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Teaching professional skills for students' competitive advantage in the era of AI workplace transformation

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Abstract

The ever-changing workplace arena poses challenges and uncertainties for the workforce due to the impact of Artificial Intelligence (AI) on the human job outlook. There is rising concern that some jobs will disappear as certain tasks no longer require human involvement. According to the job outlook reports and predicted trends, the employees' competitive advantage will lie in their ability to adapt, re-skill, and master essential professional skills. To remain competitive in the job market amidst the adoption of AI, college graduates must possess transferrable skills such as interdisciplinary collaboration, professional communication, and creative problem-solving. Therefore, higher education programs need to evolve, shifting their focus from only specialized technical competencies to a broader context. By integrating interdisciplinary learning in curricula, universities can prepare multifaceted professionals equipped with the skills needed to address the complex problems the world faces today and into the future.

This paper discusses the Interdisciplinary Teaching Initiative developed and implemented at South Dakota State University. The Initiative addresses the need to prepare college graduates to effectively collaborate with individuals from diverse educational backgrounds, disciplines, cultures, and beliefs to achieve common goals or solve complex problems. The paper outlines the implemented teaching framework, curricular advancements, and best practices, as well as proposes a model for integration of AI learning into interdisciplinary pedagogy. The implications of the Interdisciplinary Pedagogy are discussed in the context of its impact on the student career readiness in the AI-dominated workplace of the future.

Introduction

The rapid advancement of artificial intelligence (AI) and its integration into workplaces have significantly transformed professional landscapes across industries. As AI continues to automate repetitive tasks and augment human decision-making, the demand for professionals equipped with unique skill sets that complement AI systems is surging [1], [2]. To maintain a competitive edge in this evolving environment, educational institutions must prepare students not only with technical knowledge but also with professional skills such as critical thinking, adaptability, creativity, collaboration, and ethical decision-making [3], [4]. These competencies are essential for thriving in AI-enhanced workplaces, where traditional roles are being redefined, and interdisciplinary approaches are becoming the norm. In light of these challenges, the role of educators is pivotal in reshaping curricula and teaching strategies to address the gaps between traditional education and the demands of AI-driven industries [5].

This paper explores the importance of teaching professional and interdisciplinary skills to students and provides recommendations for fostering these skills to ensure students' competitive advantage in an era of AI workplace transformation.

Need for professional skills

The integration of AI into workplaces has led to the automation of routine tasks, resulting in an increased focus on higher-order thinking and interpersonal skills. Research indicates that

employers now prioritize candidates who can demonstrate critical thinking, creativity, and adaptability over purely technical expertise [2], [6]. Studies also reveal that industries transitioning to AI-driven processes require employees to collaborate effectively with both humans and machines [7]. Several review papers emphasize the importance of critical thinking as a key skill for an AI-driven workplace [8]-[10]. Of all the recent publications, an article by Chiu [9] stands out, highlighting essential skills for an AI-driven workplace. These include AI literacy, which entails understanding AI's functionality, ethical risks, and applications while developing the ability to critically evaluate AI-generated content and effectively integrate AI tools into workflows. Interpersonal communication is also emphasized, as the ability to navigate hybrid digital and face-to-face environments becomes increasingly important with AI handling cognitive tasks. Adaptability is identified as a critical skill, enabling individuals to adjust swiftly to rapid technological advancements and emerging tools. Lastly, ethical awareness is underlined as vital for ensuring the responsible and thoughtful application of AI by understanding its ethical implications in professional settings.

Therefore, to stay competitive on the dynamic job market and succeed in the everchanging workplace, college graduates have to possess not only technical expertise, but also professional communication and collaboration skills in interdisciplinary settings, and proficiency in effective and efficient use of generative AI.

Background

Today, employers expect employees to work on multi/interdisciplinary teams, communicate with diverse audiences and stakeholders, and understand how the decisions they make impact society. Employers look for college graduates that are proficient in competencies that include professionalism/work ethic, oral/written communications, teamwork/collaboration, leadership, and other related skills. These professional skills ensure that employees can effectively function within the organization and immediately contribute to the organization's success [11], [12].

With the advent of AI technology, employers are also expecting employees to change how they work in the workplace. Advances in artificial intelligence promise to revolutionize creative tasks such as developing new solutions to complex problems [5]. Generative AI utilizes vast amounts of training data from multiple sources and generates new content by synthesizing the data sources it has "learned". The generative model creates new data samples based upon patterns that are discerned in the data. The patterns discerned by the model can then be used to generate content. It can take multiple forms including text, image, video, speech, music and computer code [13]. Generative AI models can be continuously updated with more recent data and events to improve their currency and accuracy [14].

Challenges for implementing professional skills in education

Implementing professional skills training in education, though essential, comes with several challenges. Educators are encouraged to redesign curricula by embedding AI literacy, ethical awareness, and adaptability as core learning outcomes [9]. Resource limitations often hinder educators from accessing the necessary training or tools to incorporate professional skills into curricula banks. In STEM fields, the focus on technical knowledge can make it difficult to balance technical and professional skills development. Additionally, traditional assessment

methods are often inadequate for evaluating complex skills like adaptability and critical thinking, highlighting the need for innovative, and perhaps even AI-compatible assessment strategies.

To address these challenges, active learning strategies, such as in-class activities, artifact-based assessments, and originality-focused evaluations, can foster hands-on engagement. Interdisciplinary teaching approaches should also be adopted to tackle complex industry problems. More and more industry problems are complex; requiring solutions that cross more than one field of knowledge. For instance, the sustainable utilization of agricultural residues requires knowledge of sustainable practices, agricultural methods, biological and environmental sciences, and economic evaluation. Complex problems, such as this, can also benefit from the student use of AI in the development of solutions, if used properly. Finally, providing professional development opportunities for educators is crucial to equip them with the skills needed to teach and assess professional competencies effectively.

Advantages and pitfalls of AI

One of the advantages of AI in complex problem solving is that it allows people without much knowledge in a discipline to incorporate that knowledge into decision-making without having an expert available. The use of AI has the potential to immensely improve solution generation [15]. However, there is a need to understand its limitations in order to capitalize on its potential.

One of the limitations of Generative AI models is the possibility of incorrect output. Because the model is based upon probabilistic algorithms, the model does not necessarily generate the correct response, only the most likely response based on the data it sampled. This can lead to misinformation. Another limitation is that the model often can be influenced by societal bias inherent in the training data [14].

AI gives limited knowledge: it generates output depending on how we ask the questions or compose the prompt to AI. Thus, a lack of effective communications skills can compromise the quality of the generated output if the question is not clearly formulated, and the prompts are not refined or elaborated. Moreover, without an expert to evaluate the generated solution, there is a danger that the solution is based on incorrect or biased information [16]. Unless the decision makers are able to critically evaluate the generated solutions, they may make costly mistakes.

Farrokhnia, Banihashem, Noroozi, and Wals [17] completed a SWOT analysis of ChatGPT – a generative AI tool which is commonly used in higher education by instructors and students. They identified the following weaknesses and threats of generative AI:

- Lack of deep understanding of the context
- Difficulty in evaluating the quality and reliability of responses
- The risk of biases and discrimination
- Lack of higher-order thinking and cognitive skills
- Inadvertent approval of plagiarism.

Thus, higher education needs to address the identified weaknesses and threats in a systematic way by incorporating the AI literacy skills in the curricula to educate students how to use generative AI effectively and avoid compromising the validity, reliability, and integrity of the

human-artificial intelligence interaction outcomes [18], [19]. Multi/interdisciplinary skills can be used to address this shortcoming. Interdisciplinary education encourages students to prepare and ask good questions and critically evaluate information from multiple sources to make sure that the solution generated is acceptable to use.

Response of higher education to the contemporary workplace challenges

Contemporary teaching practices

Educational institutions have embraced diverse strategies to equip students with professional skills. Project-based learning has been particularly effective in fostering critical thinking and problem-solving by engaging students in real-world scenarios [20]. Role-playing and simulation exercises have also been recognized for teaching ethical decision-making and adaptability [21]. Additionally, the integration of AI tools into classrooms is an emerging methodology that allows students to familiarize themselves with the technology and understand its broader implications [22], [23]. By interacting with AI-powered systems, students gain insights into the synergies between human creativity and machine intelligence [24]. Furthermore, interdisciplinary courses combining microbiology, chemistry, and engineering, etc. prepare students for collaborative roles in AI-enhanced industries.

Role of different disciplines and skills

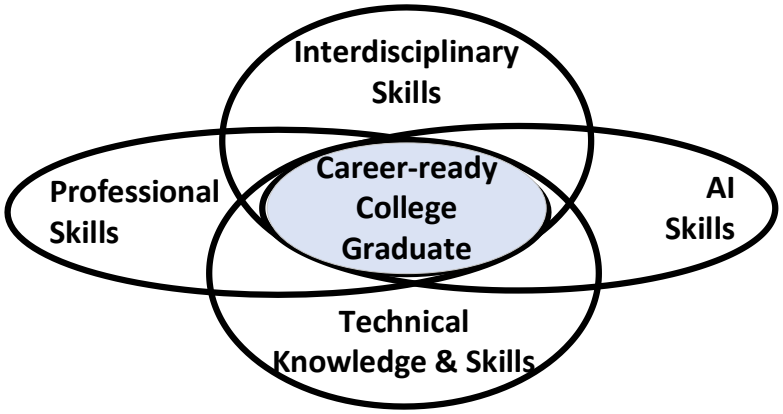
Historically, higher education institutions have successfully prepared students in their specific majors and technical fields. The technical (specialized) skills serve as a foundation for a successful career and meaningful impact of graduates in solving complex problems. Engineering expertise is necessary in contributing to solutions to most of the challenges the world faces these days. Engineering disciplines provide creative problem solving, innovative approaches, and science-based decisions. The value of specialized expertise of various disciplines, including agriculture, natural sciences, humanities, and social sciences is undeniable and serves as a prerequisite for successful collaboration finding solutions to the global challenges [25].

Many STEM, especially engineering, programs have also incorporated professional skills (communication, collaboration, critical thinking, ethics, etc.) in their curricular activities and extracurricular initiatives [12], although there is still room for improvement in facilitating development of professional skills, as reported by industry employers [26].

Moreover, it is not possible to succeed with only one skillset or subject learning. An increasingly complex global market and intense competition creates the need to solve problems that change over time which makes the solutions uncertain [27]. Complex problems such as these rarely can be solved concentrating on one discipline. They must be addressed by teams of people from multiple disciplines working together, combining their expertise, and shaping solutions that cross disciplinary boundaries. Employers are increasingly expecting employees to be able to meld their knowledge with that of other team members from diverse disciplines or other sources to develop new ways to address complex problems. Nevertheless, the multi- and interdisciplinary curricula are still in their early stages despite of the multiple approaches and pedagogies implemented in higher education programs across the United States and globally.

A new layer of complexity has recently been added with the appearance and evolvement of generative AI. Many students have started using AI for their studies, but without effective guidance and support from instructors, it is challenging for students to navigate the limitations and weaknesses of AI and to avoid the compromised low-quality outcomes, and integrity issues [28]. Since AI literacy is becoming a necessary skill in the workplace and the effective use of AI creates a competitive advantage for professionals in the job market, higher education must address the need to develop these skills in college graduates along with technical, professional, and interdisciplinary skills, as shown in Fig. 1.

Figure 1. *Skills Required for Career Readiness in the Contemporary Workplace*



A few years ago, South Dakota State University (SDSU) launched the interdisciplinary teaching initiative described in the next section of the paper to address some of the needs identified in Figure 1 for development of professional and interdisciplinary skills. Based on the identified challenges in AI use in higher education and weaknesses associated with AI, the authors are proposing a model that integrates AI into interdisciplinary pedagogy.

Interdisciplinary Teaching Initiative

Description of the interdisciplinary teaching initiative at South Dakota State University

South Dakota State University started a multi/interdisciplinary teaching initiative in 2020. The initiative started with a couple of disciplines and expanded as the faculty learned more about how the concepts and ideas enhanced education for students across disciplines. Currently, the initiative includes faculty and student participants from four colleges and eight disciplines on campus. The multi/interdisciplinary teaching models practiced include:

1) One shared multidisciplinary project for student teams from three independent courses in areas of agriculture engineering, operations management, and marketing.
2) A multidisciplinary capstone with shared capstone projects for students from the same disciplines.
3) An interdisciplinary course with students from multiple disciplines enrolled in the same course, which is team-taught by a team of faculty and is project-based in collaboration with industry sponsors.

The third model was sustained, and the interdisciplinary project experience course was offered twice at SDSU. The implemented interdisciplinary pedagogy model includes a set of shared lectures (for the entire class) on professional skills, mindset, team management, project management, the ideation process, and decision making. Most of the time in the course is dedicated to teamwork on the project facilitated by a team of faculty with relevant expertise, technical lectures on demand specific for each project, and communication with industry sponsors, including industry tours. Students complete selected homework on each shared topic and submit intermediate project reports based on the milestones schedule: project charter, project outline and proposal of methodology, a rough draft, and a final draft. Each submission is evaluated by the team of assigned faculty and feedback is shared with student teams. At the end of the semester, student teams submit the project report and present the project results to faculty, other teams, and industry sponsors. Evaluation is completed by faculty and sponsors using the project report and presentation rubrics.

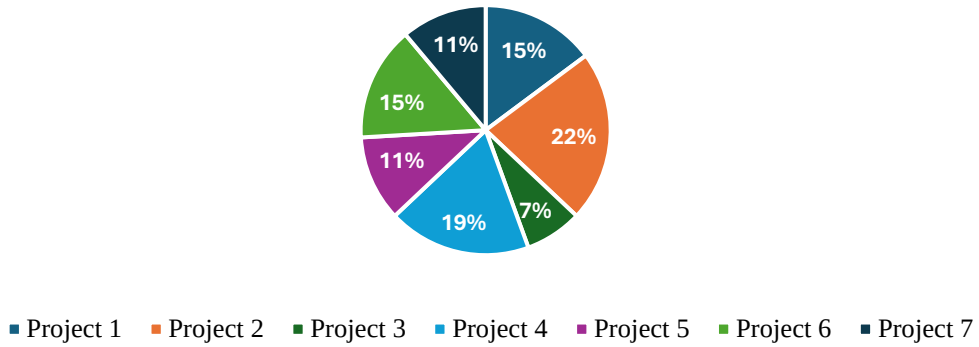
Participants, data collection, and analysis

The most recent course offering was in the Spring 2024 semester cross-listed at the undergraduate and graduate level. Student-participants were from seven disciplines Agriculture and Biosystems Engineering, Animal Science, Biology and Microbiology, Economics, Engineering Electronics Technology, Geography, and Operations Management. A total of 34 students were enrolled, 59% of them were undergraduate senior students and 41% were graduate students. Thirty-five (35%) percent were female students and 65% male students.

Fifty-six (56%) percent of the students reported that they had full-time work experience, eighteen (18%) percent worked part-time, eleven (11%) percent had internships, and fifteen (15%) percent had no industry experience. Thirty-five (35%) percent of students reported that they participated in multidisciplinary team project(s) as part of their job duties, seventeen and a half (17.5%) percent indicated that they participated in multidisciplinary teams project(s) as part of their out of class student activities (e.g., student competitions), twenty-five (25%) percent worked in multidisciplinary teams with students from other classes as part of their class project, and twenty-two and a half (22.5%) percent had no multidisciplinary teamwork experience.

All enrolled students were assigned to one of seven interdisciplinary projects based on their discipline expertise, personality and leadership assessment results, and faculty recommendations. Student preferences were taken into consideration as well. At the end of the semester, students completed an online survey to measure their perceptions of their progress and proficiency in interdisciplinary collaboration before they took the class and after the course completion. The faculty team used the Interdisciplinary Understanding Questionnaire, designed and validated by Schijf, van der Werf, & Jansen [27], to collect student responses and measure the perceived progress. The study followed the approved IRB protocol IRB-2010014-EXM. Twenty-seven students responded to the survey (79% response rate). Fig. 2 shows the distribution of responses between project teams.

Figure 2. *Responses Distribution between Project Teams*



The questionnaire is based on a framework developed by Schijf at al. [27] which includes knowledge of disciplinary paradigms and interdisciplinarity and skills on reflection, critical reflection, communication, and collaboration. The questionnaire includes questions in all six categories (knowledge and skills) and measures responses using the 5-point Likert-scale from (1) 'very inaccurate' to (5) 'very accurate.' A paired two sample t-Test for means was performed for each attribute of interdisciplinary understanding to compare student perceptions of their proficiency before taking the interdisciplinary project experience course and after completion of the course.

Results

While the analysis results indicate that students reported statistically significant improvements on the majority of the attributes for knowledge and skills relevant to interdisciplinary understanding and practice, the discussion of all attributes is out of scope for this paper. The authors focused on the attributes most relevant to mitigating the weaknesses of AI, identified by Farrokhnia et al. [17], in the context of interdisciplinary pedagogy.

Table 1. *Students Perceived Proficiency in Interdisciplinary Understanding before and after Exposure to Interdisciplinary Pedagogy*

Attributes of Interdisciplinary Understanding	Student perceptions on a scale from 1 to 5, Mean (Standard Deviation)		Paired two sample t-Test for means, p-value
	Before	After	
Knowledge of disciplinary paradigms			
(D_5) I am good at figuring out what students in another field of study have missed in explaining a problem or solution.	3.07 (0.917)	4.00 (0.784)	***<.001***
Knowledge of interdisciplinarity			
(I_2) While solving an academic problem, I am good at figuring out which information from outside my own field of study I can use.	3.33 (0.784)	4.22 (0.506)	***<.001***
(I_5) While solving problems within my own field of study, I often seek information from experts in other academic fields.	3.44 (0.801)	4.22 (0.698)	***<.001***
Communication			
(Cm_1) I am able to explain knowledge and ideas from my own field of study effectively to non-experts.	3.63 (0.839)	4.41 (0.636)	***<.001***
(Cm_5) I think that I can communicate effectively about scientific theories with students outside my field of study.	3.11 (0.934)	4.11 (0.801)	***<.001***

Although the results of students' self-reported improvements are subjective and do not reflect the objective level of progress or proficiency, they serve as a good indicator of students' awareness of the potential pitfalls in interdisciplinary collaboration and teamwork, as well as students' ability to determine and implement the strategies for improved outcomes of interdisciplinary collaboration. Therefore, awareness and strategies can enhance and improve student experience interacting with AI and treating it as an interdisciplinary team partner to counterbalance AI's weaknesses and avoid the threats posed by use of AI.

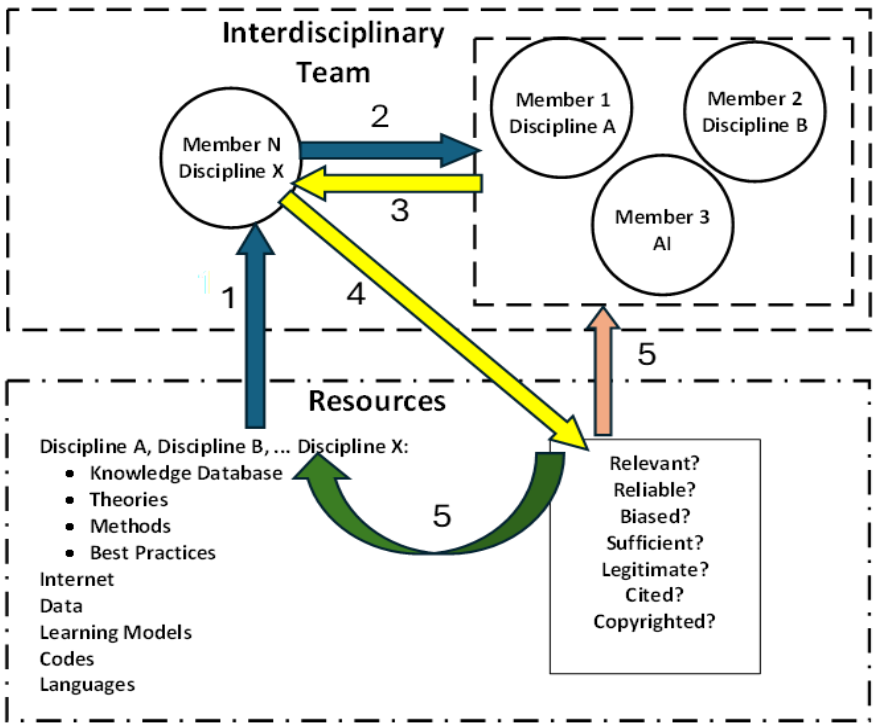
To address this gap in knowledge, the authors propose a model incorporating AI in interdisciplinary teaching pedagogy based on the identified weaknesses and threats of AI and the effectiveness of the current interdisciplinary teaching pedagogy to prepare well-rounded college graduates ready for the contemporary workplace dynamics.

A Proposed Model for Inclusion of AI Practices in Interdisciplinary Pedagogy

The proposed model (shown in Fig. 3) aims to address the students' awareness of the pitfalls and limitations of generative AI using it in their work and studies. The model focuses on two areas:

- effectively formulate and refine questions and prompts, and
- critically assess and validate the AI output.

Figure 3. *A Proposed Model for Inclusion of AI Practices in Interdisciplinary Pedagogy*



In the model, Member N from Discipline X is a generic representation of all team members from all disciplines and their interactions with other interdisciplinary team members. AI is treated as a team member in this case with the same approaches to communication and evaluation of responses as for human members.

Blue arrows represent initiation of collaboration by utilizing the discipline knowledge field and other available resources (1) and sharing ideas with team members (2) in the discipline-specific context relevant to the problem/project.

Yellow arrows represent receiving information/message from team members, including AI output (3), and critically evaluating (4) through the lens of validity, reliability, legitimacy, and social justice.

After validation, the received information is integrated (5) with the expert discipline(s) for developing an effective solution to the problem (a green arrow) or communicated back to the team members (5- an orange arrow) for refinement and discussion.

Table 2 illustrates how interdisciplinary attributes and skills are important in overcoming weaknesses and mitigating the effect of AI limitations because interdisciplinary skills equip students with effective communication strategies and critical thinking.

Table 2. *How Interdisciplinary Understanding Attributes Can Address AI Limitations*

Attributes of Interdisciplinary Understanding (an excerpt from the IUQ by Schijf at al., [27])	**AI weaknesses and threats to address [17]**
Communication	• Lack of deep understanding of the context
(Cm_1) I am able to explain knowledge and ideas from my own field of study effectively to non-experts.	
(Cm_5) I think that I can communicate effectively about scientific theories with students outside my field of study.	
Knowledge of disciplinary paradigms	• Difficulty in evaluating the quality and reliability of responses
(D_5) I am good at figuring out what students in another field of study have missed in explaining a problem or solution.	
Knowledge of interdisciplinarity	• Lack of higher-order thinking and cognitive skills • The risk of biases and discrimination • Inadvertent approval of plagiarism.
(I_2) While solving an academic problem, I am good at figuring out which information from outside my own field of study I can use.	
(I_5) While solving problems within my own field of study, I often seek information from experts in other academic fields.	

Conclusion

In an era of AI-driven workplace transformation, professional, interdisciplinary, and AI skills have become as critical as technical knowledge for ensuring students' career success. By integrating professional communication, interdisciplinary collaboration, teamwork, critical thinking, creativity, adaptability, and ethical decision-making into educational programs, institutions can equip students with the tools they need to excel in AI-enhanced environments

[2], [29]. Leveraging interdisciplinary approaches, project-based learning, and AI-integrated teaching methodologies, educators can bridge the gap between academia and industry, preparing students for the dynamic challenges of modern workplaces [5]. This comprehensive approach ensures students are prepared to be valuable contributors to the workforce, ready to navigate and thrive in AI-driven environments.

AI is undoubtedly transforming the workplace. However, nobody can be certain whether it adds value or contains inaccurate or biased information. AI can enhance and make the problem-solving process more efficient if used properly and judiciously. However, AI does not give a complete picture and cannot replace human brain creativity. If decisions are made based on AI alone, the losses the workplace or industries will incur will be higher and more disastrous. A multi-/interdisciplinary approach which involves different mindsets to solve the problem looks very promising for handling AI imperfections and limitations. Interdisciplinary pedagogy with a focus on professional skills encourages students to question AI output and discuss it with people with different skills and professional backgrounds for better results. At the same time, it creates opportunities for students to become better prepared for the new dynamic workplace where a synthesis of technical, professional, interdisciplinary, and AI skills are necessary to be competitive in the job market, be successful, and provide invaluable contributions that impact industry and society.

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