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Editors

Course-based Undergraduate Research Experiences (CUREs) for Computer Science?

Ernst Bekkering
bekkerin@nsuok.edu
Mathematics and Computer Science
Northeastern State University
Tahlequah, OK 74464

Abstract

Undergraduate research can stimulate students' interest, especially in STEM disciplines. This research can be formally offered in different formats such as Undergraduate Research Experiences (UREs). One of these is Course-based Undergraduate Research Experiences (CUREs), which are offered as an integral part of scheduled courses. CUREs have been primarily offered in Biological Sciences and Chemistry. A repository of CUREs (CUREnet) has been published with support of the National Science Foundation. This paper presents an opportunity to develop CUREs in Computer Science. It describes the content of the first authentic Computer Science CURE on CUREnet and provides links to all online materials. Students in the class completed a survey based on the Persistence in the Sciences (PITS) scale. Quantitative analysis did not demonstrate any effect on recruitment or retention. Analysis of qualitative responses was more positive. While the specific student research experiences on CUREnet are only of use in other disciplines, their use has proven beneficial in student recruitment and retention in those majors. CS faculty have an opportunity to use the model within Computer Science and get similar results.

Keywords: undergraduate research, CURE, Computer Science.

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Course-based Undergraduate Research Experiences (CUREs) for Computer Science?

Ernst Bekkering

1. INTRODUCTION

CUREs trace their roots to the broader movement toward active learning and student-centered education. While traditional lecture-based courses dominated higher education for centuries, educators recognized the need for more engaging and experiential approaches. Undergraduate Research Experiences (UREs) in general, and CUREs specifically, emerged as a response to this demand. The original focus was in the Biological Sciences and Chemistry, but has expanded to other disciplines (Wei & Woodin, 2011).

Undergraduate Research Experiences are different from traditional labs, where students expect step-by-step instructions and expected results are known. While traditional labs are designed to reinforce or verify content taught in lectures, UREs focus on authentic research and explore open-ended questions. UREs are also less prescriptive and allow students to explore, design experiments, and make discoveries. The research questions are broader, often interdisciplinary, and align with ongoing research. Students are encouraged to be independent, think critically, and use their creativity. While the focus in traditional labs is on following instructions and grading, UREs promote strong mentoring relationships with faculty (Holmes, 2020).

This paper describes the concept of URE and CUREs, a repository of projects supported by the National Science Foundation, development of the first authentic CS CURE in this repository, and result of a student survey in the class where it was offered.

2. LITERATURE REVIEW

History of undergraduate research

Undergraduate research, often described as the exploration of a specific research topic by undergraduate students seeking to make original contributions to their disciplines (Council on Undergraduate Research, 2024b), has roots in the 19th and 20th centuries. Its origins trace back to early practices in Germany where Wilhelm von Humboldt founded the University of Berlin in 1810, establishing a model for undergraduate research. By the early 1900s mentions of undergraduate research appeared in journals and magazines and in 1912 the University of Chicago established the undergraduate research prize in memory of Howard Ricketts. Since then, many universities and colleges worldwide have instituted programs to foster research at the undergraduate level. The concept gained prominence with the creation of MIT's undergraduate research opportunities program (UROP) (Massachusetts Institute of Technology, 2024) in 1969 which led to an explosion in popularity. The Council on Undergraduate Research (CUR) was established in 1978, the National Conference on Undergraduate Research (NCUR) was formed in 1987, and both have merged in 2010 (Council on Undergraduate Research, 2024a).

Type of undergraduate research

UREs are independent research projects, where students work one-on-one with faculty members on their own research or joint projects with faculty. They can be structured as research assistantships, where students assist faculty with their ongoing research, involving things like lab work, data analysis, and data collection; independent student research guided by faculty, often as honors projects or senior theses; and summer research programs, often supported by the National Science Foundation (National Science Foundation, 2024). Undergraduate research can now also be offered within courses as CUREs, which will be discussed later.

Benefits of undergraduate research

UREs have many benefits, including providing students with research skill training (Brownell et al., 2015; Szteinberg & Weaver, 2013); development of student skills like analytical, intrapersonal, and interpersonal skills (Brownell et al., 2015; Hudley et al., 2017).

Another benefit is retention and education continuation (Gentile et al., 2017; Hanauer et al., 2012; Hernandez et al., 2018). Despite high interest of students in STEM disciplines due to high demand and attractive salaries, only 40% of the students who enter a STEM undergraduate program earn a STEM degree (Seymour & Hunter, 2019). These numbers are even lower for minority students. Previous studies report that 68% of students show more interest in STEM careers after participation in undergraduate research (Russell et al., 2007) including continuing to a graduate degree (Zhan, 2014). Students are also more likely to graduate in a STEM field (Gentile et al., 2017; Hernandez et al., 2018; Ing et al., 2021). It is clear that UREs are one of the high-impact measures to increase STEM retention (Denton & Kulesza, 2024; Gentile et al., 2017).

Promoting undergraduate research also increases equity in education. Making research available to all students includes historical minority groups (Gentile et al., 2017), which might otherwise not participate. More diversity in research increases the number of points of view (Bangera & Brownell, 2014).

Students are not the only ones to benefit from undergraduate research. Faculty also benefits from closer integration of teaching and research. Many institutions, including our own, view undergraduate research as a strong positive factor for promotion and tenure. Research started in the classroom can lead to publication in scientific and education journals, and collaboration with students increases fulfillment in teaching itself (Fukami, 2013; Kowalski et al., 2016; Shortlidge et al., 2016).

The call for more undergraduate research

Since the start of this century, many have called for changes in undergraduate research to increase student interest in research (Botstein, 2000; Brewer & Smith, 2011; National Research Council, 2003; Obama, 2013; President's Council of Advisors on Science and Technology, 2012). Educational goals are evolving, with a shift towards more experiential and engaged learning. Research experience enhances employability, because the rapid technological advances give students access to sophisticated tools and resources which will be encountered after graduation. One response to this call has been to create CUREs, which are offered within courses, so that all students in the course can participate (Auchincloss et al., 2014).

CUREs

CURES have gained prominence in higher education as equitable alternatives to traditional UREs. These learning experiences make research available to all students in a course, including those from underrepresented groups. Students address real-world questions or problems, which makes research more engaging. They participate in scientific practices and collaborate extensively. There is now a growing consensus about the nature of CUREs. Auchincloss et al. (2014) mention five characteristics: 1) students learn scientific practices; 2) there is an element of discovery, so that students work with novel data; 3) topics are broadly relevant, could potentially be published, and may be of interest to the larger community; 4) students engage in a high level of collaboration with other students; and 5) Iteration is built into the project, so students can learn through repetition.

An analysis of features of CUREs in biosciences showed that students experience (1) the scientific process, (2) the technical aspects of science, (3) the professional development associated with research, and (4) building scientific identity (Burmeister et al., 2023). Within the CURE movement, more resources are now becoming available.

Resources for instructors

In 2012, CUREnet was established with support from the NSF (National Science Foundation, 2011) and expanded to CUREnet2 in 2017 (National Science Foundation, 2017). The goal is to engage a broad group of institutions, faculty, and students in CUREs into their science laboratory courses which allow students to actively participate in research projects within the classroom setting. It maintains a website at https://serc.carleton.edu/curenet/index.html (Science Education Resource Center, 2017).

Discipline	#
Life Sciences (Biology, Biochemistry, etc.)	41
Chemistry	16
Environmental Science	10
Computer Science	5
Geoscience	4
Statistics	4
Engineering	2
Physics	2
Social Sciences	2

Table 1 - CUREs on CUREnet

Currently, 57 CUREs have been published, many within multiple disciplines. Computer Science is mentioned five times, but all are support for another primary discipline (Table 1). Most are in Biology, Biochemistry, and Chemistry. This is consistent with Amad and Al-Thani (2022), who reported that out of 67 academic studies involving CUREs, 47 were from these three disciplines and 12 other disciplines shared the remaining 20

(Table 2). Computer Science only accounted for one. That does not mean that other disciplines are not interested. Even Mathematics may be interested in using CUREs. Deka et al. (2023) proposed a specific Mathematics CURE model.

Discipline	#
Biology	34
Biochemistry	7
Chemistry	6
Engineering	3
Physiology	2
General STEM	2
Food Science	2
Biotechnology	1
Geoscience	1
Computer Science	1
Environmental Science	1
Astronomy	1
General	1
Psychology (non-STEM)	3
Social Sciences (non-STEM)	2

Table 2 - Published CURE studies

Measuring CUREs effects

Student persistence, the continued pursuit of STEM degree and career, is a critical metric in science education research. Some studies measure the effectiveness of CUREs with completion of a science, technology, engineering, or mathematics (STEM) degree or advancing to a graduate program (Corwin et al., 2015). This is a very broad measurement because many factors influence degree completion, and the time from participation in the CURE to graduation may take multiple years. Hanauer et al. (Hanauer et al., 2016) addressed this concern by introducing the Persistence in the Sciences (PITS) scale, a novel instrument designed to assess how much CUREs influence students' decisions to remain in STEM fields. The PITS scale is an experimentally validated 39 question survey designed to determine student perceptions in six themes deemed predictive of continuing in a STEM discipline. The six sections on the PITS include Project Ownership-Content, Project Ownership-Emotion, Science Self Efficacy, Science Identity, Scientific Community Values, and Networking (Figure 1).

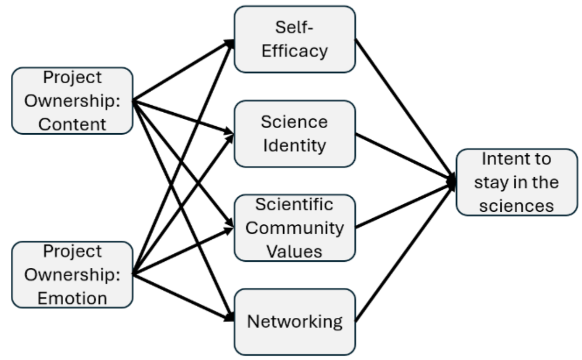

Figure 1 - PITS model

Project Ownership assesses how much a student feels connected to their research project, both emotionally and in terms of content. Self-Efficacy measures a student's belief in their ability to succeed in scientific endeavors. Science Identity assesses how strongly a student identifies with the role of a scientist and the scientific community. Scientific Community Values measures a student's alignment with the values and norms of the scientific community. Networking assesses a student's ability to build relationships and connect with others in the scientific community.

PITS has been shown to be an effective tool for evaluating undergraduate research's influence on retention (Hanauer et al., 2017, 2018, 2022). It has been validated with a Cronbach's Alpha of 0.94 (Allison et al., 2022) and has also been validated in Cole et al.(2021). The networking subscale has been validated in Hanauer (2015). A listing of the questions in the PITS scale, as used for this study, is included as Appendix A.

3. METHODOLOGY

Since PITS can be used to measure retention in STEM, we tried to use the model in PITS to demonstrate intent to continue in a STEM discipline.

This study was performed in our introductory programming class. The class consists of three hours lecture and one-hour lab for a total of four credit hours. During the semester, students complete 6 programming assignments and have one final exam in multiple choice format. In the past, since typing skills were considered a critical success factor for computer programming, students would also practice a substantial number of hours typing computer code as homework. When generative AI capable of writing computer code appeared, this clearly was no longer the case. The typing homework was replaced with a semester long research project related to using generative AI in introductory programming classes. The research report was due at the end of the semester and the material was presented to the class throughout the semester. The Blackboard website for the course contained all necessary materials, including two ISCAP publications, one on using generative AI for programming (Bekkering & Harrington, 2025) and the other on appropriate uses of generative AI in general (Firth et al., 2023).

Students could formulate their own research questions. To help them get started, they had three suggestions. The first suggestion was to compare generative AI engines for use in the class. The suggested research design was an experimental design that could be analyzed in Excel. The second suggestion was using a focus group or survey about appropriate uses of generative AI in the class, and the third suggestion was surveying student perceptions about using AI for programming. After the students submitted the research report, a link opened to the survey about the research project. Thus, only students who completed the research report could participate in the survey. The survey was for potential extra credit in the class if 80% of the students completed the survey.

The survey consisted of 36 items of the PITS scale in Likert format ranging from strongly agree to strongly disagree. In addition, two questions were added about the likelihood of graduation in a stem discipline and how much this research experience might have influenced that decision. Both were in numerical format. Finally, students could complete one open-ended question comparing the course with the research experience with a similar course without it. The questions are included in Appendix A.

4. SAMPLE AND DATA COLLECTION

Traditionally the class is a mix of majors, non-majors, and undeclared students. Enrollment in the class was 30 at the beginning of the semester, and three students withdrew during the semester.

Of the 27 students who finished the course, 19 submitted the research report. Fourteen students completed the survey, and since this fell below the 80% threshold, no extra credit was given. Demographics of the respondents are listed in Table 3.

Male	12
Female	2
Freshman	5
Sophomore	3
Junior	4
Senior	0
Post-grad	2
CS major	5
Non-major	9
Undeclared	0

Table 3 - Demographics

5. ANALYSIS AND FINDINGS

Path	Coeff.	Sign.
Content to self-efficacy	0.82	0.12
Emotions to self-efficacy	0.38	0.11
Content to science identity	0.86	0.19
Emotions to science identity	0.41	0.16
Content to community values	0.45	0.33
Emotions to community values	-0.01	0.96
Content to networking	1.10	0.05 *
Emotions to networking	0.36	0.17
Self-efficacy to effect	0.27	0.05 *
Identity to effect	0.07	0.53
Community to effect	-0.08	0.63
Networking to effect	0.08	0.56

Table 4 - Paths

After the semester was over and final grades had been awarded, the results were imported to an Excel spreadsheet. First, the Likert scores were replaced with numerical scores, with 1 for strongly disagree and 5 for strongly agree. Next, 5 missing answers out of a total of 532 answers were replaced with the mean of the other answers for that particular question. Since the PITS survey has been validated as having six factors, the average score for each factor was used for analysis. The outcome score was calculated as the product of likelihood of continuing in STEM with the relative contribution of the research project. In other words, if a student was 100% certain about continuing in STEM but the project had 0% contribution, we used a 0% score. Likewise, if a student was 80% certain and the relative contribution to that decision was 70%, we used the 56% outcome.

With the factor scores for each factor and the composite outcome score, each path was checked for statistically significant relationships with linear regression. A common rule of thumb for Structural Equation Modeling (SEM) is having at least 10-20 times as many observations as variables. For 39 questions, this would suggest a minimum of 390 to 780 responses. Since the PITS scale has been validated with SEM, it is appropriate to use the factor structure identified in SEM by using the factor scores as predictors in the regression analysis. Table 4 lists the paths, their coefficient, and the statistical significance, and the results for the PITS model are shown in Figure 2.

The table shows that only two relationships had statistical significance. Since content and networking on one hand, and self-efficacy to effect of the project on the other do not follow each other, it is not clear how this should be interpreted. Based on the results in this computer science course so far, there is no discernible effect of this CURE on recruitment and retention in the major.

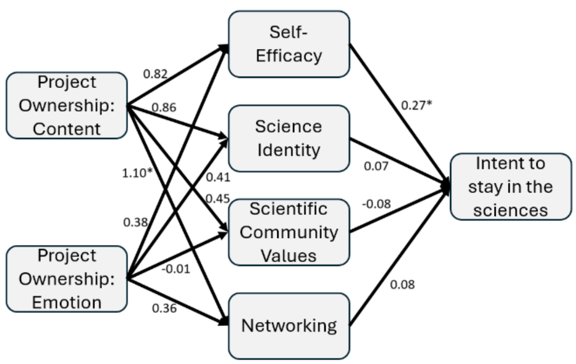

Figure 2 - Model with paths

The responses to the essay question were more encouraging. We used sentiment analysis with TextBlob in Python for preference for courses with or without a CURE. TextBlob is an effective tool to analyze sentiment (Hazarika, 2020). The Python code, individual answers, and their scores are listed in Appendix B. Using binomial distribution, the probability of 11 of 14 students preferring the CURE course was statistically significant at 0.02. The main themes of the student comments were:

- Engagement: Students found the course with a research project to be more engaging compared to similar courses without one. The project kept them more involved and interested in the course material.
- Personal and Creative Freedom: The research project allowed students to express themselves personally and creatively, making the course more meaningful and enjoyable.
- Deeper Understanding: The project enabled students to dive deeper into the course content, leading to a better understanding and appreciation of the subject matter.

Overall, the inclusion of a research project seemed to enhance the learning experience by promoting engagement, deeper understanding, and allowing creativity.

6. CONCLUSIONS AND RECOMMENDATIONS

Course-based undergraduate research experiences are virtually unknown within the field of computer science. This is surprising since many computer science majors like to work on their own projects. Other undergraduate research experiences, not course based, are frequently used. Examples are Research Experiences for Undergraduates (REUs) sponsored by the NSF, and state research days and university research days where students can show poster presentations of their research.

Perhaps one reason for the lack of CUREs in computer science is the lack of tradition. Disciplines like biology and chemistry include a lot of labs, and faculty in those disciplines have progressed from prescriptive exercises to more research-based projects. In Computer Science, labs are typically used in lower-level courses and are highly structured, not leading to problem solving and independent thinking. To combat students' impressions that this is just another lab experience, creating CUREs specifically for computer science and posting them in the CUREnet collection may provide instant credibility.

The findings of the survey are mixed. The qualitative part indicated preference for using CUREs, but the quantitative part did not. The difference in results may be attributed to the small sample size of 14 respondents, the number of quantitative questions, and the differing methods of analysis. Qualitative responses allow for more context and depth, while quantitative responses are more structured and may not capture the full range of respondents' perspectives. For instance, the absence of contact with the scientific community may make it difficult for students to feel a connection. To address the discrepancies, it is important to repeat data collection in future semesters and in different CS courses. The results can also be used to identify potential areas for improvement, such as increasing participation in undergraduate research days with the results of students' projects.

Faculty who are interested in incorporating this CURE in one of their classes, can find a direct link to all materials at https://serc.carleton.edu/curenet/collection/284384.html. The website includes advice for implementation in CS, such as explaining the need for regular demonstration and slow build-up of skills. For faculty who are interested in developing their own CURE, we recommend reviewing the submission page for CUREs at https://serc.carleton.edu/curenet/contribute_CURE.html. Going through this process involves defining Student Goals and Research Goals, Assessment materials, and planning for staffing, among others. An account is necessary but free.

While the specific student research experiences on CUREnet are only of use in other disciplines, their use has proven beneficial in student recruitment and retention in the major. CS faculty have an opportunity to use the model within Computer Science and get similar results.

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Appendix A – Survey questions (adapted from Hanauer et al., 2016)

Project Ownership: Content

1. My research will help to solve a problem in the world.
2. My findings were important to the scientific community.
3. I faced challenges that I managed to overcome in completing my research project.
4. I was responsible for the outcomes of my research.
5. The findings of my research project gave me a sense of personal achievement.
6. I had a personal reason for choosing the research project I worked on.
7. The research question I worked on was important to me.
8. In conducting my research project, I actively sought advice and assistance.
9. My research project was interesting.
10. My research project was exciting.

Project Ownership: Emotion

1. Your emotion after this project: Delighted.
2. Your emotion after this project: Happy.
3. Your emotion after this project: Joyful.
4. Your emotion after this project: Amazed.
5. Your emotion after this project: Surprised.
6. Your emotion after this project: Astonished.

Self-Efficacy

1. I am confident that I can use technical science skills (use of tools, instruments and techniques)
2. I am confident that I can generate a research question to answer.
3. I am confident that I can figure out what data / observations to collect and how to collect them.
4. I am confident that I can create explanations for the results of the study.
5. I am confident that I can use scientific literature and reports to guide my research.
6. I am confident that I can develop theories (integrate and coordinate results from multiple studies)

Science Identity

1. I have a strong sense of belonging to the community of scientists.
2. I derive great personal satisfaction from working on a team that is doing important research.
3. I have come to think of myself as a 'scientist'.
4. I feel like I belong in the field of science.
5. The daily work of a scientist is appealing to me.

Scientific Community Values

Check the answer that best reflects how much the person in the description is like you:

1. A person who thinks discussing new theories and ideas between scientists is important.
2. A person who thinks it is valuable to conduct research that builds the world's scientific knowledge.
3. A person who thinks that scientific research can solve many of today's world challenges.
4. A person who feels discovering something new in the sciences is thrilling.

Networking

I have discussed my research in this course with my parents (or guardian)
I have discussed my research in this course with my friends.
I have discussed my research in this course with students who are not in my class, but in my institution.
I have discussed my research with students who are not at my institution.
I have discussed my research in this course with professors other than my course instructor.

Intent to persist

How likely will you be to graduate in one of the STEM disciplines (Science, Technology, Engineering and Mathematics) ?
1 100% 2 90% 3 80% 4 70% 5 60% 6 50% 7 40% 8 30% 9 20% 10 10% 11 0%
How much has this research experience influenced that decision?
1 100% 2 90% 3 80% 4 70% 5 60% 6 50% 7 40% 8 30% 9 20% 10 10% 11 0%

Appendix B – Open Ended Question Responses

Python code

```
from textblob import TextBlob

text = "I have not had a similar course research project. The closest comparison is for a research topic for a final, but this was much more personal and allowed for more creative freedom. "
blob = TextBlob(text)

# Get the sentiment polarity
polarity = blob.sentiment.polarity

# Determine sentiment
if polarity > 0:
 sentiment = "1"
elif polarity < 0:
 sentiment = "-1"
else:
 sentiment = "0"

print(f"Sentiment: {sentiment}")
```

Student Comment	sentiment
I have not had a similar course research project. The closest comparison is for a research topic for a final, but this was much more personal and allowed for more creative freedom.	1
I have not had another course that is similar to this one but I would say that the research project at the end of the semester is very beneficial. You can learn over the ocurse of the semester, but I feel like its just scratching the suface. With the research project, you get to dive deep into the class and discover some things that may have not known about. It really lets you get a sense of why you took the class and what to look forward to if you were to take another class just like this one or even pursue this degree.	1
I thoroughly enjoyed this course. At first it was difficult to keep up, but (instructor’s name removed for review) made it easy to understand all the course work material. He always made sure we understood the contentand didn't ridicule us for not knowing the answers but instead using it as a teaching opportunity for the students.	1
I would compare this course with a similar course without a reaserch project by this course being more enguaging.	1
im not sure i havent had any other courses simliar course yet because this is still my first year here	-1
I can definitely say this course compares to my introduction to information security because it's similar in how much work I got to get done in the course.	1
I think this course focuses more on the cultivation of research thinking rather than just learning knowledge itself, although knowledge is also very important.	1
It has taught me some valuable lessons that I wouldn't have known if there weren't a research question involved. One of the most significant lessons I've learned is the importance of curiosity and inquiry. Research questions prompt us to delve deeper into topics, encouraging us to ask why and how things work, leading to a deeper understanding. Additionally, research teaches patience and perseverance. It's not always easy to find answers, and sometimes we encounter dead ends or unexpected results. However, these challenges cultivate resilience and problem-solving skills. Moreover, research fosters critical thinking and analytical skills. By evaluating sources, synthesizing information, and drawing conclusions, we become more adept at discerning facts from opinions and making informed decisions. Ultimately, research is not just about finding answers; it's about the journey of discovery and the personal growth it entails.	1
It felt about the same as a usual end of semester project, however this one felt like it mattered more than just a grade because I knew other people may see it, however	1

unlikely. Furthermore, I had a lot of fun knowing it is built to be an actual research project. I will be attending graduate school eventually and it was nice to get a taste of that type of research.	
This course would not have been as engaging without the research project. Comparing this course with the research project and a course without one, I believe I would have been less engaged with the course material in a class without a research project. Having this project made me enagage and dive deeper into the course material and gather a deeper understanding on my own.	1
Almost the same. The research project was a very small part of the class.	-1
My eletrical enginering course made me think hard just like this class!	-1
More challenging toward the end of the semester	1
A class with a research project gives me the opportunity to apply things I have learned, gain a better understanding, and it allows further research opportunities. A class without a research project would probably focus more on basic knowledge and building skills without experimenting with resources.	1
Binomial distribution: =BINOM.DIST(11,14,0.5, FALSE)	0.022

The Potential and Challenges of Integrating Generative AI in Higher Education as Perceived by Teaching Staff: A Phenomenological Study

Tanya Linden
lindent@unimelb.edu.au

Kewei Yuan
kyyuan@student.unimelb.edu.au

Antonette Mendoza
mendozaa@ unimelb.edu.au

School of Computing and Information Systems
Faculty of Engineering and Information Technology
The University of Melbourne
Melbourne, Victoria 3183, Australia

Abstract

Generative Artificial Intelligence (Gen AI) is making its impact on all levels of education. However, these tools must be used with caution, and it is up to instructors to teach their students responsible use of Gen AI. Therefore, there is a need to understand views of teaching staff on how to integrate Gen AI into education to maximize its pedagogical value and mitigate problems associated with the use of these tools. Focusing on higher education (HE) and applying phenomenological enquiry, this study explored possibilities of using Gen AI in teaching and learning as perceived by HE educators. The data was analyzed through the lens of the SAMR (Substitution, Augmentation, Modification, and Redefinition) framework. Although majority of the interviewees are still in the "exploration" phase, some interesting findings came to light on adopting text-based GPTs for simulating workplace interactions and associated challenges. In view of the mainly "trial and error" approaches to adopting Gen AI to teaching, it is crucial to learn from staff who experiment and grow to coordinated adoption of these tools capitalizing on their capabilities. While looking at the opportunities of Gen AI use in HE, this study also emphasizes barriers to integration of these tools as perceived by teaching staff.

Keywords: Generative AI, SAMR framework, technology integration barriers, Higher Education, phenomenology

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The Potential and Challenges of Integrating Generative AI in Higher Education as Perceived by Teaching Staff: A Phenomenological Study

Tanya Linden, Kewei Yuan and Antonette Mendoza

1. INTRODUCTION

Disruptive technologies have had a strong impact on various aspects of our lives altering how industries operate. Generative Artificial Intelligence (Gen AI) is this disruptive innovation that has made a strong impact on various domains. The ability of AI models to consume data, learn from it and generate novel artifacts that look different from the ones processed (Sarker, 2021). The latest models can produce various types of content, including text, images, music and video. In higher education (HE) Gen AI tools provide unparalleled possibilities for teaching, learning, and research (Ziebell & Skeat, 2023). However, integration of Gen AI tools in academic environments has been met with both enthusiasm and reservations (Smolansky et al., 2023). Gen AI capabilities promise to change the future of HE by empowering students and staff, however, research on its full potential is still in its infancy. Gen AI tools are still at the center of controversy. On the one hand they support knowledge acquisition and effective completion of tasks, on the other hand use of these tools raise issues of ethics and academic integrity.

Past research has shown that Gen AI tools can improve students' engagement as well as personalize learning based on the individual student needs (Bahroun et al., 2023; Chan, 2023; Yu & Guo, 2023). Since teaching staff in HE institutions are the creators of the learning environment for students, their opinions and experiences on adopting Gen AI is of high importance. It is an unexplored terrain of how to align Gen AI capabilities with pedagogical approaches while adhering to professional and ethical values. Pedagogical approaches utilizing digital technology to improve learning opportunities for students, helping them achieve learning objectives and develop the relevant skills are defined as pedagogical value (Costa, 2019).

To address this knowledge gap, this study aims to answer the following research question:

What is the pedagogical value of Generative AI capabilities for higher education as perceived by teaching staff in HE?

2. BACKGROUND

Research studies on Generative AI in education recognize a growing potential of these tools for enriching students' learning experience. The availability and capabilities of Gen AI tools have a strong impact on all aspects of teaching and learning. Pit et al. (2024) summarized opportunities presented by the tools like ChatGPT and Copilot to enhance teaching, including use of Gen AI as virtual teaching assistants which in turn improves students' engagement and interaction with the concepts they are learning. They have been used for personalized tutoring (Mahon et al., 2024) for students of all skills and varying abilities, including requiring specialized support for students with disabilities (Zhao et al., 2024). These tools can be used to provide formative feedback to students reducing markers' workload (Dai et al., 2023). Text-based tools have been shown to provide support in improving writing styles and language skills (Pack & Maloney, 2023), learning programming (Mahon et al., 2024), while fostering students' self-regulated learning (Ng et al., 2024).

The impact of these tools in the assessments is undeniable. On the one hand, instructors can use them to generate various types of questions and case studies (Eager & Brunton, 2023). On the other hand, while designing assessments it is now important to consider ease with which students can get solutions by using text-based Gen AI tools.

The way Gen AI tools affect teaching and students' learning means educators need to understand what these tools can do to support pedagogical practices. Several studies used surveys guided by technology acceptance model (TAM) or its later versions UTAUT and UTAUT2 to understand teachers' acceptance and adoption of Gen AI in their teaching practices. For example, Al Darayseh (2023) investigated acceptance of AI technologies and factors affecting this acceptance. The study was limited to science teachers in Abu-Dhabi. Some studies apply these models to participants being pre-service teachers which shows the attitudes of the teachers of the future to Gen AI tools (e.g. Yang & Appleget, 2024; Zhang et al., 2023). These statistical studies investigate attitudes towards technology and associated emotions, such as anxiety and apprehension, however, they have significant limitations, including surveying participants from only one country or even only one institution and these studies lack insights and guidelines on how to maximize benefits by adopting these tools.

Although the number of publications reporting on practical approaches to using Gen AI in teaching and learning is growing, these suggested practices are individual attempts and experiments which are quite limited in their scope, e.g. they were tested within one topic running for up to 8 weeks on one small student cohort (up to 40 students). The experiment was run only once so there is no evidence that the results will be the same if the experiment were to be repeated. Therefore, often their findings cannot be generalized. In addition, the tools are being improved so for example, problems highlighted with GPT 3.5 are less frequent in GPT 4. So there is a pressing need for researchers in this field to keep exploring staff and students' perspectives on using Gen AI, including in what context they find these tools most helpful.

3. METHODOLOGY

This exploratory study aims to investigate the perceived pedagogical value of Gen AI tools in higher education as reflected on by academic staff and explored through the lens of SAMR (Substitution, Augmentation, Modification, and Redefinition) framework (Puentedura, 2006). The framework classifies use of technology into four categories:

- Substitution, i.e. technology is a direct substitute, no functional change.
- Augmentation, where technology is used as a direct substitute with some additional functionality to benefit teaching and learning.
- Modification, i.e. technology is used and allows significant task re-design.
- Redefinition, i.e. technology provides functionality for the creation of new learning experiences, previously inconceivable or too challenging to implement.

Given the exploratory nature of this study, a phenomenological approach was employed to get insights into the experiences and opinions of faculty members about Gen AI tools in their academic practice. This qualitative methodology was chosen for its strength in uncovering rich, detailed insights into complex phenomena, allowing for an in-depth exploration of attitudes, experiences, and concerns related to Gen AI technologies (Creswell & Poth, 2018). Phenomenology involves a 4-step process consisting of époche, the phenomenological reduction, imaginative variation, and synthesis (Moustakas, 1994).

The first stage, called époche which is translated from ancient Greek as "suspension of judgment", requires the researchers to acknowledge their presuppositions and biases in order to be able to control them to ensure the personal biases do not affect data collection and analysis. Since November 2022 Generative AI have been in the center of attention of media, including social media, as well as various organizations and individuals. All these sources impact people's opinions about generative AI and form preconceived beliefs which may impact collection of data and its interpretation.

The next stage is phenomenological reduction where views and opinions are collected with the aim of creating a rich and accurate account of participants' experiences. The most common data collection approach in phenomenological research is in-depth interviews. The interviewer creates an environment of trust and reciprocity, where subjective experiences of interviewees resonate with the interviewer (Høffding & Martiny, 2016). To minimize research bias, interview questions are designed to have broader questions at the beginning so that they are not leading interviewees but rather allow them to share their lived experiences. In this study the interview questions were guided by the SAMR framework, however to allow for rich and non-biased collection of opinions, the interview protocol allowed for additional questions to get clarification on the main questions as well as insights on the interviewers thoughts and concerns which may not fit within the SAMR framework. The core interview questions are presented in Appendix 1. To keep interviewing process consistent, all interviews were conducted by the same team member.

Personal narratives of the lived experiences provide the researchers with insights into the nuances and complexities of the phenomenon during the imaginative variation.

The third stage, imaginative variation, involves getting familiar with the recorded accounts of participants experiences and achieving understanding of the phenomenon from various perspectives (Eddles-Hirsch, 2015). This stage is often performed by applying thematic analysis (Braun & Clarke, 2006). It was important to identify common themes, as well as individual variations experienced by only one participant.

Finally, the synthesis stage involves finding commonalities of participants experiences, merging them into a big picture. However, Moustakas (1994) warned about the necessity to stay open-minded and accept that the created synthesis is a snapshot created at a particular time and therefore new perspectives may enrich the understanding of the phenomenon as life goes on. These interviews were conducted in May 2024 and since AI technologies and interfaces to this technology are rapidly developing, it is expected that what we discovered as testing out attempts of using Gen AI in teaching and learning will become and more common stream approaches and more accessible to staff with lower proficiency in technology.

Participants

Phenomenological studies use criterion sampling. Since the aim of the study was to assess the perceived pedagogical value of Gen AI tools, the selection criteria for this study required participants to have at least five years of teaching experience and to have some experience in using at least one of the available Gen AI tools. Although the definition of an "experienced" teacher may vary among educational institutions based on the context, often teachers are considered to be beginners when they have under 5 years of experience (Arkoudis et al., 2023). The focus on teaching experience was due to the findings that educators confident in delivering subject content and their pedagogical approaches are more likely to consider innovative approaches in their teaching (Averill & Major, 2020).

It is recommended that for phenomenological studies the sample size is not predetermined but rather guided by the concept of saturation (Morse, 1994). Saturation is reached when no new information is obtained, and further coding is no longer feasible (Guest et al., 2006). Typically, phenomenological studies achieve saturation with between five to 25 participants (Creswell & Poth, 2018). This range provides flexibility to ensure depth of understanding while acknowledging that saturation will ultimately determine the final number of interviews conducted.

10 academics across four universities in Melbourne, Australia were interviewed (Table 5), although majority of the interviewees showed common views allowing identification of common themes. All interviewees had experience in using ChatGPT; five of them also used Copilot, Dall-E and other Gen AI tools. Seven interviewees teach and research the IT domain including IT education as the research field. Three participants were from non-IT domains.

Initial themes were identified after the first 4 interviews and saturation was achieved after 8 interviews. However, to ensure that we did not miss any interesting insights, we kept interviewing until we did not see any potential in finding additional themes.

4. DATA ANALYSIS

This study was guided by phenomenology, so all researchers had a discussion of strategies to minimize bias when conducting interviews and analyzing data. One of the adopted strategies is to do separate coding, group codes into themes and then compare the results. So initially the coders identified micro-level themes, then they discussed whether the micro level was too fine-grained while adopting the agreed label for the subtheme. The coders also discussed how the codes fit within the dimensions of the SAMR framework. However, at this stage it was decided that some subthemes do not fit within the SAMR framework but rather should be labelled as points of concern as it causes either challenges for which there is no obvious solution or uncertainty where there is a need to wait for university of guidelines or for advice from the Community of Practice.

Participant	Teaching Domain	ChatGPT	Copilot	Dall-E	Other
P1	Engineering Education	✓		✓	✓
P2	Computer Science	✓			
P3	Computer Science	✓	✓		
P4	Computer Science	✓			
P5	Computer Science	✓	✓	✓	
P6	Psychology	✓		✓	
P7	Computer Science	✓			
P8	Early Childhood to School Education	✓			
P9	Chemical Engineering	✓	✓		✓
P10	Information Systems	✓			

Table 5. Participants background details

Some subthemes were considered as potentially matching both the Concern category and a dimension from the SAMR framework or two dimensions from the SAMR framework. The latter applied to cases where AI capabilities could cause concerns and also support tasks modification or even redefinition. Finally, the micro-level themes were grouped into higher level themes.

Table 6 depicts the final themes, subthemes and coding of subthemes using the SAMR framework as resulted from the common understanding. Overall eight high level themes were identified.

Most interviewees referred to text-based Gen AI tools when answering questions, especially ChatGPT. One of the first experiences for everyone was *testing Gen AI capabilities* which was the first standing out theme. The majority wanted to evaluate whether ChatGPT can answer assessment questions evaluating how much they will need to modify assessment tasks. This capability was a reason for concern as well as an encouragement to use a different approach to creating subject activities and students' assessment. Certain capabilities were a concern due to Gen AI providing incorrect answers while students were not experienced enough to judge the quality of the provided responses. Testing of capabilities naturally lead interviewees to discussing how these capabilities could support their own professional activities, e.g. writing case studies, *developing assessment rubrics*, *creating multiple choice questions* (MCQs)..

Theme	**Subthemes**	**SAMR+ Concern**	**Participants**
Testing capabilities	Summarize a book	M, R	P5
	Paraphrasing	S, A, M	P6, P7, P8
	Write an essay	C, R	P6
	Answer assessment questions	C, M, R	P1, P2, P3, P5, P6, P9
	Writing case studies	A	P3
	Creating multiple choice questions (MCQs)	A	P3
	Developing assessment rubric	A	P2, P8
	Writing programming code	C, M, R	P7
	Generating class activities	A, M	P8
	Counselling service	R	P6
Digital divide	Some students not having access to the latest (better) version of ChatGPT	C	P1, P4
Assessment	Academic integrity	C, M, R	P1. P4, P6, P7, P8, P9
	Keep invigilated exams and hurdles		P4, P6
	Oral presentation		P2, P3, P10
	Grading	M, R	P9
	Generating feedback	M, R	P1, P3, P5
Students' approved use	Idea generation, thinking starter	M, R	P5, P7, P8, P10
	Paraphrasing, polishing English expressions	A	P2, P4
	Translation	S	P5
Impact on student learning	Generation of misinformation and bias	C	P2, P3, P5, P7, P8, P10
	Impediment to developing critical thinking skills	C	P4, P8
Change how we teach	Teach to use Gen AI tools responsibly and as per industry expectations	A, M	P1, P2, P5, P7, P8, P9, P10
	Incorporating use of Gen AI in exercises	A, M, R	P7, P8
	Teach Prompt engineering	M, R	P1, P2, P3, P8, P9, P10
	Use GPT for role-playing	R	P9
	Revamping the whole subject	M, R	P5, P6
	Create an AI tutor	R	P9
	Redesign assessments and assessment metrics	M, R	P1, P3, P4, P8, P9
Social aspect	No attendance – no live communications	C	P4
Need for clear guidelines	Universities to regulate use	C	P3, P6, P8, P10
	Addressing privacy issues	C	P4, P9

Table 6: Summary of themes and subthemes

These three productivity approaches were coded as A “Augmentation” since they supported staff productivity but did not revolutionize teaching and learning. Also academics from different professional domains tested some domain specific capabilities. For example, P6 tested ChatGPT’s capabilities to provide counselling advice, whereas P7 was interested in its coding capabilities.

All academics expressed concerns with potential issues related to academic integrity, however they discussed this issue from different angles. Some (P1. P4, P6, P7, P8) stated that misuse needs to be expected, others added ways to mitigate the problem, such as use *oral presentations* to test students’ knowledge (P2, P3, P10) or *keep invigilated exams and hurdles* (P4, P6). These two points were not coded using SAMR as these responses focused on concerns regarding academic integrity caused by Gen AI availability and it was discussed in the context of testing students knowledge of important concepts without which they cannot judge the quality of Gen AI generated output.

All participants agreed that there is impact on student learning and that there is productive, useful use of Gen AI tools which is approved use, e.g. *idea generation* or *thinking starter* (P5, P7, P10), *polishing English expressions* (P2, P4), *translation* (P5). These participants incorporate Gen AI in their teaching *augmenting* original tasks and *modifying* them to teach students how to use Gen AI ethically and responsibly.

> “*I would like them <students> to use it, especially during idea generation.*” - P5, IT domain

> “*I create an activity where want students to ideate with generative AI or get feedback from generative AI…*” - P1, Engineering domain

> “*I actually show them in my tutorial how ChatGPT can create a rubric with the various criteria. …use it in this way as it can actually give you some ideas for starting points…*” - P8, Secondary School Education domain

However, there was also a valid concern that use of Gen AI tools could be *impediment to developing critical thinking skills* (P4, P8) and the known issue of *misinformation and bias* (P2, P3, P5, P7, P8, P10) so there is a need to teach students how to use Gen AI and for staff to monitor students’ use of these tools.

> “*We created a workshop about how to do prompt engineering… it can give you contradicting information and wrong information… We don’t’ want to stop them <students> from using it <ChatGPT>… We want them to be able to use it properly and don’t over trust it…*” - P2, Machine Learning domain

Many participants commented on the need to change how we teach and assess students’ knowledge, from *revamping the whole subjects* (P5, P6) to *redesigning assessments and assessment metrics* (P1, P3, P4, P8).

> “*… change the assessment task in such a way that there is more critical thinking happening from the students.*” - P8, Education Studies (Secondary School) domain

Although we could not find examples of such drastic approaches, which would align with Redefinition in SAMR, some staff looked into what aligns with the Modification dimension of SAMR. Majority of participants commented that we need to *teach how to use Gen AI tools responsibly and as per industry expectations*, including teaching AI literacy and specifically prompt engineering. Many participants (P2, P3, P5, P7, P8, P10) also raised concerns that a lot of students accept Gen AI output as correct information, without critically evaluating it.

> “*Because companies, industry is using that <Gen AI tools>, we can’t expect students not to know anything… we need to teach them how to use AI in different fields… they need to see different AI tools used in industry*” - P5, IT domain

> “*You have to have a sense of whether the answer is right or wrong.*” – P4, Computer Science domain

Some participants (P3, P6, P8, P10) pointed out challenges for educators due to lack of common views between educators and lack of guidelines from universities. This discrepancy between universities and their leadership in terms of guiding their staff was flagged as a Concern. Some universities issued a temporary ban for educators until they released the guidelines, other universities provided no formal instructions at the time of interviews.

"*The institution that I work for has a policy on the use of Generative AI, where they allow the chief examiners or the unit convenors to choose the extent to which students could use Generative AI … and currently the guideline for the one specific unit I am talking about is not to use Generative AI*." – P10, IT Research Methods subject

"*I don't know if there are any guidelines at my university*." – P8, Education Studies (Secondary School) domain

Only one of the participants, P9, actually implemented GPT in their teaching at the SAMR Redefinition level. This staff member experimented with using AI for role-playing. In one of the subjects coordinated by P9, students need to discuss their project with an industry consultant. Since time with the real consultant is costly, students get only 30 mins for this discussion. However, when GPT became available, this subject coordinator collaborated with a programmer and they created a Retrieval-Augmented Generation (RAG) so that students could continue a discussion with the GPT based tool playing the consultant role. Interestingly, while staff considered the AI-played role as inferior to the communications with the real consultant, anecdotal evidence suggested that some students preferred communicating with an AI-based consultant due to their anxiety when communicating with industry professionals.

"… *we found this subset of students who expressed a preference for using the AI consultant over the human consultant. That was weird, like what's going on there, I wasn't expecting that. … They're meeting with the consultant and 3 other students, and some students have an anxiety around being asked a question that they don't know the answer to, or looking dumb in front of the consultant, who is a very senior engineer. … So there was this minority of students who expressed a preference for discussing with the AI consultant…*" – P9, Chemical Engineering domain

These experiments using AI-based personas for role playing has a lot of potential in many learning areas (both in educational institutions and in industry) where there is a need to develop specific communication skills for dealing with customers, patients, clients and peers. This area of learning design aligns with the Redefinition dimension of SAMR. However, at this stage this advanced approach cannot be easily implemented as it requires some advanced technical knowledge so mainly teaching staff with computer science background or teaching enthusiasts collaborating with programmers manage to implement it.

While many participants discussed Gen AI abilities to write answers to questions or write an essay or a report as a threat to students' academic integrity, P9 pointed out that ghost writers have existed for many years, however GPT made these services more accessible. So this participant added an assessment task to the assignment to test student's understanding of their own submitted report to mitigate any AI writing.

"*After they've submitted the report, they'll go into a close book, prompted environment, and they'll answer 10 short questions about their own report. And the point of the questionnaire is not for them to answer the questions correctly, it's for them to answer the questions the same as their report. So we're gonna use that questionnaire as a way of assessing students understanding of their written report, and then we'll give them a mark for their written report, and then we'll score the question, 1 or 0, and that will be like 1, yes, you understand your own report. 0, no, you could not, we ask you basic questions about what's in the content of your report, and you were not able to answer those questions*." – P9, Chemical Engineering domain

Unlike all other interviewees, P9 is actively trying different approaches to take advantage of the capabilities of Gen AI and RAGs.

However, P9 was the only interviewee who was very creative about using AI (specifically GPT) providing students with authentic learning. All other interviewees were much more cautious having reservations related to the negative aspects that are being brought in by using Gen AI (marked in the SAMR+C column in Table 6). Most of concerns were discussed by P4, who focused on these negative aspects brought about by Gen AI, including

- social aspect explaining that students replace communications with humans by communications with Gen AI:

"*Students don't want to come to campus… It's not that you don't need to* *come, it's that you don't need any friends*".

- the trustworthiness of AI output, emphasizing that students need to have sufficient subject knowledge to check the output quality which can be gained by doing the tasks yourself:

"*I teach programming… And that is something that you learn by doing it yourself, by practicing*."

"*You have to have a sense of whether the answer is right or wrong*."

"*I wouldn't want the AI writing my life support software*."

- digital divide aspects reflecting on some students paying for the latest version of Gen AI or for frequency of access

"…*if some students use them and some students don't, then we will have some kind of disadvantage for students who don't when Gen AI is really powerful and help students' learning*…"

- privacy issues, including the fact that OpenAI and other Gen AI providers collect our data, but we do not know how it is stored, where it is stored and how secure it is:

"*I think OpenAI is going to be blackmailing every student on the planet in 5 years or 10 years, when they become CEOs of companies, or when they become prime ministers*."

5. DISCUSSION

Gen AI as a disruptive technology has had a significant impact on Education and therefore the views of academics as creators of learning environments need to be examined to understand what inspires them to integrate new capabilities into the teaching and learning processes and what causes concerns. The SAMR framework (Puentedura, 2006) was deemed as suitable for analysis of education transformation using new technologies. The summary of results is depicted in Table 7. The simplest one is *Substitution*, where users replace manual activities or one technology with another without any functional changes achieving the same results but often more effectively. From this point of view, the participants discussed using Gen AI Chatbots to help with grammar and spelling, simple translation tasks (replacing translation tools), such as individual words and expressions, finding answers to questions replacing Google search.

Substitution	Technology is a direct substitute, no functional change	Gen AI helps with spelling, grammar, findings synonyms to help paraphrasing, finding answers to questions, basic translation
Augmentation	Technology is a direct substitute, plus additional functionality	Gen AI helps with spelling, grammar, plus paraphrasing or even generating sections of essays; grade not only MCQs, but long text answers.
Modification	Technology allows significant task re-design	Gen AI provides answers to questions, humans need to evaluate quality of the output (e.g. writing essays, writing programming code). Providing starting point for a topic, e.g. idea generation RAG providing answers to questions trained on the specified knowledge base.
Redefinition	Technology allows for the creation of new learning experiences, previously inconceivable or too challenging to implement	Conversational agent, role-playing, virtual tutor within the limited expertise domain and managing hallucinations by answering "I don't know" if the question is beyond the scope of the domain. Gen AI can generate feedback; it can do grading if tight criteria are provided. Use Gen AI for idea generation (e.g. under the tutor's guidance.

Table 7: SAMR- Technology and Transformation framework (Puentedura 2006)

Augmentation encompasses new functionality in addition to being a direct substitute. The participants provided insights that students use AI for paraphrasing, where the task expands on basic synonym search. These capabilities make a long-term impact as using Gen AI tools help students improve their essays, as well as writing skills. Educators have used technology to mark multiple choice and fill-in-the-gaps questions, however now these new tools can generate formative feedback and if provided with a rigid grading rubric, the summative feedback will also be somewhat useful.

Modification means using technology for significant tasks enrichment. If in the past students in programming subjects searched for code or searched for explanation on how to write a function to perform a programming task, now they can ask a text-based tool to pinpoint mistakes in the code or write code for them. Gen AI tools place detailed comments within the generated code which helps with understanding of the code. Staff needs to consider these capabilities to incorporate them in the handouts to support students' learning, to teach students how to evaluate the quality of Gen AI generated output and how to build upon this output.

When running assessments, it has been shown that formative feedback is crucial for student learning. However, after the mark for an assessment is published teaching staff don't know whether students are learning from the provided feedback because they are not allowed to resubmit an improved version of their work. Although there were studies reporting on teaching approaches that allowed assessment resubmissions (Linden, 2018), the mainstream teaching cannot adopt such learning strategies because it is too time-consuming and therefore too costly to mark multiple submissions of the same assessment. However, if we employ AI-based markers, the cost will be significantly reduced whereas learning value for students will be enormous, because they will participate in cycles of continuous learning and practicing necessary skills, getting feedback on where they are doing well and what knowledge gaps they need to address. In certain aspects there may be a blurry border between Modification and Redefinition. An existing assignment can be updated with some new approaches using GenAI which could be classified as Modification, however, the changes may not be feasible in the past which could classify the change as Redefinition, i.e. using technology to create new authentic experiences.

The most interesting advances in learning and teaching processes brought by easy access to GPT can be categorized as *Redefinition*. Such approaches are useful for creating authentic learning by simulating industry situations where students can practice necessary skills in the security of the simulated environment (e.g. practicing chemical reactions without the risk of poisoning or an explosion, practicing clinical psychology with simulated patients without the danger of causing severe consequences to the patient's mental state). In the past simulations required programming complex environments (e.g. Cybulski & Nguyen, 2012; Guadagno & Powell, 2012) so it was too challenging and often expensive to implement. Access to GPT allows us to combine a basic Chatbot interface and a GPT wrapper to implement the necessary simulation. Taking into consideration the speed of AI technologies development, "talking" AI chatbots are under development and they will make simulations even closer to real life experiences. These role-playing scenarios have a lot of potential, however, there is no easy access to developing the relevant personas for academics who don't know programming or have access to funding for such developments and maintenance.

The views of teaching staff showed the dichotomy between their understanding of Gen AI potential for students learning and barriers to technology integration in higher education. Ertmer (1999) suggested a framework classifying technology integration barriers as external (or first-order) and internal (or second-order). Organizational support, including ineffective leadership and guidance is classified as a first-order barrier and it has a strong impact on success of adopting new technologies (Gkrimpizi et al., 2023). As shown in our data analysis, some interviewees flagged their institutions support as an issue. Some did not know whether their institutions have a policy on using Gen AI, others feel the policy is vague, so they prefer to be on the side of the caution and wait to see how the situation develops. Another reason for the universities to provide the policy on integration of modern technologies in the education process are privacy concerns (Emezirinwune et al., 2024), since it is not clear how Gen AI uses and stores data uploaded to these tools. Although Ertmer's framework (Ertmer, 1999) does not include privacy among technology integration barriers, this aspect is an important concern in the 21st century and some of our interviewees referred to it as an explanation why they are relying on their university guidelines.

Second-order barriers are typically rooted in beliefs and attitudes towards teaching and use of technology in teaching (Ertmer, 1999). Some of our interviewees expressed resistance to this new technology citing all negative consequences that could happen and actually happen due to its ease of access. One of the concerns is that students use Gen AI as an instrument to cheat in their assessments, so the participants emphasized the need to continue with invigilated closed-book exams and mid-semester tests, as well to consider oral assessments.

Another important concern cited by teaching staff is that Gen AI can be an impediment to developing critical thinking skills as well as students' lack of skills in recognizing misinformation. Although there were suggestions to mitigate these issues by teaching students prompt engineering and emphasizing the need for skills to evaluate output generated by these tools, our interviewees have not integrated relevant tasks into their teaching. At this point in time only a very small number of teaching staff treat Gen AI as an opportunity, rather than a problem.

6. CONCLUSIONS

The release of Gen AI tools is revolutionizing education. The fast developments of this technology create growing opportunities in enriching student learning experience, so it is crucial for academics to move with times. Although some academics try to resist the changes and only see Gen AI as a threat to academic integrity, others embraced the evolving capabilities and explore the options of applying these tools in their teaching.

This study used phenomenological enquiry to get insights into the current views and attitudes of academics towards Gen AI, including what value they are getting or hope to get for their teaching and for students' learning. Although the majority of respondents are still trying out Gen AI capabilities, they all understand that Gen AI tools, especially text-based tools, need to be harnessed so that they affect students' learning in a positive way and possibilities are very wide.

Examining uses of Gen AI through the lens of the SAMR framework demonstrates that at this stage most frequent uses of Gen AI are at the Substitution and Augmentation levels. However, a plethora of opportunities that will seriously enrich the learning process under the guidance of academics are to be found at the Modification and Redefinition levels. However, our analysis of participants' views uncovered a multitude of concerns, which is a dimension that needs to be added to the SAMR framework. Use of technologies for teaching and learning needs to be examined from the perspective of potential they can bring to education but also negative effects that they may introduce which need to be controlled and mitigated.

In terms of potential AI brings to education, there have been experiments in using AI bots as conversational agents, improving students' speaking skills when learning foreign languages (Duong & Suppasetseree, 2024; Tai & Chen, 2024). However, there are many opportunities including creating interactive environments that simulate in-workplace interactions. Unfortunately, there are some serious barriers for such developments. As classified by the technology integration framework (Ertmer, 1999), first-order barriers are mostly beyond teaching staff control. They include lack of funding, restrictions from universities on access to GPTs, lack of technical skills to implement ideas using APIs and on-going costs. There is a need for staff to have access to developmental environments with user-friendly interfaces that do not require advanced programming skills, preferably through a learning managements system plug-in. Future research needs to examine the application of such Gen AI simulations in different study domains, its benefits and challenges, as well as staff and students' perspectives on such pedagogical approaches.

Students often use Gen AI tools to get answers to assignment and test questions. However, it has been proven that learning by examining a provided solution is passive and less effective (Dolan et al., 2002). It is important to develop problem-solving skills which happens when students tackle different approaches to solve a problem. So, the goal is to train Gen AI to guide students towards finding the solution as opposed to providing the solution to the problem. Training AI models in a specific domain, e.g. on subject materials, creating detailed prompts to provide important context for the model and guidelines not to provide solutions but to use scaffolding, which in this context will be a special approach to prompt engineering. Teaching staff need to learn these skills before they can confidently start developing AI tutors. They also need technical and educational support, as well as funding. As staff flagged the need for institutional support, it is not only policies and guidelines they need.

They also need technical and financial resources as well as a supportive environment to test use of AI tutor for students' learning.

In terms of concerns, one of the issues is the issue of privacy that is positioned between first and second-order technology adoption barriers. This issue was not discussed in the Ertmer's framework as it was not a pressing issue in the previous century; however, it needs to be considered in the modern day and age. On the one hand we do not know how data collected by Gen AI is stored and who has (or will have) access to it which places privacy in the category of first order barriers. However, people have different attitudes towards privacy in IT with some having strong concerns and others ignoring the risks for rewards (Fui-Hoon Nah et al., 2023; Gerber et al., 2018). Some teaching staff express privacy-related concerns citing their own negative expectations on how private data may be misused, others refer to privacy as part of the university policy on use of Gen AI. So, privacy cannot be clearly categorized as a first or second-order barrier but must be considered when deciding on how to incorporate Gen AI tools in education.

We know that different versions of GPT have different costs associated with them and produce different quality outputs with GPT3.5 being prone to "hallucinations" and GPT 4 using advanced algorithms to decrease bias. So as emphasized by the participant P9, there is a need not to just evaluate the quality of output of each version, but also check whether users notice the difference.

This study is limited to examining views of teaching staff in universities in Melbourne, Victoria, Australia. Also, as a qualitative study, the researchers interviewed only a small number of academics (until saturation was achieved). However, potentially involving teaching staff from other countries would enrich the findings. Also, the study focused on use of Gen AI for teaching and learning only, however, some of these tools capabilities could enrich other types of activities in HE institutions. However, this was beyond the scope of this study.

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APPENDIX 1. CORE INTERVIEW QUESTIONS

No.	Question	SAMR
0	Are you using any GenAI tools, if yes, which ones? If no, why not?	NA
1	Can you begin by describing your initial experience or experiments with integrating Generative AI into your teaching or curriculum?	Substitution
2	What motivated you to start using Generative AI in your educational practices?	NA
3	How does Generative AI fit into your current teaching methods and learning objectives?	Augmentation
4	In what ways have you noticed Generative AI enhancing the learning experience or outcomes for your students?	Augmentation
5	Can you share any challenges you've encountered in using Generative AI for teaching and how you've addressed them?	Modification
6	Have there been opportunities to redesign traditional tasks or introduce new learning activities with Generative AI? If so, could you provide examples?	Modification Redefinition
7	What are the observable outcomes or impacts of integrating Generative AI into your curriculum on both teaching and student engagement?	Redefinition
8	How do you navigate the ethical considerations and academic integrity issues that come with using Generative AI in education?	NA
9	Looking to the future, how do you envisage the role of Generative AI evolving in higher education?	Redefinition
10	What support or resources do you think educators need to effectively integrate Generative AI into their teaching practices?	SAMR as a whole

AI Skills for Entrepreneurs: A Practical Experiential Learning Approach

Tamilla Triantoro
tamilla.triantoro@quinnipiac.edu
Business Analytics & Information Systems

Tuvana Rua
tuvana.rua@quinnipiac.edu
Department of Management

Guido Lang
guido.lang@quinnipiac.edu
Business Analytics & Information Systems

Quinnipiac University
Hamden, CT 06518

Abstract

This study explores the effectiveness of experiential learning in teaching generative AI to entrepreneurs and small business owners. The in-person training program, grounded in Kolb's Experiential Learning Theory, aimed to enhance participants' understanding, attitudes, and perceived benefits of AI adoption. Through a structured cycle of Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation, participants engaged in hands-on activities with AI tools. The results highlight significant improvements in AI competency, showcasing the potential for experiential learning to reduce perceived technological complexity and drive innovation. This approach provides insights into upskilling entrepreneurs, equipping them with the practical knowledge needed to harness AI for business growth and sustained competitiveness.

Keywords: Generative AI, Experiential Learning Theory, Entrepreneurship, AI teaching methods.

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AI Skills for Entrepreneurs: A Practical Experiential Learning Approach

Tamilla Triantoro, Tuvana Rua, Guido Lang

1. INTRODUCTION

The rapid advancement of artificial intelligence (AI) technologies has created unprecedented opportunities and challenges for businesses (Przegalinska & Triantoro, 2024). Entrepreneurs and small business owners must navigate the evolving nature of technologies to maintain competitiveness and foster innovation. Industry research shows that there are many AI opportunities that entrepreneurs could pursue (Shepherd & Majchrzak, A. 2022). However, the adoption of AI in small businesses can be hindered by the perceived complexity of these technologies (Upadhyay et al 2023). Therefore, effective training programs are essential, particularly those that leverage experiential learning methodologies to bridge this knowledge gap (Lang & Triantoro, 2022).

In today's rapidly evolving economic landscape, the importance of upskilling and reskilling the workforce cannot be overstated. The World Economic Forum (2024) reports that almost a quarter of all jobs are expected to change in the next five years, requiring reskilling due to technological advancements and the changing nature of work. Upskilling and reskilling are essential to ensure that workers can adapt to new roles and tasks, maintaining employability and contributing to economic growth (Lang & Triantoro 2022). For entrepreneurs, especially those running small businesses, staying abreast of technological developments is necessary for maintaining competitiveness and fostering innovation. Training programs that incorporate experiential learning can provide entrepreneurs with the practical skills and confidence needed to adopt and implement new technologies, such as generative AI.

Economic data supports the importance of training and development for local entrepreneurs. A study by Bloom et al. (2020) found that management training programs for small businesses led to significant improvements in business practices and performance. Such programs not only benefit individual entrepreneurs but also contribute to broader economic development by fostering a more skilled and innovative business community.
Kolb's Experiential Learning Theory (ELT) posits that learning is the transformation of experience into knowledge, involving Concrete Experience, Abstract Conceptualization, Reflective Observation, and Active Experimentation (Kolb & Kolb, 2021). This continuous, iterative cycle enables learners to experience, reflect, conceptualize, and act, integrating observations into abstract concepts that inform new actions (Kolb et al., 2014).

Given the critical role of experiential learning in enhancing technological competence and the significant economic benefits of upskilling entrepreneurs, this study aims to assess the impact of a targeted AI training program on local entrepreneurs. By utilizing Kolb's Experiential Learning Theory as the theoretical framework, the training program was designed to engage participants in concrete experiences, reflective observation, abstract conceptualization, and active experimentation with AI tools.

The following sections will introduce related literature and hypotheses, followed by the methodology of this study, design and implementation of the AI training program, the data collection methods, and the analytical techniques used to evaluate the program's effectiveness.

2. RELATED LITERATURE AND HYPOTHESES DEVELOPMENT

Experiential Learning

Kolb's Experiential Learning Theory (ELT) conceptualizes learning as the process through which experience is transformed into knowledge (Kolb & Kolb, 2021, Kolb, 1984). In ELT, learning is seen as a process of knowledge construction, involving a dynamic interplay among four modes: Concrete Experience, Abstract Conceptualization, Reflective Observation and Active Experimentation, which adapt to contextual requirements. In this learning cycle, the learner engages in experiencing, reflecting, thinking, and acting in a continuous, iterative process. Concrete experiences provide a foundation for observations and reflections. These reflections are then integrated and distilled into abstract concepts, which can inform new actions. These new actions can be tested, leading to the creation of further experiences, thus perpetuating the learning cycle.

Research underscores the importance of experiential learning in various educational and professional contexts. For example, Beard (2023) highlights the effectiveness of experiential learning in developing practical skills and enhancing learner engagement. Similarly, Van Wart et al. (2020) emphasize that experiential learning can significantly improve the understanding and application of complex concepts in professional training programs.

The ELT has been extensively used to study end-user software use and end-user training in the fields of computer and information science (Kolb et al. 2014). This application has shown that experiential learning can significantly enhance user competence and confidence in using complex software tools. Such findings underscore the theory's relevance in various contexts, including the training of entrepreneurs in utilizing AI technologies.

Research in information systems and educational technology supports the effectiveness of experiential learning methods. Studies have shown that experiential learning enhances user engagement, satisfaction, and knowledge retention. For example, Jewer & Evermann (2015) highlighted the importance of experiential learning in information systems education, demonstrating that hands-on activities significantly improve learning outcomes and engagement. Konak et al. (2014) found that experiential learning approaches in software training programs lead to higher levels of user competence and confidence in virtual settings. Kolb and Kolb (2017) reaffirmed the relevance of ELT in modern educational settings, emphasizing its adaptability and effectiveness in diverse learning environments.

Importance of Training Local Entrepreneurs

Training local entrepreneurs is vital for economic development, particularly in fostering innovation and driving local economies. Small businesses are often the backbone of local economies, creating jobs and providing essential goods and services. According to the U.S. Bureau of Labor Statistics (2024), small businesses contributed 55 percent of the total net job creation from 2013 to 2023, and currently employ 46.8% of the entire workforce, with about 61.6 million employees (SBA Office of Advocacy, 2023). The trends also hold globally with small businesses accounting for 90% of all businesses and creating more than 50% of employment worldwide (World Bank, 2019).

Despite their value, not all small businesses manage to survive the entrepreneurial journey. 20% of all small businesses fail in their first year, while 50% shut their doors within 5 years of incorporating (Bureau of Labor Statistics, 2023). Aside from difficulties associated with financing, many of these businesses fail due to inadequate management, ineffective business planning (Perry, 2001) and marketing mishaps (Perry, 2001, Arriaga-Muzquiz, et al., 2015).

Entrepreneurs are key drivers of innovation, job creation, and economic growth (Hossein 2018). By equipping them with the necessary skills and knowledge, training programs can have far-reaching social impacts. Effective training programs can help entrepreneurs acquire better management techniques, effective business planning and marketing strategies, which can help curb the aforementioned failures. In addition, they can help leverage technologies such as generative AI to improve efficiency, enhance customer engagement, and drive growth. Training that focuses on experiential learning methods, such as those outlined in ELT, can be particularly effective. By engaging in hands-on activities, reflecting on their experiences, and applying new concepts in practical settings, entrepreneurs can develop a deeper understanding and greater proficiency in using AI tools.

Training local entrepreneurs also promotes inclusivity and equity. It can empower underrepresented groups, such as women and minorities, by providing them with the skills and confidence to start and grow their own businesses (Motoyama et al. 2024, O'Brien et al. 2019). This empowerment helps bridge socio-economic gaps and contributes to a more inclusive economy. Women owned businesses currently make about 39.1% of the small businesses in the US (NWBC Annual Report, 2023), and they are more likely to be solo ventures with no employees (Small Business Economic Profile, 2023). Despite owning a smaller percentage of the small businesses, women entrepreneurs, especially women of color entrepreneurs, have been credited for the small business boom after the pandemic as they have been responsible for half of new businesses created for three consecutive years since 2019 (NWBC Annual Report, 2023). However, research indicates that the failure rates are higher among female entrepreneurs in comparison to their male counterparts (Yang & Del Carman Triana, 2019). Therefore, the training programs geared toward women entrepreneurs become especially important not only to sustain the recent momentum among women entrepreneurs but also to help them continue to grow and sustain their businesses after the initial stage of starting their ventures.

Universities can play a pivotal role in training local entrepreneurs (Mason & Brown, 2014), as they possess the resources, expertise, and infrastructure needed to deliver comprehensive and effective training programs. Collaborations between university researchers and local entrepreneurs can lead to the development of new products and services tailored to community needs (Pahurkar, 2015), mentorship programs and networking opportunities (Etzkowitz & Zhou, 2017).

Generative AI

Generative AI is a rapidly advancing branch of artificial intelligence, known for its ability to produce unique and innovative content that closely resembles human behavior (Dwivedi et al., 2023). These AI systems are trained on extensive datasets comprising text, images, or audio, enabling them to generate original content (Przegalinska & Triantoro, 2024).

The practical applications of generative AI are vast and varied, encompassing fields such as content creation, virtual assistants, decision-support systems, data visualization and education (Gkinko & Elbanna, 2023, Triantoro 2023, Przegalinska & Triantoro, 2024, Lang et a. 2024). In the context of human-AI collaboration, generative AI can significantly enhance productivity and innovation by assisting human workers in various tasks and providing valuable insights (Przegalinska et al. 2025, Dwivedi et al., 2023). This potential makes it important for entrepreneurs to understand and leverage generative AI to maintain a competitive edge and drive growth.

Given the critical role of effective training in enhancing entrepreneurial capabilities, it is essential to assess the specific impacts of such training programs. This study aims to evaluate the effects of a generative AI workshop on entrepreneurs' perceived benefits of AI, their understanding of AI technologies, and their attitudes towards AI. By examining these dimensions, we can gain insights into how experiential learning-based AI workshops can influence key outcomes and contribute to the broader goal of fostering technologically adept and innovative entrepreneurs.

Hypotheses Development

According to Kolb's Experiential Learning Theory, direct engagement and hands-on activities enhance learners' experiences and understanding, leading to more positive attitudes (Kolb, 1984). The AI workshop that includes interactive elements such as practical applications and real-world examples, is likely to make participants more receptive and positive towards AI technologies. Prior studies have demonstrated that experiential learning approaches can significantly improve attitudes towards new technologies (Konak et al. 2014, Jewer & Evermann 2015).

H1 *Participation in the AI workshop will significantly improve the attitudes of entrepreneurs and small business owners towards AI.*

ELT posits that learning through concrete experiences and reflective observation can help individuals see the practical advantages of new tools and technologies. By providing real-world examples of AI applications in business and personal contexts, the workshop may help participants understand the tangible benefits of AI. Previous research in information systems has shown that experiential learning can enhance perceptions of technology benefits (Kolb et al. 2014).

H2: *Participation in the AI workshop will significantly increase the perceived benefits of AI among entrepreneurs and small business owners.*

ELT emphasizes the importance of active experimentation and reflective observation in deepening understanding. The AI workshop's structure, which includes hands-on activities with AI tools followed by reflection and discussion, aligns with this principle. Experiential learning has been proven to increase comprehension and retention of complex concepts (Kolb & Kolb, 2017). By engaging in active experimentation, participants can directly apply theoretical knowledge, thereby enhancing their understanding of AI technologies.

H3: *Participation in the AI workshop will significantly enhance the understanding of AI among entrepreneurs and small business owners.*

3. METHODOLOGY

This study was conducted in person, leveraging the social and interactive components inherent in face-to-face learning environments. Participants were invited from the Entrepreneurship Academy supported by a university located in the Northeast of the United States. Participation in the study was free.

A group of 18 entrepreneurs attended the training. The average age of the participating entrepreneurs was 45. 15 out of the 18 participants were women, 82% of which were women of color. The majority of the businesses were in their first three years of operation and 65% of them were solo entrepreneurs with no employees.

The participants completed a survey at the beginning and at the end of the workshop. The pre-test was administered before any training exposure to establish a baseline understanding of AI, while the post-test assessed improvements in AI attitude, perceived benefits, and understanding. The survey data was collected via Qualtrics and subsequently analyzed in R. Additional information about the survey items can be found in Appendix A.

The training was designed and implemented by an experienced professor with expertise in AI-human interactions. The session followed a structured agenda, beginning with an introductory lecture, followed by hands-on activities, guided experimentation, and group discussions. The professor structured a two-hour training session that adhered to Kolb’s Experiential Learning Theory (ELT), integrating all four stages of the ELT framework to optimize learning outcomes. First, the professor initiated the training with a brief explanation of how AI, specifically Large Language Models, operate. The instructor then demonstrated practical examples, such as creating a job post and a social media post using text, images, and music generated by AI tools. This hands-on demonstration illustrated the practical applications of AI in business contexts. The instructor also discussed the importance of context in generating content and guided participants through the steps of effective prompting techniques. Participants were then tasked with applying these techniques to create their own job posts and social media ads tailored to their business needs. This structured approach from theoretical grounding to practical application laid the foundation for implementing the four stages of Kolb’s Experiential Learning Theory as follows:

Abstract Conceptualization involved the introduction to various types of AI, providing a foundational understanding of AI technologies. Participants were introduced to LLMs, learning about their functionalities and applications. Furthermore, effective prompting techniques were taught, including the importance of context, few-shot learning, and implementing chain of thought methods. Few-shot learning enables AI to perform tasks with minimal examples, enhancing adaptability to new tasks. A chain of thought method involves breaking down complex problems into sequential steps, improving reasoning and problem-solving capabilities. This stage aimed to equip participants with a robust theoretical framework and conceptual understanding of AI and its practical applications.

Concrete Experience was addressed by showcasing real-world examples of how businesses and individuals utilize AI. Practical examples of AI applications in business settings, such as assisting in writing and creating written and visual materials, illustrated the impact and benefits of AI technologies. Additionally, examples of personal use cases of AI demonstrated its versatility and relevance to everyday activities. Participants gained tangible insights through these examples, grounding their theoretical knowledge in real-world contexts.

Active Experimentation included participants engaging in hands-on activities using ChatGPT, DALL-E, and Suno to create their own text, image and audio examples. Participants applied their learning directly by using these AI tools to develop a job post and a comprehensive social media advertisement. This involved generating engaging text with ChatGPT, creating visually appealing images with DALL-E, and producing accompanying music with Suno. This stage facilitated the practical application of concepts, enabling participants to experiment with AI technologies in a controlled, supportive environment.

Reflective Observation included reflection and evaluation of experiences. Participants reflected on their experiences using AI tools, discussing what they learned, challenges encountered, and insights gained. They also presented their AI-generated examples to each other and the class, receiving feedback and learning from peers. Additionally, participants completed a post-test survey to assess their learning outcomes, changes in attitudes towards AI, and overall training effectiveness. This stage ensured that participants critically evaluated their experiences, fostering a cycle of continuous learning and improvement.

By leveraging the strengths of ELT, this study aimed to provide participants with an engaging and practical learning experience, enhancing their understanding and application of AI technologies in entrepreneurial contexts. The structured methodology ensured that participants moved seamlessly through each learning phase, reinforcing both conceptual understanding and practical application. The AI training tasks are summarized in Table 1.

ELT Stage	AI Training Task
Abstract Conceptualization	Types of AI. Definition and mechanism of LLMs. Prompting: Adding Context, Few Shot Approach, Chain of Thought.
Concrete Experience	Real world examples of how businesses use AI. Real world examples of how people use AI.
Active Experimentation	Participants apply hands-on application and experimentation ChatGPT, DALL-E, and Suno to create their own examples.
Reflective Observation	Reflection and evaluation of experiences, presenting in class, and post-test survey.

Table 1. AI Training Tools and ELT Stages.

4. RESULTS

Of the 18 participants that completed the pre-test survey, 13 (72.22%) also completed the post-test survey. Detailed personal and business information about the participants that completed both the pre- and post-test survey can be found in Appendix B.
Three paired samples t-tests were conducted to compare AI attitude, AI perceived benefits, and AI understanding pre- and post-test. There was a significant difference in AI attitude before ($M = 4.15$, $SD = 0.89$) and after ($M = 4.85$, $SD = 0.36$) the workshop ($\Delta = 0.70$, $t(12) = -2.92$, $p = 0.01$). Thus, H1 is supported.

Likewise, there was a significant difference in AI perceived benefits before ($M = 4.15$, $SD = 0.89$) and after ($M = 4.92$, $SD = 0.28$) the workshop ($\Delta = 0.77$, $t(12) = -2.99$, $p = 0.01$). Thus, H2 is supported.

Finally, there was a significant difference in AI understanding before ($M = 3.31$, $SD = 0.75$) and after ($M = 4.23$, $SD = 0.73$) the workshop ($\Delta = 0.92$, $t(12) = -3.21$, $p < 0.01$). Thus, H3 is supported. Figure 1 depicts the difference in the three variables between pre- and post-test.

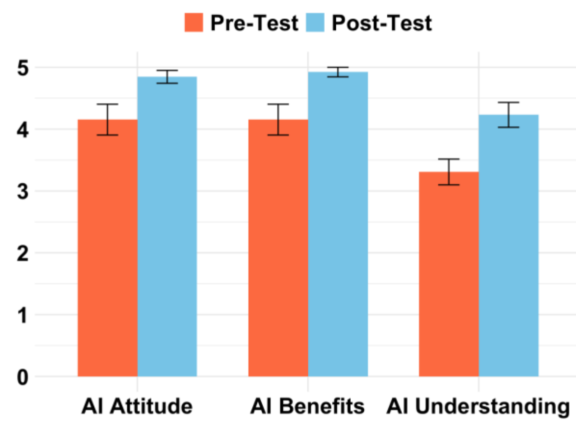

Figure 1: Pre- and post-test scores

To better understand the factors that may have affected the increases in AI attitude, AI perceived benefits, and AI understanding, a pre-test vs. post-test difference score was calculated for each variable. Subsequent correlation analyses (for quantitative variables) and ANOVAs (for nominal variables) revealed that none of the personal or business background variables seem to have affected the increases in AI attitude, AI perceived benefits, or AI understanding. However, the extent to which participants enjoyed the tasks in the workshop was positively correlated with an increase in AI understanding ($r = 0.57$, $p = 0.04$). Stated differently, the more participants found the tasks in the workshop to be enjoyable, the higher their increase in AI understanding after the workshop. Interestingly, neither the difference in AI attitude nor the difference in AI perceived benefits was similarly affected by task enjoyment.

Finally, to determine to what extent higher levels of AI attitude, AI perceived benefits, and AI understanding might have downstream consequences impacting future behavior, several correlation analyses were conducted. It was found that the increase in AI understanding was positively correlated with an intention to obtain additional AI education ($r = 0.57$, $p = 0.04$). Hence, the more participants learned about AI in the workshop, the more likely they are to seek out additional education about AI. Finally, it was found that the level of AI understanding is positively correlated with an intention to use AI for business ($r = 0.75$, $p < 0.01$). Thus, the higher a participant's AI understanding, the higher their intention to use AI for business. Interestingly again, neither AI attitude nor AI perceived benefits had similar correlations with intention to obtain more AI education or intention to use AI for business.

5. DISCUSSION AND CONCLUSION

Contributions

This study makes several important contributions to the theoretical understanding of experiential learning and its application in the context of AI training for entrepreneurs. First, it extends Kolb's Experiential Learning Theory (ELT) by demonstrating its efficacy in the rapidly evolving field of AI. By integrating four stages of ELT into the AI training program, this research provides empirical support for the theory's applicability beyond educational settings, into professional and entrepreneurial domains.

Second, the study contributes to the literature on technology adoption and learning by highlighting the critical role of experiential learning in enhancing not only technical skills but also attitudes and perceptions towards new technologies. The significant improvements observed in AI attitude, perceived benefits, and understanding among participants underscore the value of hands-on, reflective, and conceptual learning experiences in fostering technology adoption.

Third, this research adds to the body of knowledge on the intersection of AI and education. By focusing on the practical application of AI tools such as ChatGPT, DALL-E, and Suno, the study bridges the gap between theoretical AI knowledge and its real-world applications. This integration of AI and experiential learning provides a framework for future studies exploring innovative educational methods to enhance technological competence.

From a practical perspective, this study offers insights for designing and implementing effective AI training programs for entrepreneurs and small business owners. Given the high rates of failure among small businesses after incorporation, developing training programs that leverage new technologies can help entrepreneurs lower the risk of failure and provide substantial benefits for the entrepreneurial ecosystem. Since failure rates are higher for women entrepreneurs, these training programs are additionally important to create an entrepreneurial ecosystem with fewer socio-economic gaps, leading to a more inclusive economy.

Additionally, the use of Kolb's ELT framework ensures that training programs are comprehensive, engaging, and conducive to deep learning. Practitioners can adopt this model to create training sessions that not only convey theoretical knowledge but also provide ample opportunities for hands-on practice and reflection.

Moreover, the study underscores the significance of providing a supportive and interactive learning environment. The in-person format of the training facilitated social learning, allowing participants to share experiences, provide feedback, and learn from each other. This aspect of the training can be particularly beneficial for entrepreneurs, who often rely on peer support and collaboration.

Finally, the study's results suggest that AI training programs can have a positive impact on entrepreneurs' future behavior, such as their intention to seek additional AI education and integrate AI into their business practices. This implies that well-designed training programs can have long-term benefits, contributing to the overall digital transformation and competitiveness of small businesses.

Limitations and Future Research

We acknowledge that the small sample size is a limitation that affects the statistical power and generalizability of our findings. At the same time, through the substantial work undertaken in this study, we developed and implemented a comprehensive in-person AI training program designed specifically for entrepreneurs. This methodology provided participants with a robust learning experience, combining theoretical knowledge, practical application, and reflective observation.

Recognizing the need for further validation, we are planning a longitudinal study and a broader survey based on this initial work. Future studies would also benefit from using additional measures to capture the multi-dimensional factors alluded to in this work. These future efforts aim to involve larger sample sizes and incorporate additional objective measures to strengthen the reliability and applicability of our findings.

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APPENDIX A: SURVEY ITEMS

Personal and business background information

Attitude Towards AI: How would you describe your attitude towards the use of artificial intelligence in business? 1 (Very Negative) to 5 (Very Positive)

Perceived Benefits of AI: To what extent do you feel that artificial intelligence is beneficial for businesses like yours? 1 (Not Beneficial at All) to 5 (Extremely Beneficial)

Understanding of AI: How confident are you in your understanding of the benefits and risks of artificial intelligence in business? 1 (Not Confident at All) to 5 (Extremely Confident)

Task Enjoyment: I enjoyed working on the task. 1 (Strongly Disagree) to 5 (Strongly Agree)

Intention to Use AI (adapted from Venkatesh et al. 2012): I plan to continue to use the technology I used for this task frequently. 1 (Strongly Disagree) to 5 (Strongly Agree)

Intention to Obtain AI Education: How likely are you to seek out additional resources to learn about AI after this workshop? 1 (Very Unlikely) to 5 (Very Likely)

APPENDIX B: PERSONAL AND BUSINESS BACKGROUND OF PARTICIPANTS

Education	**Some college, but no degree**	**Associates or technical degree**	**Bachelor's degree**	**Graduate or professional degree**				
	3 (23.08%)	1 (7.69%)	2 (15.38%)	7 (53.85%)				
Age	**18-24**	**25-34**	**35-44**	**45-54**	**55-64**			
	1 (7.69%)	2 (15.38%)	3 (23.08%)	5 (38.46%)	2 (15.38%)			
Gender	**Female**	**Male**						
	11 (84.62%)	2 (15.38%)						
Business Type	**Consulting Services**	**Education and Training**	**Food and Beverage**	**Manufacturing and Craft**	**Professional Services**	**Retail and E-Commerce**	**Other**	
	3 (23.08%)	2 (15.38%)	1 (7.69%)	1 (7.69%)	1 (7.69%)	2 (15.38%)	3 (23.08%)	
Employees	**Solo Entrepreneur**	**2-3 Employees**						
	12 (92.31%)	1 (7.69%)						
Years in Business	**< 1 Year**	**1-3 Years**	**4-6 Years**	**7-10 Years**	**> 10 Years**			
	5 (38.46%)	4 (30.77%)	1 (7.69%)	2 (15.38%)	1 (7.69%)			
Business Revenue	**< $10k**	**$10-20k**	**$20-50k**	**$50-100k**	**$100-200k**	**> $200k**		
	8 (61.54%)	2 (15.38%)	1 (7.69%)	1 (7.69%)	0	1 (7.69%)		
Is Business Primary Employment?	**Yes**	**No**						
	4 (30.77%)	9 (69.23%)						
Hours Per Week	**1-5h**	**6-10h**	**11-15h**	**15-20h**	**21-25h**	**26-30h**	**31-35h**	**36-40h**
	4 (30.77%)	1 (7.69%)	0	0	4 (30.77%)	0	1 (7.69%)	3 (23.08%)

Note that some categories with 0 responses have been omitted from the table for space reasons

Teaching Case

Agile Learning in Action: Fostering Students' Agile Mindsets and Experience with a Classroom Client Project

David M. Woods
woodsdm2@miamioh.edu

Andrea Hulshult
hulshuar@miamioh.edu

Computer & Information Technology Department
Miami University Regionals
Hamilton, OH 45011, USA

Abstract

IT/IS educators continue to work to develop content and activities for teaching Agile practices, processes, and methodologies to their courses to ensure students have the skills expected by businesses. Given the wide range of tools and technologies that fall under the umbrella of Agile and the wide range of places where Agile is applied, educators face a daunting task. Since Agile is a methodology for completing projects in a changing environment, providing students with real-world experience using Agile is essential. This work presents an activity that uses a real-world client project to allow students to gain experience with Agile practices and projects while also working to develop and use an Agile mindset.

Keywords: Agile, active learning, collaboration, Agile project.

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Agile Learning in Action: Fostering Students' Agile Mindsets and Experience with a Classroom Client Project

David M. Woods and Andrea Hulshult

1. INTRODUCTION

As the use of Agile methodologies by software developers, IT professionals, and others continues to grow, IT educators are bringing Agile into the classroom (Digital.ai, 2024; Krehbiel et al., 2017). The growing use of Agile is also leading to discussions about the challenges of adopting and scaling Agile. Bryar and Carr (2021) ask "Have we taken Agile Too Far?" and discuss concerns that organizations are using Agile without enough consideration about whether it is appropriate for their circumstances. Similarly, the 17th State of Agile report notes that "At this moment in time, it feels like Agile is having difficulty adapting." (Digital.ai, 2024). Despite these concerns, discussions with employers continue to support the value in teaching our students about Agile.

Agile is a methodology for doing work and building products, so, naturally, IT/IS classes teaching Agile should have a project component where students use and develop their Agile skills. Additionally, since a key part of being a successful Agile practitioner is developing an Agile mindset that "welcomes uncertainty, embraces challenges, empowers individuals, and views failure as a learning opportunity" (ICAgile, n.d.), the project component must include an environment that promotes the development of this mindset. This paper describes a class project where students spend several weeks using Agile methods and practices to complete a project for a real-world client.

This client project is used in a course that all IT majors are required to take. The class is accredited by the International Consortium for Agile (ICAgile), and students who complete the class earn the ICAgile Agile Fundamentals Certification. The class is a prerequisite for two additional elective Agile courses. IT students typically take the class at the end of their first year or the beginning of their second year. The class is open to students from all majors and regularly enrolls non-IT students. The course does not focus on a specific methodology or flavor but rather focuses on the development of an Agile mindset. The course starts with a discussion of the history of Agile and the Agile mindset, and it provides an overview of the main Agile practices and processes and how they fit into the iterative Agile development process. Throughout this part of the course, students are introduced to a variety of Agile tools, practices, and methods that the instructors feel are appropriate for students at the beginning of their Agile journey. After this initial lecture and discussion-based phase of the course, students complete a short practice project using Legos (Woods & Hulshult, 2024). The remaining six to eight weeks of the course are then spent on the client project.

2. MOTIVATION

It is a common practice for the technologies and practices used by working IT/IS professionals to drive changes to the content taught in IT/IS programs. Hence, as organizations continue to adopt Agile methodologies, IT/IS educators are working to bring Agile into the IT/IS curriculum. As noted by Reed and Killingworth (2024), "it is important to educate Information Systems (IS) project managers in a way that prepares them to use their new skillset in the workplace immediately." This supports teaching Agile using both traditional teaching methods to provide foundational knowledge and hands-on activities that allow students to gain experience working with Agile and develop an Agile mindset.

Previous work (Woods & Hulshult, 2024) discusses a short practice project that can be used to provide students with initial experience using Agile and also provides a review of other activities and approaches that have been developed for teaching Agile. While there are several useful activities for teaching Agile, many are short, focusing on a particular aspect of Agile or using a simulated project that provides fewer opportunities for students to encounter the uncertainty and ambiguity present when working with a real client. An additional consideration for a longer Agile project activity is the level of the student's technical skills. There are longer project activities (Babik, 2022; Baham, 2019), but the expected level of student technical skills would limit these to upper-level students, delaying the introduction of Agile until late in the curriculum.

3. DESIGN

The main goal of the client project is for students to gain experience working with Agile and begin developing an Agile mindset. The project has several constraints. The primary constraint is the limited time available for the project. In a typical semester, the classwork needed to provide students with an introduction to Agile will take about half of the semester. It is also helpful to do a short practice project to allow students to get more comfortable before they work on an actual client project, leaving 6 - 8 weeks for the client project. Another constraint is that the students are new to Agile. In a professional setting, Agile teams typically have a mix of experience levels, allowing the more experienced members to provide leadership on the more complex aspects of Agile, such as estimating, coaching the team, and interacting with the client. A final constraint that must be considered is the students' technical skills. The typical student in the course is an IT major in their first or second year of study, but the course is open to all majors. These factors mean that the students in the course often have limited technical skills.

To address the constraints, we decided to be realistic about our goals for having students gain experience with Agile and focus on ensuring that students gained experience with a limited set of Agile practices and processes while still seeing all aspects of an Agile project. Based on discussions with local companies and Agile professionals, one of the main goals was to provide students with the opportunity to develop aspects of the Agile mindset, including learning and discovering quickly, prioritizing to deliver customer value quickly, continuous inspection and feedback, and the value of self-directed teams.

To support the detailed goals of promoting an Agile mindset and having students gain experience with basic Agile practices and processes, we decided to structure the client project with a focus on the iterative Agile development cycle of planning, development, showcase, and retrospective. The project would also include the initial planning, especially writing user stories to document client requirements. However, given the lack of prior experience with Agile, we decided that the planning would focus most on documenting how the user stories provided value to the customer and prioritizing the user stories. While students would do other aspects of planning, including estimating and release planning, we expected these to be more challenging for students.

During the project iterations, the focus would be on having students work on the project and use the project storyboard to track progress on the iteration. Typically, the project uses two-week iterations, resulting in three or four iterations. Daily standup meetings were used to promote team communication and offer students an opportunity to gain experience in the Agile coach role. It was also important to focus on the showcase and retrospective activities of the iteration to give students experience discussing the value of their work with the client, receiving feedback from the client, and engaging in retrospectives to provide an opportunity to improve their teams.

Less emphasis was placed on iteration planning due to expected challenges with estimating. The main focus of planning was to ensure that the user stories brought into the iteration were well prepared, had defined acceptance criteria, and would be a reasonable amount of work for the team to complete during the iteration. The project was also designed with the expectation that the instructor would fill the Agile coach and business product owner roles as needed.

4. IMPLEMENTATION

The implementation of the project design was divided into two parts. The first part involved the initial project initiation activities, including the project kickoff meeting with the client, team building, project conceptualization, project initialization, and planning for the first iteration. The second part involved the iterative work to build the project, which typically consisted of three to four two-week iterations, with students showcasing their work to the client at the end of each iteration.

Two groups of assignments were used to assess the team and individual student work during the client project. One group consisted of assignments where submissions were made by the team, and with a few exceptions, all team members received the same score. The assignments in this group consisted of a project kickoff assignment and showcase assignments for each iteration. The assignments in this group counted for 30% of the overall course grade.

The second group of assignments were individual assignments designed to allow students to show their individual contributions and their progress using Agile practices and processes and the Agile mindset. Students submitted a written assignment reflecting on their accomplishments at the end of each iteration. For these assignments, students were prompted to discuss their individual contributions during the iteration, the value of these contributions, how Agile practices and processes were used, and how the Agile mindset was used. Students were also asked to identify at least one other team member who made particularly valuable or helpful contributions during the iteration and explain why the contributions were valuable. The assignment instructions also set the expectation that the discussion would be in a narrative format, well-written, and organized. The instructions stressed that the student needed to be specific and demonstrate the impact of their efforts. A minimum page length was not specified, but the instructions noted that it was unlikely that a page or two would adequately demonstrate the students' efforts. The individual accomplishments assignments at the end of each iteration were 20% of the overall course grade.

At the end of the course, students also completed an individual reflection and individual accomplishment paper that covered the entire course. This assignment counted for 20% of the overall course grade and asked students to discuss five separate areas. First, students were asked to bring in their individual accomplishments documents from each of the iterations and revise these documents based on the feedback provided by the instructor. Next, students wrote an individual accomplishment reflection for the final iteration. In the third section, students were asked to summarize and highlight one to three of their most valuable or noteworthy contributions to the team project. After this, students reflected on the course learning outcomes (See Appendix A) and discussed how their learning in the course connected to each learning outcome. Finally, students discussed one teammate whose overall contributions during the project were most valuable and explained how these contributions provided value to the team.

Project teams completed an extensive set of activities to initiate the project. These are discussed in detail in Appendix B. The project started with a project kickoff and a client meeting. Next, the teams completed teambuilding activities, including setting up the team’s infrastructure for the project and naming the team. After this, the teams worked on activities to build a conceptual understanding of the client’s request. This included writing a focusing statement, discussing initial project ideas, and identifying a minimal viable product (MVP). Finally, the teams initiated their work project development and prepared for the first iteration by developing user personas and documenting client requirements by writing user stories. The user stories were then prioritized and sized, and work for the first iteration was identified and documented on each team’s project storyboard.

During the iterations, teams worked to develop and test solutions for the user stories allocated to the iteration. At the end of each iteration, the client joined the class for a session where each team made a 7 - 10 minute presentation about the work completed during the iteration, including a demonstration of the product they were building. The showcase also included time for the client to provide feedback and teams to ask questions about upcoming iterations. After the showcase, each team completed a retrospective discussion of what went well during the iteration and what could be improved and used this to identify any changes to how the team works for the next iteration. Finally, the team identified the user stories for the next iteration, which often included adding new stories or revising existing stories based on feedback from the client.

5. DISCUSSION

Several different instructors have used this client project approach over several years. During this time, several lessons have been learned. As expected with Agile, the instructor’s approach to the client project has evolved to incorporate the experience of previous semesters.

A key part of a successful experience for the students is the selection of the client and the project. The instructor must start lining up a client and project a few months before the class begins. It is important for the instructor and client to establish a good relationship and for the instructor to ensure that the client is comfortable with the Agile approach, will be readily available to answer questions and provide information, and understands that the results of a student project can be unpredictable. As discussed in the design section, it is helpful if the project is one that students can easily understand and, ideally, one where students would be users of the product developed by the project.

It is also helpful if the technology used to build the project is one students are familiar with or can quickly learn. In our case, students are in their first or second year of study in an IT program, but they can also be students from other majors, so teams often have limited technical skills. Projects that involve developing content for a website implemented using Google Sites, WordPress, or other easy-to-learn tools have worked well.

In the real world, an Agile team will have members with previous experience using Agile. When someone new to Agile joins the team, they can learn from their teammates and adopt the Agile practices and processes already used by the team. Instructors in a classroom setting face the challenge of working with newly formed teams where all of the team members have no previous experience with Agile. To address this, the instructor must constantly monitor the teams and step in to provide coaching and feedback when needed. The instructor will also need to be familiar with the client's expectations for the project so they can fill the Agile business product owner role when needed.

Sample Projects

We offer examples of projects we have used in past semesters to help readers understand how they might implement this approach to an Agile client project. Several examples involve students building websites. One example was building a site with content focused on using Agile in teaching. The client was the university's Center for Teaching Excellence, where the instructor had a long-term relationship with the center and its staff. The instructor also had extensive experience using Agile in their teaching, so they could guide students in selecting the content developed for the site. The content also overlapped with the course content the students were learning, allowing them to think about how Agile concepts could benefit students in a course.

Several projects were connected to a campus-wide focus on student retention. For these projects, the client was the assistant dean for student and academic success, who was also the leader of the team exploring issues and ideas for improving student retention. The first student project was motivated by research showing that student engagement outside the classroom was the most important predictor of student retention. This focus was intentionally broad and allowed the student teams in the course to develop their own ideas. Retention team members were invited to all the showcase events and found it very useful to learn what students thought would help them be more engaged outside the classroom. Two groups explored the use of Discord, with one group looking at how Discord could be used for informal class discussions, tutoring, and other academic-related uses. The other group explored the use of Discord for student events and other non-academic uses. Another group explored using an education-focused online virtual environment for academic and non-academic uses. A final group explored ideas for a virtual major fair and a student-focused website containing the information students needed to successfully navigate tasks, including course registration, finding student services, and campus maps. The student-focused website prompted significant discussion, with all the students in the class agreeing that they struggled to find the information they needed on the university's website.

The retention team was very interested in the student-focused website idea, so a later class did this as a project using Google Sites as the hosting platform. This generated much discussion with the student teams. The retention team was especially interested in seeing what information students thought was important and how content written from a student perspective - the perspective of the people actually using the resources, differed from how the same content was written by the professionals providing the services. There was also much interest in the videos created by the student teams, which showed the influences of TikTok, with short, casual videos rather than the longer, more professional, and dull format used on the university website. The result of this project was that the campus web content team decided to implement the idea of a student-focused website. This led to yet another iteration of the project idea using the campus WordPress platform along with a focus on creating a consistent set of video content.

Challenges

The Agile client project can be challenging due to the uncertainties of working with a real client and the fact that the students are new to Agile. One issue is that in discussions and written work, students will focus on what they did rather than why they did it. For example, a student will discuss the details of content they added to a website. This is good, but more is needed. Agile focuses on delivering value to the client, so students must also discuss why what they did has value to the client. For most students, this improves as they receive feedback from the instructor.

Another issue is with the Agile practice of limiting the work an individual team member is responsible for at a given time. In an Agile iteration, the team commits to completing a set of user stories. During the iteration, a team member will take ownership of a story and complete that story before taking ownership of another story. Some students will want to be told what to do rather than picking their own work. Also, some teams will select a leader to assign work to team members. The instructor will need to watch for these practices. A key to addressing these issues is ensuring that teams create and regularly maintain an Agile storyboard showing the status, including ownership of the stories a team is working on during an iteration. We require that all project teams use Trello to create Agile storyboards and that the instructor have full access to the team's storyboard. This allows the instructor to regularly review the storyboard to ensure that stories are moving from a to-do status to a doing status and then to a done status. Instructors also look to see that a team member owns all stories in the doing or done status and that team members are not working on too many stories at once. Trello also allows the instructor to see whether all students are engaged in maintaining the storyboard rather than having one person assign and update stories. With coaching and prompting from the instructor, this issue can usually be resolved during the initial iteration. However, it should be noted that some students do not get out of the mindset of expecting someone else to tell them what to do.

Many of the student issues seen in the class are related to the course's fundamental goal of having students develop an Agile mindset. Students cannot be given a set of steps for doing this. Instead, the client project is an activity designed to prompt the development of this mindset. Much of the instructor's work during the project is prompting students to think about how to do things using an Agile method and coaching them as needed with ideas on how to do this. We have noticed that developing an Agile mindset can be more difficult for first-year students who are also working to shift from a high school mindset, where they are provided more structure and direction, to a college mindset that requires more student initiative and organization. To address this concern, we recently added our university's required first-year English composition course as a prerequisite for the Agile course.

Use of AI

With the rapid expansion of AI, especially generative AI, we are seeing student use of AI in this course. We find that with the client's approval and the instructor's guidance, using AI to help build the client's product can be helpful. Students are expected to understand the limitations of AI and take responsibility for all of the content included in the project, for example, making sure that AI-generated content is correct and relevant to the project. With these limits, students have made good use of AI. For example, careful use of AI can help ensure that all of the content on a website has a consistent voice.

It appears that students are also using AI to complete the assignments required as part of the client project. There is no way to confirm this, but some student submissions show the hallmarks of AI. This use of AI has not been successful, especially for the individual accomplishment assignments. These assignments require students to discuss what they did during an iteration and why this has value. Students must also discuss how they used Agile practices and processes and demonstrated the Agile mindset. The suspected AI submissions are well-written but are very high-level discussions lacking the details needed to support the statements about what a student did or how they used Agile. They also tend to be very generic; for example, in the website building projects, some submissions would discuss implementing a login or building software for a web application when there was no login and the project used a content system like Google Sites or WordPress.

6. CONCLUSION

This activity allows students to practice using Agile practices and processes and develop an Agile mindset in a real-world setting, where they can experience the uncertainty and ambiguity they will encounter when using Agile in a professional setting. Over several years, the use of this activity has shown that it can be effective, but it also has challenges. An instructor with experience in the Agile coach role and previous experience with client projects can overcome many of these challenges.

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APPENDIX A
Course Learning Outcomes

At the end of the course, students will be able to:

1. Describe the history and mindset of Agile
2. Describe and apply Agile practices that facilitate effective communication and Agile values
3. Describe and apply Agile practices that facilitate effective customer interaction in order to control risks and adapt to change in product development
4. Describe and apply practices that help the team to quickly deliver products that are of value to the customer
5. Describe and apply Agile practices that help the team to plan, monitor, and improve their way of working.
6. Describe and apply Agile practices and mindset to the course project within a team environment.

APPENDIX B
Details of Project Initiation Activities

Project Kickoff

The main purpose of the project kickoff is to provide a launching point for the project and the student teams. The project kick-off introduces the client and the students and provides students with the opportunity to hear about the customer’s goals and needs from the customer's perspective. A large portion of the project kick-off involves assisting the student teams in team-building activities to get organized and bond as a team. The project kick-off allows student teams to learn concepts for solution ideation and develop possible solutions for the client’s problem. This ideation session leads to a preliminary list of tasks and a project schedule to help the teams get started.

Client Kickoff

The client kickoff meeting occurs early in the project, usually before students begin to work on the project, so the students can meet the client and discuss the project. This meeting can be held in person or virtually. The authors suggest that the course instructor provide the client with a list of meeting dates early on in the project or even before the academic session begins. The authors of this paper find a client the academic session before the course is to be taught so dates for meetings can be determined and booked on calendars. It is recommended that dates be set for the client kickoff meeting, two or three check-in points, and the final project presentation.

Teambuilding

After the project is kicked off, the project teams progress through a series of team-building activities to encourage team bonding and accountability. The first team-building exercise is creating a social contract for each student team. Social contracts can be written on a virtual document or a physical piece of paper. A social contract is a set of rules a team develops together that govern how their team works above and beyond their project tasks. While there is no defined set of questions for developing a social contract, questions that can get teams thinking about their governance include: What do we value as a team (e.g., accountability, being on time, listening, etc.)? How will we handle conflict? How will we run our meetings? How will we manage our work? How will we know if we are successful? How will we have fun? As a team develops a social contract, they learn more about each other and create shared expectations for how they want to work as a team. According to the Agile Academy (2018), the benefits of a social contract are that (1) teams need to own their practices and standards to have a commitment to them; (2) it contributes to a safe working environment, giving people the power to have conversations about behaviors considered inappropriate; and (3), it helps build the unique character of the team and creates a shared sense of identity. As the class and project progress, the team can refer back to the social contract if behaviors arise that are addressed in the social contract (Hulshult & Krehbiel, 2019).

Infrastructure

The next team-building activity is discussing and outlining the team's infrastructure from a functional perspective. Each team discusses where they will store their files, create any necessary file structure, and ensure all team members have access. Teams create a storyboard to manage their work. The authors recommend using the platform Trello for storyboards. Other infrastructure items include discussing any specific team roles and responsibilities. The infrastructure activity aims to ensure that each team has the tools to do its work.

Team Names

The last team building activity is for each team to develop a team name, which helps to create their identity as a team.

Concept Activities

Concept activities assist teams in developing an initial solution for the client project. The three concept activities used in the Agile Client Project are the focusing statement, developing initial product ideas, and outlining the Minimal Viable Product (MVP).

Focusing Statement

The focusing statement helps teams have a shared understanding of their focus. Focusing statements help teams to stay on track and remember what they are supposed to be developing. If the team is discussing if they should do something or not, they should refer to the focusing statement so they do not end up doing work that is not necessary. Focusing statements also help a team remain focused on completing the project rather than going in a different direction. A simple template for a focusing statement is: "How can <our team> create/solve <product/problem> for <client> so that <benefit for client> while <how benefits are achieved>. It is helpful if each team shares its focusing statement with the client to obtain feedback. The team should keep this document in their team folders where it is readily accessible.

Initial Product Ideas

Once the focusing statement is completed, each team starts ideating initial solutions to the client's problem or project. One effective technique for ideating initial solutions is to have each team member write one or more ideas on Post-it notes. There should be one idea per Post-it note. Next, the teams select one idea as their product using techniques such as horse racing or an Agile lean coffee introduced earlier in the semester. Both of these ideation approaches help teams come to a shared understanding of what their solution is going to be.

After identifying a project idea to proceed with, the teams should check the idea against their focusing statement to ensure the idea aligns with their project mission. After the focusing statement has been reviewed, each team sketches out a high-level solution and creates a list of the product's main features. These sketches and lists were saved so that teams could refer back to them throughout the project.

Minimal Viable Product

The Minimal Viable Product, or MVP, is an agile concept that helps teams create a first cut of the project that contains the most important features. The solution's most important features are developed first, and this becomes the MVP. The MVP is the smallest viable product, and because it contains a small set of features, it can be launched quickly and additional features added in the future (Abbott et al., 2022).

Initiate Activities

The initiate phase of the Agile process contains several activities that assist teams in developing tangible work items for project completion: personas, prioritization, and sizing. After completing these activities, teams have a solid outline of the work at hand and the priority for completion.

Personas

In Agile, personas are fictional characters created to represent different user types that might interact with a product or project. These personas represent the target audience and help teams understand and empathize with the client's needs, goals, behaviors, and challenges and ensure their work meets those needs.

User Stories

User stories, sometimes called story cards, are an Agile practice teams use to represent requirements for a project, and they are displayed on a physical or virtual Kanban board. A collective group of user stories defines the project requirements and maps out the work that needs to be completed. A user story contains a sentence or two that describes a necessary function or requirement for a project (LeanDog, 2012). User stories contain criteria that must be met for the story to be marked "complete," and user stories are verifiable, meaning the work outlined on the user story can be validated or tested. User stories can be written on index cards and attached to a whiteboard or created and managed virtually on a storyboard using a platform such as Trello. This helps track the progress of projects because team members can assign story cards to themselves and take accountability for the work. User stories also allow instructors to see the progression of a team's work and allow for instructor intervention and support.

Prioritization

After students develop a backlog of user stories for their project, they need a democratic way to prioritize the work and determine which user stories should be completed first. The goal of prioritizing user stories is to build the MVP. Student teams should ask themselves, "What user stories must we complete first to build the MVP?" MoSCoW is a prioritization technique Agile teams use to prioritize their user stories. All user stories are put into one of four categories: Must have (M), Should have (S), Could have (C), and Won't have (W) (Krehbiel et al., 2017). Students can discuss the user stories and mark each one with an "M" if the requirement is a "Must," a "S" if the requirement is a "Should," a "C" if the requirement is a "Could," and a "W" if the requirement is a "Won't." This helps students to prioritize their work and complete the work marked with an "M" first, so they are focused on creating the most important requirements first.

Sizing

Once prioritization is complete, teams need to size or estimate user stories. Sizing user stories helps teams determine the effort needed to complete a user story. This helps them understand how simple or complex a user story is so they can budget their time accordingly. The two most common sizing approaches are the Fibonacci sequence and t-shirt sizing. The Fibonacci sequence (1, 2, 3, 5, 8, 13, 21) is used because the gap between each number increases as the sequence progresses, reflecting the uncertainty and increasing difficulty in estimating larger tasks. The more complex the task, the higher the number given to the user story. T-shirt sizing uses standard t-shirt sizes: XS, S, M, L, XL. The purpose of t-shirt sizing is to quickly gauge the effort or complexity of a user story.

Planning the First Iteration

Once the project kickoff activities are complete, the teams plan for the first iteration of work. The first step in iteration planning is to select the user stories with the highest priority ("M" for "Must"). The "Must" user stories will be completed first. Each team evaluates their "Must" user stories and estimates how many of them (based on the sizing) they can complete in the first round of work (two weeks, two class periods, one month, etc.). User stories that have a higher sizing increment reflect more complex and difficult work, which will take longer. Sizing helps teams understand the level of effort required to complete the user story so they do not over-commit to completing work. After user stories are selected, each team member signs up to complete user stories during the iteration. Iteration planning takes practice, and students will most likely not get it right at first.

When to use ChatGPT: An Exploratory Development of a 2x2 Matrix Framework

David R. Firth
david.firth@umontana.edu
Management Information Systems
University of Montana
Missoula, MT 59812, USA

Adam Gonzales
adam.gonzales@vermontlaw.edu
Vermont Law
South Royalton, VA 05068, USA

Michelle Louch
mel321@pitt.edu
Healthcare Management
University of Pittsburgh at Greensburg
Greensburg, PA 15601, USA

Bryan Hammer
bryan.hammer@umontana.edu
Management Information Systems
University of Montana
Missoula, MT 59812, USA

Abstract

ChatGPT is having an impact on students, and information systems (IS) and computing academic professionals alike. Our goal for this paper is to help faculty and students know the conditions in which generative AI such as ChatGPT should or should not be used. To that end, we describe the development of a 2x2 matrix. On the horizontal axis we have the faculty member, and on the vertical axis we have the student. The faculty member is dichotomized into being there to just give a grade or being there to teach a skillset. The student is similarly dichotomized into being there to just get a grade or being there to learn a skillset. This dialectic expresses the real and important tension between the actions and intentions of faculty and students, and we use it to develop a framework as to when each should use ChatGPT. For each of the four quadrants of the 2x2 matrix we discuss three challenges facing IS and computing education: 1) cheating by students, 2) career readiness of students, and 3) faculty response. Important directions for future research are also provided.

Keywords: Information Systems Education, Generative Artificial Intelligence, ChatGPT, Cheating, Career Readiness

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When to use ChatGPT: An Exploratory Development of a 2x2 Matrix Framework

David R. Firth, Adam Gonzales, Michelle Louch and Bryan Hammer

1. INTRODUCTION

The impact of generative AI such as ChatGPT on higher education is evolving by the minute. A search of YouTube about ChatGPT reveals a myriad of "how to" videos, such as "10 ChatGPT Hacks | THAT TAKE IT TO THE NEXT LEVEL!!!" (Hayls World, 2023) with over 546,000 views, and "ChatGPT Tutorial - A Crash Course on Chat GPT for Beginners" (Twarog, 2022) with 5.8 million views. The "how-to" of ChatGPT has been well addressed by the non-academic community. Less well addressed is when to use ChatGPT. The research question for this paper was: from a student and faculty perspective, when should each use generative AI (such as ChatGPT), or not? It is our contention that understanding when faculty and students should use generative AI is an important step to understanding how to incorporate, or ban, generative AI in the classroom.

2. PRIOR RESEARCH ON GENERATIVE AI IN THE CLASSROOM

We first note that the corpus of prior research in this field is expanding quickly, and keeping up with it and including it in a paper is more difficult and complex than usual. Van Slyke et al. (2023) note that we "currently lack in-depth knowledge about how ChatGPT and related tools might influence IS education in the next five years." They go on to structure their research around the three challenges facing IS Education: 1) cheating by students, 2) career readiness of students, and 3) faculty response, for instance in how to write questions for exams. We use these three challenges to frame our discussion of prior research on generative AI as it relates to faculty and students.

Challenge of cheating by students

At the 2023 Information Systems & Computing Academic Professionals (ISCAP) conference, Dr. Sue Brown of the Eller School at the University of Arizona gave the keynote speech, "Challenges and Opportunities for IS Teaching and Research in the Age of GenAI" (Brown, 2023). She noted that "over 43% of college students have used AI, with between 20% and 40% having used it for graded assignments," and that "51% of students see using AI tools for assignments as cheating."

On the topic of cheating, a "desire to get ahead" has been found to be an important motivating factor (Simkin & McLeod, 2010). The degree of academic preparation, and the student's perception of opportunities to cheat has also been found relevant (Hongwei et al., 2017). This seems particularly relevant in the context of this paper, as both degree of preparation and the opportunity to cheat are highly influenced by ChatGPT. As noted by Van Slyke et al. (2023), ChatGPT is very good at handling lower-level skillsets tasks, which means that a student who has not put in the time and effort to be prepared would find ChatGPT highly useful. Similarly, the fact that ChatGPT is free and easy to use provides students opportunity to cheat on assignments that are not proctored by faculty.

Challenge of career readiness of students

"Numerous studies have highlighted the importance of relational and professional competencies for the information systems (IS) profession" (Tyran & Tyran 2020). Prior studies have also shown that students' behaviors, skills, and knowledge levels are important themes for graduates when they enter the workforce (e.g. Faisal et al., 2021).

Emerging research has also shown that the ability of generative AI to automate and augment what graduates can and will do at work covers a wide array of industries, including "marketing and advertising, retail, healthcare, banking and finance, news and media, e-commerce, social media, legal services, hospitality, telecommunications, and government" (Sirithumgul, 2023). This means that students who have a solid understanding of AI concepts and tools will have an advantage when it comes to contributing to the integration of AI technologies in business (Chen & Quin, 2023). A generative AI career-ready student is important because "organisations have realised positive benefits from AI projects" (Raftopoulos & Hamari, 2023).

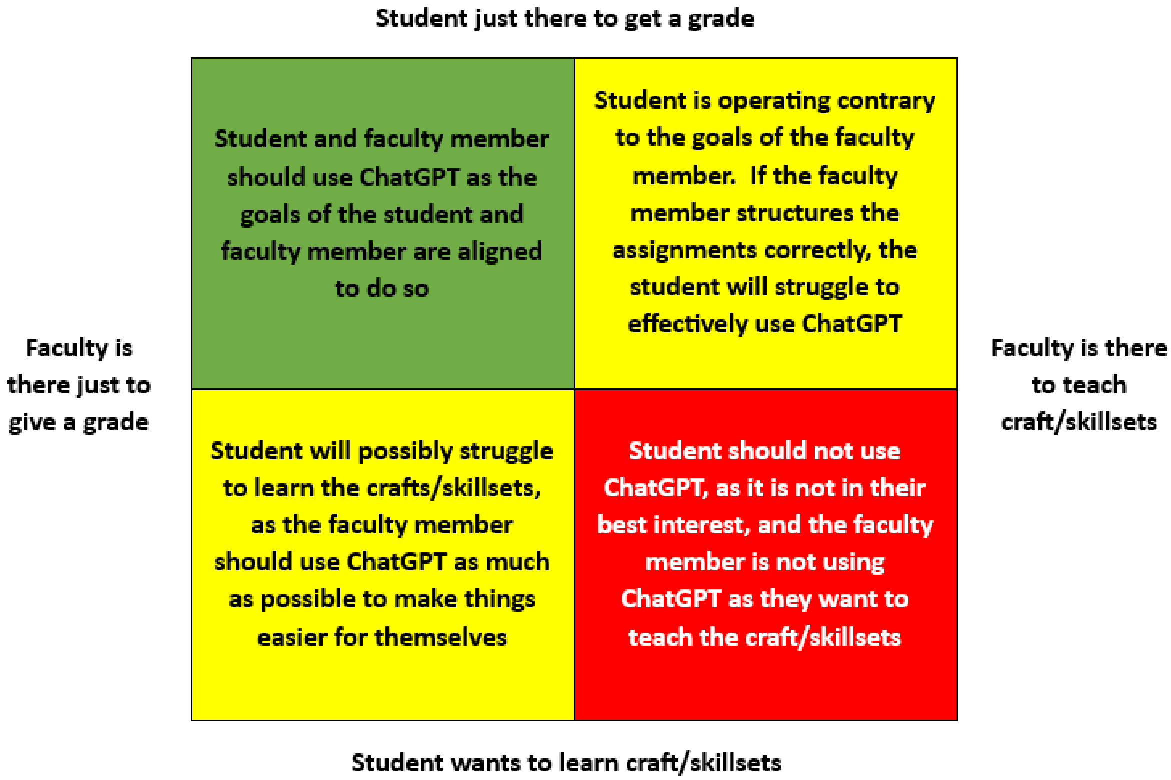

Figure 1: When to Use ChatGPT 2x2 Matrix

Faculty Response

Van Slyke et al. (2023) discuss faculty response largely with respect to how to develop, deliver and grade assignments, projects, and exams in the context of students' ability to use generative AI to generate answers and deliverables.

Brown (2023) noted in her keynote that this is not the first time that a new technology has permeated the classroom, and faculty have had to make decisions on whether to ban or incorporate it. Though there are many examples, one of the clearer ones is when graphing calculators emerged, and the subsequent upheaval around when or when not to use these when teaching mathematics. As we now know, graphing calculators have been fully integrated into the high school classroom.

In sum, the currently limited prior research on generative AI has focused on the three challenges facing IS Education: 1) cheating by students, 2) career readiness of students, and 3) faculty response. The literature on cheating by students is substantial, and we believe can be used in the context of generative AI, as we will show. We will also incorporate the challenges of career readiness of students, and faculty response to generative AI as we describe our 2x2 framework on when to use ChatGPT.

3. 2x2 MATRIX FRAMEWORK CREATION

This paper aims to provide guidance for students and professors on when to use ChatGPT. With these two dimensions, to us it was natural to develop a 2x2 matrix with students on one axis, and professors on the other. The 2x2 matrix provides a simple to understand, easy to explain, and useful way to introduce a complex topic to students.

When it comes to developing a 2x2 matrix, Lowy & Hood (2004) say to "create a 2×2 matrix that expresses a real and important tension in your life … 2×2 modeling is characterized by discovery and unpredictability."

It is our experience with students that they can, simplistically, be broken into two types: those who are in class to learn, and those who are in class to just get a grade. We have also observed this with our faculty colleagues: some are there to teach the skillsets that are important and relevant for the class, others are there to just give a grade. This is the "real and important tension" that we decided upon to form the ends of our two axes (Lowy & Hood 2004).

As we were developing the "important tension," we tested the 2x2 we had developed on 18 MBAs in the Generative AI section of a weekend Digital Economy course to validate its usefulness, as well as to solicit qualitative feedback during class discussion. All 18 of the students were live via Zoom. From the feedback we received, we refined the 2x2 matrix to the axes presented in this paper and used it again in the Generative AI section of a class of 74 business students in a graduate-level Introduction to MIS class. This class had 32 of the 74 students on Zoom with the remaining 42 students participating asynchronously from the live-on-Zoom recordings

as well as custom-made recordings. Shortly after, we used the 2x2 matrix in the Generative AI section of an undergraduate-level Introduction to MIS class, populated by over 100 sophomores of all majors, to subject it to a rudimentary test of generalizability across business students and both graduate and undergraduate students.

The *When to Use ChatGPT 2x2 Matrix* is presented in Figure 1 on the previous page. On the horizontal axis we have the faculty member, and on the vertical axis we have the student. The faculty member is dichotomized into being there to just give a grade or being there to teach a skillset. The student is similarly dichotomized into being there to just get a grade or being there to learn a skillset. It is important to note that on the horizontal axis, when we say faculty, this can also mean just one or more classes by the faculty member, or one or more assignments in a class. That is, we can use this at different levels of abstraction. The same is true for a student on the vertical axis. A student could be just there to a just to get a grade for a class, or there just to get a grade for a particular assignment in a class.

Checked-out/Checked-Out (top left)

We have tested out this 2x2 matrix in class, as discussed previously, and when we do, we start with the upper left quadrant: The faculty is just there to give a grade/the student is just there to get a grade. We call this "checked-out/checked-out" as we think it reflects the fact that the faculty member, in just wanting to give a grade, is checked-out of their teaching responsibilities, and that the student is also checked-out of their learning responsibilities. We color coded this quadrant green, meaning that both the faculty member and student should use ChatGPT as much as possible. It is in both of their interests to do so. We again note that although we have labelled this "faculty," the 2x2 matrix here is just as useful at the "class" level of analysis and the "assignment" level of analysis. By this we mean it is quite possible that a faculty member has just one class of several that they teach for which they determine that they are there for, or their preference is to "just give a grade." Further, an otherwise engaged member of faculty might have an assignment, or several, that is there just to give a grade to.

The intent of this paper is not to give justifications for the reasoning behind the faculty member's choice to "just give a grade" for the class or just for the assignment. We also do not intend to give ethical reasons as to why this is appropriate or inappropriate, leaving that to a future paper (see Section 5 on future research).
We will provide speculative reasons for this for a faculty member which include: a) they have been assigned to the wrong class or subject, b) they have no knowledge of the class or subject and no interest in acquiring that knowledge in order to teach it, c) the department, college or university has policies or other factors in place that mean they don't care about or measure the faculty member's quality of instruction, d) the faculty member has other life issues that are impacting their ability to deliver the proper and appropriate instruction, e) the faculty member has other university issues that are impacting their ability to deliver the proper and appropriate instruction, f) the faculty member has determined that this is just one class (for instance, a colleague is on sabbatical) that they will only ever teach once, and does not want or care to put in the time or effort to instruct properly, and g) the faculty member has determined, for their own reasons, that the class is irrelevant to students. This list is not exhaustive, but we believe that the length of the list does provide evidence that there are situations and reasons for a faculty member to "just want to give a grade."

On the student axis, the top left quadrant represents a student who "just wants to get a grade." As for the faculty axis, it is important to note that this could be at the class level of analysis, that is there is a particular class that the student just wants to get a grade for. Additionally, this could be at the assignment level within a class, that is the student just wants a grade for a particular assignment within a class.

As with the faculty member, we believe that there are reasons why a student might be taking the class or completing the assignment "just to get the grade." Many of these reasons align with the findings of Miles et al. (2022). For instance, a student might just want to get a grade because the technology (including ChatGPT) facilitates the ability to get a grade. This could be a least-effort reason on the part of the student, or a try-the-new-technology out for a more effort-based student. The teaching environment could be a factor, including that the student has realized that the faculty member is just there to give a grade. Prior research has shown that the level that a student sees the investment in their learning by their faculty member impacts the level of cheating by the student (Andersen & Andersen, 1987; Ashworth et al., 1997; Stearns, 2001; Rabi et al., 2006).

Pressure to get a specific grade is another reason to just get a cheat. Pressure to succeed and/or fear of failure are related to cheating (Abdolmohammadi & Baker, 2007; Jeergal et al., 2015). Research on collegiate athletes has shown how this behavior manifests in this element of the student body. NCAA rules for participation in athletics for Division I student-athletes require a student to meet academic eligibility, which includes maintaining a minimum grade point average, and a steady progress toward completing their degree. This is also true for non-Division I athletes. A recent study on Division I student-athletes reports that the most at-risk for "just getting a grade" are those who view their main reason for attending college as mostly athletics, are majoring in business, and are in a high-profile men's sports such as football or basketball (Yukhymenko-Lescroart 2023). A full 20% of Division I student-athletes attend college exclusively for athletic reasons (Yukhymenko-Lescroart, 2022). The NCAA reports that over 25% of college athletes study business (Mikrut, 2022). Given this information, the university's business school is a likely nexus point for students who succumb to the pressure to cheat to just get a grade.

Checked-in/Checked-in (bottom right)
When we use this 2x2 matrix in class we next move to the lower right quadrant: the faculty member is there to teach a craft or skillset, and the student is there to learn a craft or skillset. We call this "checked-in/checked-in" as we think it reflects the fact that the faculty member is checked-in to wanting to teach skillsets to students, and that the student is also checked-in to wanting to learn skillsets for their future career. We color coded this quadrant red, meaning that neither the faculty member nor student should use ChatGPT.

At our universities, faculty response to when to use ChatGPT in class is across the board, from outright banning it, to promoting its use (Tallman, 2023). As part of the research to support this paper, we performed interviews with those on our campus who banned ChatGPT use in the classroom to better understand their reasoning. We found that the major underlying reason for banning ChatGPT use by students is that the faculty member wants to teach the craft or skillset associated with the class that they are teaching. For instance, the faculty member for an undergraduate class on writing noted that the majority of students in the class were wanting to head to law school, and "given the amount of writing that will require, teaching them how to write properly is going to be a fundamental skill for them" (Shearer, 2023). For the faculty member in this situation, the key here is that it is not about the end product, the output of the writing. Instead, in this quadrant it is about the teacher teaching, and the students learning the skillsets of the process of writing (in this instance). The faculty member here was adamant that the class was about making sure the students were career ready, and the faculty response was to do that by banning the use of ChatGPT.

One issue does arise in this quadrant: when ChatGPT is part of being career ready, and how to use it is a skillset. We coded this quadrant red, as a signal to not use ChatGPT, but if the intent of the faculty member is to teach the skillset of using ChatGPT to students who want to learn it for their careers, then obviously ChatGPT needs to be used.

Checked-in/checked-out (top right)
The top right quadrant is where the faculty is there to teach the craft or skillsets, but the student is there to just get a grade. We call this "checked-in/checked-out" as it reflects the fact that the faculty member is checked-in to wanting to teach skillsets to students, but that the student is checked-out and just wants to get a grade. In this quadrant, the student should use ChatGPT whenever they can get away with it in order to earn the grade. We color coded this quadrant yellow, as this quadrant is one in which the faculty member needs to pay attention.

Using ChatGPT for assignments and other gradable tasks is the prevalent student response in this box. We believe that a big issue here comes back to Brown's (2023) contention that a key to understanding students' use of ChatGPT when the faculty member believes they should not be, is to understand why students cheat. Prior research has found a major reason students cheat is that they do not consider what they are doing to be cheating. This is based on students' lack of understanding of what constitutes academic misconduct, cultural differences frequently arising from international students, and a cheating culture which has normalized cheating so that it is not considered cheating anymore (Miles et al., 2022).

ChatGPT use by the student when it is not the intent of the faculty member for students to use ChatGPT can be entirely unintentional due to ignorance (Brimble & Stevenson-Clarke, 2005, Chen & Qin, 2023). The faculty response to this would be to include syllabus language on what is expected from students around the use of ChatGPT. We have provided a copy of what we use in Appendix A. We specifically refer to this item in the syllabus, and also include a reference to this in every assignment that the student could possibly use ChatGPT for. Given our approach to letting students use ChatGPT, we also specifically tell students that if they use ChatGPT, they must provide the stream of prompts they use to develop their ChatGPT answer in an appendix or footnote to their answer.

The fact that the use of ChatGPT to entirely generate an assignment answer is plagiarism may not be understood by international students because of different cultural beliefs as it relates to ownership of ideas (Busch & Bilgin, 2014; James et al., 2019). The faculty response to this would be to include syllabus language specific to plagiarism, and what it means. Faculty might consider which courses, and when, plagiarism is covered in their college as they try to understand which quadrant in our 2x2 matrix students are in.

Most difficult of all when it comes to faculty response is when there is a culture of cheating which has been normalized to the level that it is not considered cheating anymore. Though we do not find research around the normalization of a culture of cheating in any particular student population, the prior discussion on collegiate athletes suggests an area where this may be more likely to exist. This highlights that where a student is in our 2x2 matrix may be a product of the institution, as much as an inherent aspect of the student themselves. This would therefore require an institutional-level response which could easily be out of reach of the faculty members.

When it comes to career readiness and faculty response (Van Slyke et al. 2023), if the student is there just to get a grade, then there are at least two interventions that the faculty member, who cares about teaching the skillsets to be career ready, can follow. One is that faculty members will need to develop assignments and assessments that are not able to be completed by ChatGPT, which is no easy task. This requires extra work by the faculty, including learning the tools themselves in order to know and test that assignments cannot be completed by ChatGPT. Van Slyke et al. (2023) suggest "mini-in-class assignments to effectively assess students' ability to evaluate and analyze content," but how do you prevent or limit the use of ChatGPT during these mini-assignments? And what about the impact on the faculty member of the extra grading created by many mini-assignments?

The other path for faculty members is to teach the ChatGPT skills that employers are looking for. At a basic level, one element of this comes down to "prompt engineering," and a focus on the how to use ChatGPT to get the answers that the student, or faculty member, or employer, wants. This has led to the development by faculty of in-class and out-of-class assignments where the use of ChatGPT is the whole point (e.g. Firth & Triche, 2023).

Checked-out/checked-in (bottom left)
The bottom left quadrant is where the faculty is there just to give a grade, but the student is there to learn craft/skillsets. We call this quadrant "checked-out/checked-in" as it reflects the fact that the faculty member is checked-out and should use ChatGPT as much as possible, but the student is checked-in and wants to learn the skillsets to be successful in their career. We have color coded this quadrant yellow, as this quadrant is one in which the student needs to pay attention. From the faculty member aspect, because they are just there to give a grade, there is likely little incentive to structure learning delivery or assessment any differently in a ChatGPT environment. The faculty member should use ChatGPT as much as they can. For a student who wants to learn the craft or skillset, this might be very frustrating.

From a career readiness perspective, this faculty member is already likely not engaged with making sure students are career ready. Van Slyke at al., (2023) note that "over time, the capabilities of AI tools may also lead to dramatic shifts in the skill requirements for IS professionals. Faculty must remain vigilant of such disruptions and adapt their programs accordingly." This is a "non-vigilant" group of faculty, so you are going to get an increasing gap between what students need and what is being taught. That is, in this quadrant, things get worse over time.

From a faculty response perspective, Van Slyke at al., (2023) note that "in addition to adapting teaching to assess student learning differently, faculty will need to learn to leverage ChatGPT to support the design and delivery of materials." Again, in this quadrant, faculty won't respond.

As a result of the faculty in this quadrant being "non-vigilant," two issues arising are: 1) what to do with this faculty member, and 2) how to help the student. For the faculty member, the primary issue is that the department faculty, chair, dean or others in the college need to identify the faculty member. The next issue would be to determine what is the reason for lack of engagement with students, or the use of ChatGPT to merely generate content without much thought or effort. The reasons could be wide ranging from mental health issues, physical health issues, over focus on research be it a personal choice or an institutional directive, stress from either internal or external sources, and other factors, and we do not one is in this paper other than to note that it would be important to figure out what the underlying issue is for this faculty member.

If the impact on the mission of the department is sufficient to be worthy of effort, then the next step is intervention. "Successful intervention begins with identifying users and appropriate interventions based upon the patient's willingness to quit. The five major steps to intervention are the '5 A's': Ask, Advise, Assess, Assist, and Arrange" (Agency for Healthcare Research and Quality, 2012). This paper does not focus on interventions.

From a student perspective, if they find themselves in a class where the faculty member is just there to give a grade, but the student is there to learn a skillset, then the first step is for them to confirm if the class is required to graduate. If it is, then the student needs to complete the class, and make sure they do what they can to earn a good grade. If the class is an elective, even one relevant to the student's chosen career path, then we recommend not taking the elective. Instead, we recommend the course of action suggested by Friedman (2004), "you should figure out on campus who the best teachers are, be they Greek Mythology, Calculus or Russian Literature, and take whatever class they are teaching, because you learn to learn by learning to love how to learn, and you learn how to love how to learn from great teachers." All of this means that students need to be engaged with other students in their major, so that they can have their finger on the pulse of who the best teachers are, and who are there just to give the grade.

4. DISCUSSION

The left-hand side of our 2x2 matrix is the most novel and leads to the most useful and interesting additions to the current literature, because it relates to a type of faculty that is not frequently mentioned in the literature: faculty who are there just to give a grade. A recent search of the literature (December 2023) using the term "disengaged faculty" was sparse in its results and had very little to say about teaching. Hillinger et al. (2022) discuss "faculty disengagement mechanisms that were related to their reticence towards misaligned and externally imposed policies." Huston et al. (2007) focus on how interactions amongst colleagues impacts disengagement and disillusionment. Finally, Boice (1986) examines the impact of faculty development programs have on neglected middle-aged, disillusioned, disengaged faculty. We discussed in our checked-out/checked-out quadrant that a checked-out faculty member who is just there to give a grade may not consider themselves as disillusioned in any of the ways described by the literature briefly cited above. For instance, faculty members who just give a grade to ensure that members of the university's sports teams can continue to play, as described by the New York Times (Thamel, 2006), may consider themselves to be very engaged in their university.

An additional contribution from this paper is the dissection of the types of students into those taking the class or completing the assignment just to get a grade, and those students taking the class or completing the assignment to get the skillsets needed for their future career. On the right-hand side of the 2x2 matrix, where the faculty member is wanting to teach the skillsets, this dichotomy helps faculty members to consider that there are two different types of students, potentially in class at the same time, seeking different outcomes. Knowing this, and taking it into consideration, can impact how class activities and assessments are modified. For instance, knowing that a student is there for the skillset might mean an assignment can be given outside of class, as their goal is to improve themselves and put in the time and effort to do so, be it with or without the use of ChatGPT. This is in contrast to the recommendation that faculty move to a flipped pedagogy and then use class time for assessment and activities (e.g. Van Slyke et al. 2023). With our dissection of the types of students into those taking the class or completing the assignment, a flipped pedagogy might not be the best strategy, or might be the best strategy but only for some of the students.

5. FUTURE RESEARCH

The 2x2 matrix that we present here, and the commentary and discussion that has flowed from the four quadrants, suggests several avenues for future research. One is how we might determine whether or not a student is in class, or completing the assignment, just for a grade or is instead there in order to learn a skillset for their future career. In discussions with the university colleague that banned ChatGPT because they want to teach the skillset of writing to future lawyers (Shearer, 2023), he acknowledged that he doesn't know what the split is between these two different types of students in his class. We discussed assessing students in some way to determine this, but this brought up the issue of whether or not a student would be truthful in disclosing this information (what student is going to tell their professor they are just there for the grade?), and whether this student determination would hold up for every point of the semester, when the pressures of the class, or other internal issues such as health, or external issues such as family arise.

One is the issue of ethics and how it influences when a member of faculty or student might choose to use ChatGPT, or not. The current research in this area is very preliminary. For instance, Zhang & Zhao (2023) find that the use of ChatGPT influences the overall well-being of students and faculty. They also find that there are two types of students, those that just use ChatGPT to get the output, and those that use ChatGPT to improve their critical thinking skills to get better results. This aligns with our dialectic for students who just want to get a grade, and those who want to learn the skillsets. What is still not clear is what the antecedents are that drive these students to these different outcomes. Future research should focus on understanding drivers on both the student and faculty sides.

6. CONCLUSION

We are operating at a wonderfully interesting time when generative AI tools such as ChatGPT are changing the way we deliver education. Our 2x2 matrix shows that we need to understand our students in a different way than we currently do. Are they in class or completing the assignment just for the grade, or to learn the skillset? Similarly, we need to understand our IS faculty colleagues along the same dimensions: are they delivering content just for the grade, or to teach the skillsets? Put together, this leads to different outcomes as to when to use ChatGPT for the faculty, and for the student.

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Appendix A: AI Policy for the syllabus, from Dr. E. Mollick, Wharton Business School

III. AI Policy

I expect you to use AI (ChatGPT and image generation tools, at a minimum), in this class. In fact, some assignments will require it. Learning to use AI is an emerging skill, and I provide tutorials in Canvas about how to use them. I am happy to meet and help with these tools during office hours or after class.

Be aware of the limits of ChatGPT:

- If you provide minimum effort prompts, you will get low quality results. You will need to refine your prompts in order to get good outcomes. This will take work.
- Don't trust anything it says. If it gives you a number or fact, assume it is wrong unless you either know the answer or can check in with another source. You will be responsible for any errors or omissions provided by the tool. It works best for topics you understand.
- AI is a tool, but one that you need to acknowledge using. Please include a paragraph at the end of any assignment that uses AI explaining what you used the AI for and what prompts you used to get the results. Failure to do so is in violation of academic honesty policies.
- Be thoughtful about when this tool is useful. Don't use it if it isn't appropriate for the case or circumstance.