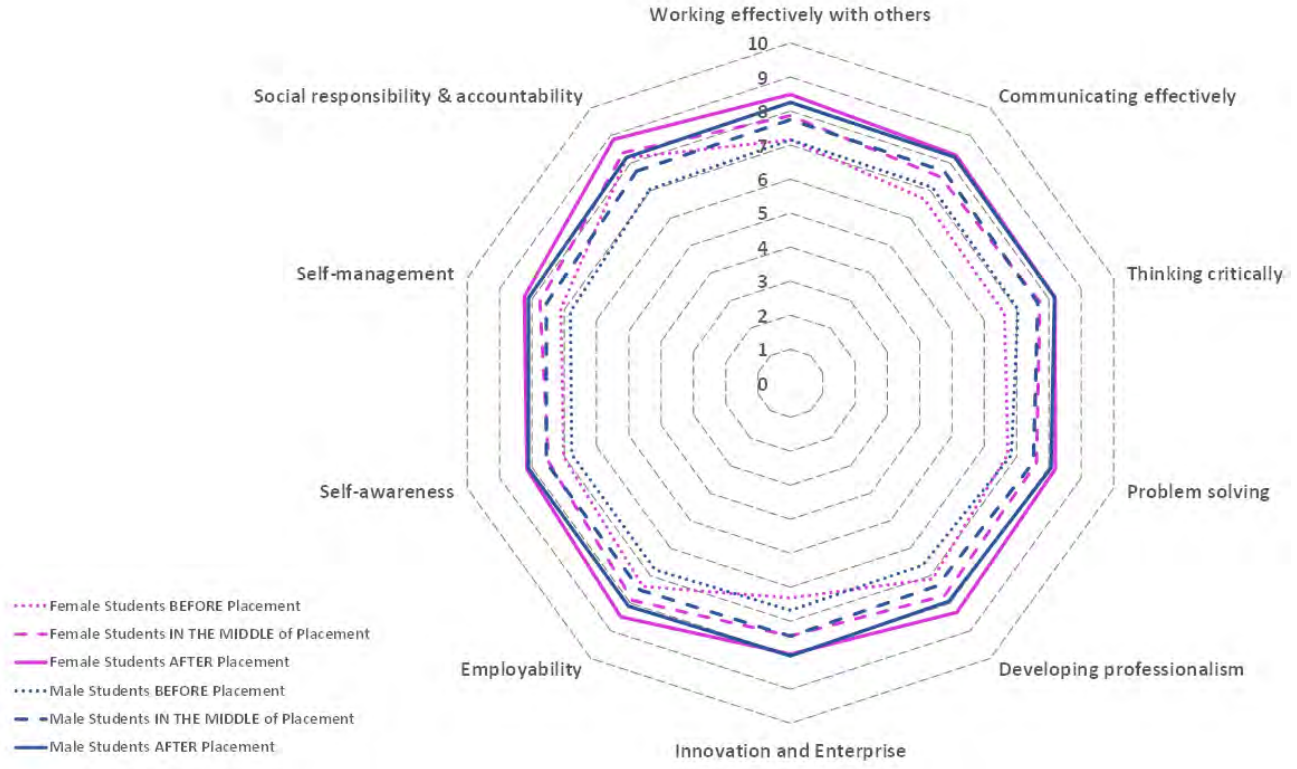
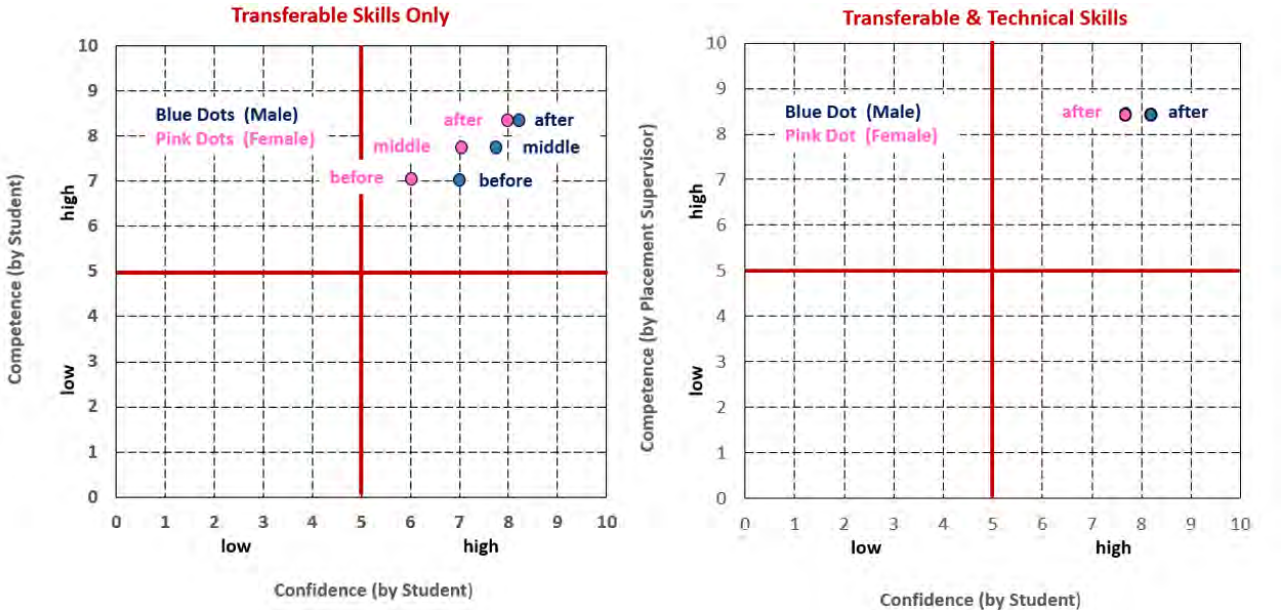


Figure 2: Employability, Innovation and Transferable Skills Development Average Score Results across whole engineering student cohort related to gender diversity

Figure 2 revels that female students obtain a marginally better result at the end of their placement experience compared to their male counterparts (especially in relation to social responsibility, accountability, employability, developing professionalism and working effectively with others.) Although males and females were even when we talk about innovation and enterprise, it was in a way a surprising outcome (due to fact that 75-80% of engineering leaders in real life are males.) It is also interesting that both groups perceive gain in the skills scoring at the end of the placement process. Male patterns of skills development before, in the middle and at the end of the placement program look far more even. However, the highest skill gain in females during and after the placement program was surprisingly achieved in the innovation and enterprise. Females have marginally better scoring when it comes to social responsibility and accountability (probably due to imposed social expectations and nurturing style of their gender upbringing.)

Figure 3 a) presents an average scoring across 275 engineering students related to the confidence-competence grid (before, in the middle and at the end of the placement) and in relation to the transferable skills development (on the same scale from 0-10) used in the questionnaire performing gender analysis. It is apparent that both the confidence and the competence have increased almost linearly as the placement process progresses from the start to the end (both for male and female cohorts.) Although both groups scored very close on the competence scale, male group experienced higher level of confidence (especially before and in the middle of the placement experience.) However, at the end both groups scored almost identical confidence competence scores.

In Figure 3 b) confidence related to both transferable and technical skills (perceived by students) has been examined against the competence level (judged by placement supervisors.) The placement supervisors' marks were recorded and used as a measure of competencies across both technical and transferable skills and were converted into a 0-10 scale. Both groups' average results were then determined. The same pattern is found again. Male group scored higher on confidence scale, while the female group reached the same level of competencies.



a) b)

Figure 3: The Confidence - Competence Grid (gender analysis) calculated across the whole engineering student cohort.

Table 2: Confidence versus competence results related to age group analysis

Confidence (Student) versus Competence (Student)				Confidence (Student) versus Competence (Placement Supervisor)
Age 19-21	***Before***	***In the middle***	***At the end***	***At the end***
Confidence	7.65	7.63	8.07	8.07
Competence	7.67	7.67	8.19	8.24
Age 22-25	***Before***	***In the middle***	***At the end***	***At the end***
Confidence	7.00	7.67	8.08	8.08
Competence	7.71	7.69	8.20	8.21
Age 26+	***Before***	***In the middle***	***At the end***	***At the end***
Confidence	8.00	7.75	7.88	7.88
Competence	7.76	7.71	7.96	8.32

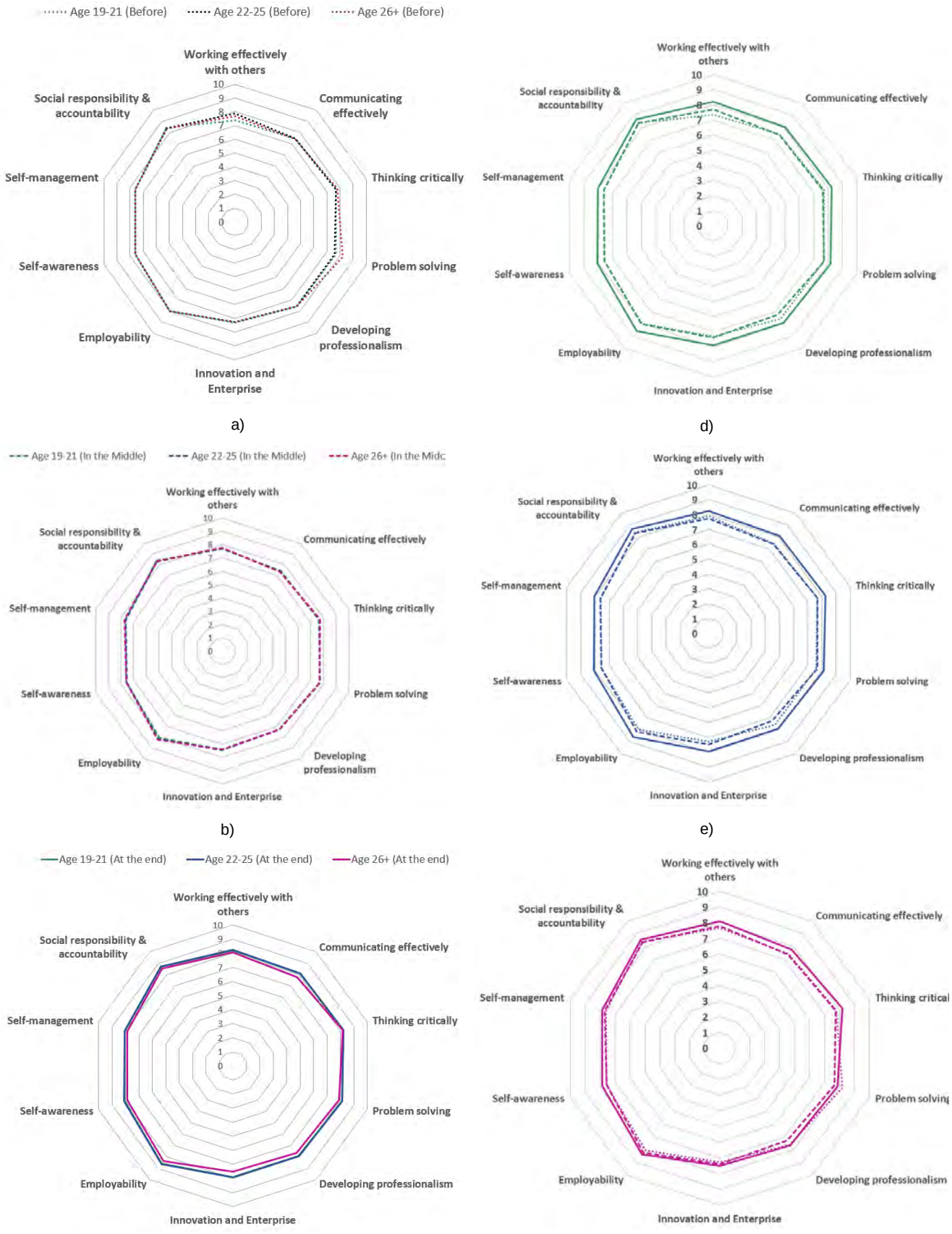


Figure 4: Employability, Innovation and Transferable Skills Development Average Score Results across whole engineering student cohort related to different students' age groups

Figure 4 presents the employability, innovation and transferable skills outcome of the survey per measure (on the scale from 0 to 10) related to students' age groups. There are three distinctive age groups: 19-21, 22-25 and 26+. Figures 4a), 4b) and 4c) explore differences between different age groups before, in the middle and at the end of the placement program. Figures 4d), 4e) and 4f) bring insight into how the specific group of skills was developing for 19-21, 22-25 and 26+ age group respectively. The comparison of the results for each individual age group reveals that all three age groups overestimated the specific set of skills before the placement. For example, the 19-21 overestimated developing professionalism, while the 22-25 were overconfident in working effectively with others and developing professionalism. Interestingly, the 26+ overestimated the problem-solving skills. The results for all three age groups reveals that the 26+ group scored marginally lower across all skills in comparison to the 18-21 and the 22-25 age groups at the end of the placement process (while all three groups were even in the middle of the placement process.)

Table 2 summarises results related to the competence versus competence grid in (relation to age group) analysis. Overall, the result shows that the confidence gained by the students at the end of the placement process is slightly lower than the scoring of measured competence assessed by the placement supervisor. Interestingly, the 26+ group seems more critical and less confident about its performance compared to the 19-21 and the 22-25 age groups at the end of the placement program.

Findings/Benefits

The proposed research is significant, as it contributes equally to the research literature in: (a) education and (b) innovation/employability/self-perception. Additionally, qualitative data responses have confirmed that the learning process resulted in an overall development of the transferable, innovative, and technical skills (as well as contributing to the realistic healthy self-perception/confidence development.)

Future Work

It would be interesting to investigate how the obtained results defer across different types and sizes of placement organizations. Due to current sample size the longitudinal data collection needs to continue so that we can perform in the future Confirmatory Factor Analysis using software like AMOS.

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