Asia Pacific Science Press

Critical Humanistic Social Theory
ISSN(O):3005-9291
ISSN(P):3005-9283
Vol. 3 No.3 (2026)

From Traditional Engineering to AI Driven Energy Systems: Professional Identity Transformation among Oil and Gas Engineering Students

Chenyu Wu[1], Zhiyu Xue[2], Shenghao Zhang[3], Bo Gao[1], Naixin Hou[1], Gaoshan Wu[2]*

1. Xi'an Shiyou University, Xi'an, Shaanxi, 710065, China
2. Macau University of Science and Technology (MUST), Macau, 999078, China
3. City University of Hong Kong (Dongguan), Dongguan, Guangdong, 523808, China

Corresponding author: Gaoshan Wu, 963417627@qq.com

Abstract: This research paper aims to analyze the perception of oil and gas engineering students about the transformation of their engineering education into artificial intelligence-enabled energy systems and the influence of this change on the development of professional identity, competency awareness, and career prospects of students. The findings are based on the analysis of semi-structured interviews with 12 participants and show that AI is considered an additional element to existing knowledge, which forms hybrid professional identity but generates competency anxiety.

Keywords: AI-Enabled Energy Systems; Professional Identity; Competency Awareness; Oil and Gas Engineering; Thematic
Published: Sep 10, 2026
DOI: https://doi.org/10.62177/chst.v3i3.1649

1. Introduction

Currently, the energy industry is witnessing a radical change as artifi cial intelligence is incorporated into all aspects of energy exploration, extraction, storage, transmission, safety monitoring, and optimization. While engineering education in oil and gas storage and transportation has always focused on such aspects of the energy sector as pipe design, fluid mechanics, storage facilities, transport systems, safety, and technical reliability, the growing prevalence of AI-driven energy systems is altering what energy professionals of tomorrow should know and do. Specifi cally, smart monitoring technologies, predictive maintenance, risk forecasting, digital twin, automated inspection, and data-based decision-making processes are redefi ning knowledge boundaries of the field, which means that oil and gas engineering graduates need to be prepared not only to solve technical problems but to combine knowledge and skills from various areas, be competent in dealing with data, and be capable of thinking about their future roles in terms of such concepts as smart energy and digital energy management. Although several scholarly works have already examined artificial intelligence applied to energy systems as well as the possibilities created by intelligent engineering, much fewer have considered students' perceptions of this shift from a disciplinary standpoint. In particular, there is a lack of qualitative studies of how oil and gas engineering students experience professional transformation from traditional education in engineering disciplines to AI-driven energy sector. This research gap is essential for at least two reasons. First, professional change takes place through more than just technological innovation: future professionals' perceptions of their disciplines, self-evaluation practices, and professional identities are crucial here.

Second, the role played by AI in energy sector transformation implies that future engineers' understanding of their future profession will play an important role in this transformation process.

Having this in view, the current research examines the knowledge of oil and gas engineering students about the transformation from traditional engineering to that related to the use of artificial intelligence driven energy systems and its effect on their formation of professional identity, competence awareness, and career goals. Using the Professional Identity Formation Theory, the research views the engineering students not just as recipients of knowledge and skills but as agents in constructing their own understanding of the profession, competences, and role in the future. Such a theory can be used in the study since the introduction of AI driven energy systems would require rethinking the value of their education, recognition of new competences, and reconstruction of the position within the innovative context. Research Questions In order to accomplish the outlined research objective, this study will investigate the following two questions: RQ1 How do oil and gas engineering students perceive the change from traditional engineering to AI driven energy systems? RQ2 What is the effect of such a change on their professional identity, competence awareness, and career aspirations? Methodology The proposed methodology for this research implies using a qualitative research design based on semi-structured interviews. The chosen method appears to be adequate for the present research due to its primary focus on perception, interpretation, and subjective experience of the respondents. More precisely, through interviews the participants can provide explanations of their interpretation of AI driven energy systems in the context of oil and gas engineering and its significance for their current studies; reveal their opinions about their current education; and explain what competencies they associate with their future AI based job and the corresponding future career paths.

2. Literature Review

2.1 Understanding the Shift from Traditional Engineering to AI Driven Energy Systems

Previous empirical findings on engineering education and energy transformation indicate that there is a growing recognition of the need for a shift from traditional energy-related systems towards those relying on the principles of intelligence, data, and digitization [1]. Studies related to AI technologies in oil and gas operations have addressed topics like AI applications in pipeline monitoring, leak detection, predictive maintenance, reservoir management, storage optimization, safety inspections, and risk prediction [2]. The research demonstrates that AI technology should be understood not merely as an exogenous technology, but also in relation to the reconfiguration of engineering energy systems, where engineering judgment gets integrated into data analytics, automation, prediction algorithms, and decision-making processes [3]. On the other hand, research on engineering education has indicated that the existing approach in engineering training needs to be retained due to the necessity of providing engineering students with disciplinary knowledge like fluid dynamics, thermodynamics, pipeline design, storage safety, materials science, transportation, and risk management [4]. Thus, AI-driven energy systems are not supposed to replace the traditional engineering training, but rather to require a combination of knowledge acquired during it with modern computational approaches [5]. Yet, the existing literature on the issue of interest seems to focus on topics like technological implications, curricular reform, and industry-wide digitalization. There has been little qualitative research concerning the views of oil and gas engineering students regarding their future profession under conditions of digitalization and AI revolution [6]. The problem is that the adoption of AI technologies in the energy sector represents both a technological process and a process of interpretation, according to which students construct their knowledge and perceptions of what they expect from their future career. In accordance with the professional identity formation theory, the views of engineering students regarding the transition towards AI technology should be considered within the scope of their professional identity formation [7]. Students build their professional identity through the interpretation of educational experience, disciplinary expectations, occupational possibilities, and future role models. That is why RQ1 will be concerned with understanding how oil and gas engineering students interpret the shift from traditional engineering to AI-driven energy systems. Such a research question will enable the exploration of the phenomenon under consideration at the individual level of analysis and provide deeper insights into the interpretive aspects of students' perceptions.

2.2 Professional Identity, Competency Awareness, and Career Aspirations in an AI Driven Energy Future

The previous literature on professional identity development among engineering students revealed several factors influencing the formation of their perception of becoming engineers, such as disciplinary learning, vocational training, peer competition, institution, interning, and career imaginations [8]. Oil and gas engineering students not only learn technical knowledge; at the same time, they start building beliefs about what type of professional they become and what types of competencies are recognized and appreciated [9]. Professional identity research emphasizes the role of the periods of technological and industrial change when students may face a need to reevaluate their concepts of professional capabilities and career belongingness [10]. As regards artificial intelligence, recent research suggests that the future engineers are required to build up hybrid professional competencies that include domain knowledge, data literacy, computational thinking skills, multidisciplinary communication, and ethical awareness [11]. The problem arising from this expectation is twofold for the students of energy-related programs: first, they may feel motivated because AI allows them to expand their career vision to such spheres as smart energy system, digital energy management, intelligent infrastructure, and technology-driven innovations [12]; second, they may be subject to competency anxiety since they may realize that their previous training was not sufficient for acquiring such important competencies as programming, machine learning, data analysis, and artificial intelligence-based decision making [13]. Although there are many existing studies on employability, digital skills, and adaptation of engineering curricula to new realities, they generally consider students as future workers who should gain new competencies. Little attention is paid to students as emerging professionals who should reconsider their identity in view of changing expectations of industry and employers [14]. That is why there is a shortage of data about how energy engineering students view the influence of AI on the development of their professional identity, strengths and weaknesses, and future career opportunities in the new combination of traditional energy jobs and technological innovations. This is what RQ2 attempts to discover about the impact of the transition to the AI-based energy on the students' professional identity, competency awareness, and career expectations. Professional Identity Formation Theory is a good way to answer the above-mentioned research question because it enables to analyze how new professionals build their identity based on their prior education, current experience, and future career opportunities. According to Professional Identity Formation Theory, competency awareness is more than a list of skills possessed by the student and not possessed by him/her. It is an integral part of the student's identity because he/she decides whether he/she is still an oil and gas engineer, what kind of energy professional he/she will become in the future, and what position he/she occupies in the new environment.

3. Methodology

3.1 Research Design

The research is carried out within a qualitative research design based on semi structured interviews and thematic analysis. This design of the research is appropriate for the given topic because the current research deals with the issue of transition from traditional engineering to intelligent energy. Thus, the topic involves the need to analyze the way in which students perceive the phenomenon of transition in terms of their personal identity transition, self-perception of their competencies, and their expectations related to their future career. This type of research cannot be conducted using quantitative approaches as these phenomena are subjective perceptions, meanings, and experiences that students gain throughout their education process and in the context of future identity formation. Thus, semi-structured interviews are appropriate for conducting the current study. Firstly, the interviewer has a set of questions to conduct interviews. Secondly, all students will be interviewed concerning certain aspects such as students' perception of the AI and its usage in the oil and gas industry; students' perception of studying at the oil and gas engineering school; self-perception of their competency gaps in terms of using AI technologies; students' expectations concerning their future career in the sphere of AI implementation in the oil and gas industry. Thirdly, the researcher can use the opportunity to ask additional questions related to unexpected findings during the process of interviewing. It is important for the current study as the Professional Identity Formation Theory is applied in the research process. Indeed, the formation of students' professional identity involves the complicated processes of meaning-making, comparison with others, aspiration to become professionals of certain type, and negotiations among students themselves. As a result, thematic analysis will be used for analyzing interviews. It will allow finding the patterns common to students' experiences and, at the same time, respecting their diversity. Thematic analysis makes it possible to find codes, subthemes,

and themes inductively while paying attention to specific theoretical perspective of the study.

3.2 Data Selection and Collection

In the current research, a sample of 12 participants – oil and gas engineering students, will be recruited. It is decided to employ purposive sampling technique in the study as it would be important to select participants whose personal accounts can be information rich. They should possess particular attributes. First, they have to be undergraduate students pursuing degree in oil and gas storage and transportation engineering or at least a related one such as oil and gas engineering in general. The reason behind the choice of the target sample population lies in its specific expertise. Students have to receive formal education in traditional energy engineering discipline, which includes knowledge on pipelines transportation and storage, safety management and engineering operations. Moreover, they should have an interest in artificial intelligence, digital energy, intelligent engineering or interdisciplinary postgraduate study. The criterion is crucial as the research targets only those students who are able to make sense of the transformation into AI based energy systems, and, therefore, their peers from other engineering disciplines who do not know about the development are excluded from the study. Finally, participants need to have the ability to reflect on their experience, perceived competence, and career plans for the future. The targeted sample will comprise several students whose demographic features will vary in terms of gender, academic year, internship experience, AI familiarity, and intention to apply for postgraduates. The chosen sample size can be seen as sufficient for qualitative inquiry since statistical generalization is not needed. The aim of the research is not associated with the necessity to prove certain findings but it is oriented towards developing insights on meaning making and professional identity formation. When it comes to semi-structured interviews, the number of participants can be small provided they are selected properly and the interviews reveal enough rich, detailed and relevant data. The adequate number of participants will be verified with the help of information saturation. It can be reached if recurring patterns emerge in students' perceptions of artificial intelligence, gaps in their competencies, and the career they see for themselves. Further interviews will confirm already discovered categories and, therefore, 12 participants will be sufficient for obtaining answers to two research questions.

3.3 Semi Structured Interview Data Collection

The data will be collected using offline one to one semi-structured interviews conducted during January to April 2026. Offline interviews are preferred because they help the researcher to establish a rapport with the participant, make observations, and have an exclusive conversation focusing on the participant's personal experience with learning in this discipline and career plans in the future. In addition, participants will be informed about the aim of the research, their rights regarding participating in the research, the length of the interview, and the way their data will be used prior to the interview. Informed written consent will be obtained before each interview. In addition, it will be made clear that refusal to answer certain questions or withdrawal from the study is also an option for the participant. Each interview will take place within 40-60 minutes, and the interview will be held in a quiet location either in the university campus or an offline location that is agreed upon with the participant. The participants will be asked if the interviewer could record the interview with their permission. Moreover, field notes will be recorded right after each interview in order to note context information, impressions, and potential follow-up questions. In terms of questions to be asked in the interviews, they will be arranged according to some themes. First, there will be some questions about the undergraduate education received in the area of oil and gas engineering and the knowledge base of the discipline. Then, it will be asked whether the participants are aware of any developments in the area of AI-driven energy systems such as intelligent monitoring, predictive maintenance, digital twins, risk forecasting, and data-based energy management. Furthermore, questions will be raised about what the participants think regarding the link between oil and gas engineering and AI technology. Finally, there will be questions about their professional identity, strengths and weaknesses, competency needs related to AI, postgraduate plans, and future career ambitions. If at all the participants raise some areas in need of further exploration through the interviews, like programming fear or anxiety, level of confidence in engineering fundamentals, and concerns with employment opportunities, then follow-up questions will be asked. The interview process will be followed by transcription of the audio records.

3.4 Data Analysis and Thematic Development

The data obtained from the interviews was analyzed using thematic analysis in a clear and systematic manner. The initial

phase in this kind of analysis involved repeatedly reading the interview transcript and gaining an understanding of the participants' views as well as developing some initial patterns concerning the research questions that the analysis addresses. In this phase, brief analytic notes were taken where some of the ideas expressed by the participants were noted together with any surprises as well as potential connections with the theory of professional identity formation. Another phase involved inductive coding where codes are created in meaningful data segments such as the students' understandings of how traditional engineering is changing to be AI driven energy systems, their evaluation of their competencies as well as future imagination of their professional identities. For example, the codes "AI as engineering enhancement" were created from statements explaining how AI makes monitoring of pipelines easier. Codes such as "AI competency anxiety" were created from comments such as gaps in programming and machine learning capabilities. Codes that show similarities were then compared and clustered to form sub-themes. A sub-theme was considered valid if it had been mentioned by different participants and had some interpretive depth rather than an isolated statement. Examples of codes such as "traditional engineering remains useful," "pipeline knowledge as foundation" and "domain knowledge advantage" were then placed into the sub-theme "traditional engineering knowledge as a disciplinary anchor in intelligent energy systems." Themes are created by finding a link between the sub-themes and the research questions in order to answer them. This process results in two themes "Reinterpreting Traditional Engineering as a Foundation for AI Driven Energy Systems" and "Reconstructing Professional Identity through Competency Awareness and Future Career Imagination". The themes were validated using both supportive and contrasting cases from the interview transcripts and the themes were finally interpreted using Professional Identity Formation Theory.

4. Results

4.1 Reinterpretation of the traditional engineering as the foundation of the AI driven energy systems

Theme addresses the question of RQ1 by illustrating the perception of students about the shift to AI driven energy systems. Most of them did not see AI as a replacement of the traditional oil and gas engineering, but as an additional tool. They associate AI with monitoring, maintenance, operation, storage, and optimization processes and emphasize its dependence on engineering knowledge.

Sub theme 1: AI as an extension of the traditional engineering knowledge. The students did not perceive AI as a substitute of existing systems but as something that makes them smarter. They associated it with the operational data, risk detection, pipeline leakages, pressure detection, maintenance, warning system, and transportation. As regards pipeline safety monitoring, P1 explains the matter as follows:

"Before learning AI, my perception of the pipeline safety was that it is ensured by inspection and engineering knowledge only. But after learning about the role of AI, now I think that AI will be useful for the early detection of any abnormalities related to pressure or flow levels in pipeline systems. AI won't replace the engineering knowledge; on the contrary, it will make engineering decisions more effective and efficient. It might be difficult to evaluate the output of AI without engineering knowledge of pipeline systems."

The participant sees AI as support of judgment and improved safety decisions. P3 describes AI as follows:

"I think that the idea of AI should not be considered as an entirely new element that has to be added to the traditional oil and gas storage and distribution systems. On the contrary, AI can be perceived as a smarter brain which is added to the existing system. Pipelines, tanks, pumping stations, and all other safety measures stay the same while AI technologies may help in data analysis and problem prediction."

This reflects continuity rather than disruption: AI adds intelligence to existing systems rather than replacing traditional engineering.

Sub theme 2: Traditional engineering knowledge as a disciplinary anchor in intelligent energy systems. Participants considered oil and gas engineering expertise necessary for AI applications. They stressed that AI models and energy data must be understood through practical contexts such as pipeline design, fluid characteristics, safety, environment, and device performance. P6 stated:

"While AI can compute and predict, it does not necessarily interpret the true scenario involved in oil and gas logistics. For

instance, in case of anomalies in pressure values, it is important to determine whether the same anomaly results from faulty operation, operation modification, temperature changes, or an engineering issue. It is possible for people who only understand AI to misinterpret such scenarios when they are not conversant with oil and gas engineering."

This shows that domain knowledge was essential for interpreting AI results and avoiding incorrect decisions. P10 connected engineering knowledge with interdisciplinary study:

"At first, I felt uneasy thinking that the field of study was quite traditional compared to all the talk surrounding artificial intelligence. However, I came to see that artificial intelligence also requires application cases. Oil and gas storage and transportation are among such application cases. In addition, knowing the processes involved in engineering may be an edge when studying artificial intelligence in the energy sector."

The participant reassessed engineering knowledge as relevant for entering AI-driven energy sectors.

4.2 Reconstructing Professional Identity through Competency Awareness and Future Career Imagination

This theme answers RQ2 by showing how AI-driven energy systems affected professional identity, competency awareness, and career aspirations. Some retained a strong oil and gas engineering identity, while others imagined roles bridging engineering and AI. Many also felt inadequate in programming, data analytics, machine learning, and computational thinking.

Sub theme 1: From traditional engineering student to interdisciplinary energy professional. Participants did not abandon their traditional engineering identities.

Instead, the knowledge from engineering was complemented by energy systems and digitization, resulting in an expanded professional identity. The explanation provided by P8 was:

"In the past, whenever I mentioned my major, all I could say is that I majored in oil and gas storage and transport. I had always identified myself based on what I would do; pipelines, stations, and safety management. But with the knowledge gained in artificial intelligence, I think I will not just become an engineer but someone knowledgeable in energy and intelligent systems."

It was a development of identity rather than discarding it. For P11, the image used was that of "a bridge":

"Strengths of mine could be my ability to serve as a bridge between engineering and AI. There could be some AI students with good algorithms but no knowledge in the field of energy. On the other hand, there could be some engineers with good pipeline knowledge but poor data knowledge."

The quote reflects a mixed identity, with the participant as a bridge between engineering and AI.

Sub theme 2: Competency anxiety and career repositioning in an AI driven future. Participants saw AI-driven energy systems as an opportunity but questioned whether their training was sufficient. They recognized gaps in programming, data analysis, machine learning, and AI modeling. This produced competency anxiety and encouraged reconsideration of postgraduate study and careers. P12 explained:

"In terms of skills, I think my engineering knowledge will be helpful, but in terms of artificial intelligence skills, I'm afraid I don't have enough confidence. For instance, I do know the basic principles of pipeline transport; however, when they discuss machine learning algorithms or processing data, I can sense there remains a huge distance between me and them."

This shows competency awareness becoming part of identity construction as the participant assessed strengths and weaknesses before further study. P2 also linked AI competency with career repositioning:

"If I depend solely on my undergraduate field, then I am likely to be working in an established oil and gas corporation performing routine technological jobs. However, when I integrate my experience with AI, I will have several options available, including working in digital energy firms, smart energy operations, or conducting studies on intelligent energy. Hence, pursuing my postgraduate studies in AI is not something new but a step towards shifting my career path."

The quote shows that AI changed career aspirations without requiring participants to abandon oil and gas engineering. Further education became a way to shift career direction.

5. Discussion

5.1 Understanding the Shift from Traditional Engineering to AI Driven Energy Systems

The answers to RQ1 demonstrate that oil and gas engineering students understand the shift to AI-driven energy systems in terms of continuity instead of replacement. The students do not see any obsolescence in traditional engineering knowledge in relation to AI but rather extend engineering practice to areas like pipeline monitoring, safety prediction, equipment maintenance, storage management, and decision making. This is possible because the students interpret AI in the framework of engineering language and practical problems of oil and gas industry. The theoretical foundation that helps understand this process is Professional Identity Formation Theory, since the students associate their educational experience and disciplinary values with the future professional roles. Engineering knowledge continues to be relevant for assessing the plausibility and utility of the AI results. Therefore, the transformation driven by AI reinforces their disciplinary affiliation and encourages viewing undergraduate engineering knowledge as critical domain expertise for intelligent energy systems.

5.2 Professional Identity, Competency Awareness, and Career Aspirations in an AI Driven Energy Future

In regard to RQ2, AI-driven transformation affected students' professional identity, competency awareness, and career aspirations. Instead of leaving oil and gas engineering, many of them started to see themselves as multidisciplinary energy professionals that are able to link engineering knowledge with data analysis and digital energy. This transformation is explained by the application of Professional Identity Formation Theory that allows establishing connections between past training, current competency awareness, and future professional roles. The students continued being confident in their engineering background, but were also aware of the lack of coding, machine learning, data analysis and modeling skills, what made them feel anxious and motivated to learn more. Such perception gaps led to the reformation of career goals and resulted in consideration of smart energy platforms, intelligent operations, digital energy management, graduate AI studies, and multidisciplinary research. Identity transformation, thus, reflects hybridization rather than transition from one profession to another.

6. Conclusion

The current study investigated the perceptions of oil and gas engineering students about the transition from traditional engineering to AI-driven intelligent energy systems and its impact on professional identity, competency awareness, and career possibilities. Through interviews with 12 participants, it was found out that the students did not expect AI to replace them. Instead, they saw AI as the extension of existing engineering systems, while maintaining the importance of their disciplinary knowledge. The transition also encouraged hybrid professional identities that combine engineering expertise and data analysis in intelligent energy systems. Applying the concept of Professional Identity Formation Theory, this study proves that the AI-related transformation includes not only skill acquisition but professional identity formation as well. The contributions of this research consist in focusing on the students' perceptions and not only technology or curriculum. Limitations involve the limited number of respondents, self-reports of career aspirations and the lack of perspectives of teachers and employers.

Funding

No

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

Reference

[1] Erhueh, O. V., Nwakile, C., Akano, O. A., Esiri, A. E., & Hanson, E. (2024). Digital transformation in energy asset management: Lessons for building the future of energy infrastructure. Global Journal of Research in Science and Technology, 2(02), 010-037.

[2] Ma, J. (2023). The application of artificial intelligence technology in the safety monitoring system of oil and gas ground. Procedia Computer Science, 228, 486-493.

[3] Davidsson, P., & Sufyan, M. (2023). What does AI think of AI as an external enabler (EE) of entrepreneurship? An assessment through and of the EE framework. Journal of Business Venturing Insights, 20, e00413.

[4] Díaz Palencia, J. L. (2025). Institutional distance between academia and industry in relation to the pedagogy in a fluid mechanics course. Industry and Higher Education, 39(4), 472-481.

[5] Afridi, Y. S., Ahmad, K., & Hassan, L. (2022). Artificial intelligence based prognostic maintenance of renewable energy systems: A review of techniques, challenges, and future research directions. International Journal of Energy Research, 46(15), 21619-21642.

[6] Al-Hajri, A., Hamouda, A. M., & Abdella, G. M. (2025). Sustainability-based strategic framework for digital transformation in the oil and gas industry. IEEE Access.

[7] Sarraf-Yazdi, S., Pisupati, A., Goh, C. K., Ong, Y. T., Toh, Y. R., Goh, S. P. L., & Krishna, L. K. R. (2024). A scoping review and theory-informed conceptual model of professional identity formation in medical education. Medical Education, 58(10), 1151-1165.

[8] Wu, J., & Smith, K. N. (2026). Shaping Possible Selves: The Influence of Internships on Women's Career Paths in Computing. American Educational Research Journal, 00028312261423533.

[9] Beane, M., & Anthony, C. (2024). Inverted apprenticeship: How senior occupational members develop practical expertise and preserve their position when new technologies arrive. Organization Science, 35(2), 405-431.

[10] Ahn, Y. H., & Oh, E. Y. (2024). Effects of the international training program for enhancing intelligent capabilities through blended learning on computational thinking, artificial intelligence competencies, and core competencies for the future society in graduate students. Applied Sciences, 14(3), 991.

[11] Hu, Z., He, H., Zhang, C., & Guan, Y. (2025). Development and influencing factors of artificial intelligence literacy and computational thinking in Chinese university students. Scientific Reports, 15(1), 42708.

[12] Singh, R., Akram, S. V., Gehlot, A., Buddhi, D., Priyadarshi, N., & Twala, B. (2022). Energy system 4.0: Digitalization of the energy sector with inclination towards sustainability. Sensors, 22(17), 6619.

[13] Chang, L. C., Lin, H. R., & Lin, J. W. (2024). Learning motivation, outcomes, and anxiety in programming courses—A computational thinking–centered method. Education and Information Technologies, 29(1), 545-569.

[14] Ghanbaripour, A. N., Talebian, N., Miller, D., Tumpa, R. J., Zhang, W., Golmoradi, M., & Skitmore, M. (2024). A systematic review of the impact of emerging technologies on student learning, engagement, and employability in built environment education. Buildings, 14(9), 2769.