Use of Generative AI Tools in Software Quality Assurance Work

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***Abstract*—This innovative practice full paper describes the authors' experiences introducing the use of generative AI (GenAI) in a hybrid undergraduate video game project course. On our campus hybrid courses have both in-person and online students participating in a single course taught by the same instructor. Online students often struggle with resolving technical issues that arise in the development of software products. The authors argue that use of GenAI in commercial software development is inevitable. We believe that students should be given opportunities to experiment with GenAI tools to complete some software engineering tasks. In this paper, the authors discuss how they integrate ChatGPT into the debugging process. The authors created a module on prompt engineering and the use of ChatGPT to help determine the causes of video game defects. The students were given two weeks to correct issues in a broken Unity 3D scene. Students used ChatGPT to generate defect repair recommendations. Students were asked to use reflective writing to assess the quality of the ChatGPT recommendations. Most students were able to correct all five game defects by entering zero-shot prompts to ChatGPT. Online students received a smaller number of suggestions from their prompts than the in-person students. Most students felt that ChatGPT helped them complete the debugging task more efficiently and enhanced their understanding of the Unity 3D environment.**

Keywords—Computer science, Critical reflection, Project based learning, Problem solving, Engagement, Product development, Distance learning.

I. Introduction

Generative Artificial Intelligence (GenAI) represents a cutting edge field within artificial intelligence that focuses on developing algorithms capable of producing content that mirrors human-like outputs, such as text, images, audio and video [1], [2]. One of the most promising and widely popular applications using GenAI today is ChatGPT [3], a GenAI-based large language model (LLM) developed by OpenAI [3], which has gained global recognition for its ability to handle complex language processing tasks and generate responses in an interactive conversational way. The recent advent of ChatGPT with its fast growing user base of approximately 180.5 million users [4] and free version offerings, has made it easily accessible [5], thus introducing the domain of GenAI to a large general audience of users. Additionally, it has spurred growing interest in both research and industry, driving a wide range of applications across multiple fields. [6].

The shift to the use of code libraries has had a profound impact on the efficiencies and capabilities in commercial software development. This higher level of code abstraction makes it difficult for novice programmers to determine the root causes of defects that may only be observed in the run-time behavior of the software. AI tools may be a useful way to augment developer capabilities in several phases of the software development life cycle (SDLC) besides coding (i.e. requirements analysis, design, testing, maintenance). It is likely, that significant interaction between software developers and AI tools will be necessary for some time to come [7].

GenAI tools can help to increase the efficiency and productivity of software developers. Software engineers want some freedom to configure their development environment to allow them to exercise their own creativity. Software engineers have a deeper and more holistic understanding of the SDLC that extends beyond the technical assistance provided by an AI tool. This expertise is the key to ensuring the quality of a software product. Engineers rely on their own creativity when refactoring code they have not seen before or when reusing code in clever ways [8]. Similarly the essence of game programming is figuring out innovative ways of combining game objects to create new game experiences.

Among the diverse domains impacted by GenAI, one that truly stands out is its role in transforming the traditional educational practices and the way people learn. For example, ChatGPT can act as a personal tutor for students, offering easy access to information, answering questions, and even generating code based on specific requirements [9]. Additionally, ChatGPT can foster independent learning by allowing students to explore topics at their own pace. With its ability to answer a wide range of questions, students can use it to delve deeper into subjects that interest them, reinforcing classroom learning and promoting curiosity [10]. Numerous educational institutions are investigating how ChatGPT can enhance learning environments. Furthermore, universities have been creating their own GPT-based tools to assist students with coursework using no-code platforms, which facilitate student engagement and learning without requiring programming skills.

However, the growing popularity of these tools has also raised concerns about their possible impact on students' learning and educational achievements. Some educational institutions have even started taking measures to prohibit the use of certain AI platforms to maintain conventional teaching methods and skills [11]. One of the major reasons behind restricting the usage of ChatGPT by educational institutions tends to be concerns related to direct copy-pasting of content, which may decrease student engagement and diminish critical thinking skills. Educators face challenges in preventing the use of ChatGPT for completing assignments, coding tasks, and homework, which could lead to issues like plagiarism, overreliance on technology, misinformation, and ethical problems [5]. Despite efforts to limit its usage in the educational domain, its widespread availability and easy access make it challenging to control its adoption by students [12].

Based on our experience with teaching ChatGPT, we believe that rather than banning ChatGPT, instructors should teach students how to utilize such tools effectively to enhance their learning experiences. We believe the advantages offered by GenAI tools in the educational domain outweigh the disadvantages, since their widespread usage is almost inevitable. Research has demonstrated that tools like ChatGPT can significantly improve student learning by acting as a personal tutor, providing immediate feedback, and generating new ideas [13], [14].

GenAI may have untapped potential due to students' limited knowledge of how to engage with these tools effectively. One study [15] found that despite students' intentions to use ChatGPT, there is a noticeable gap in their ability to engage with it effectively. Additionally, prior research indicates that enhancing students' interaction skills with large language models (LLMs) is crucial for maximizing the educational benefits, such as increased motivation and engagement [16], and enhancing their learning interest [17].

We believe that learning can be enhanced if students learn to make effective use of prompt engineering and to critically assess the resulting GenAI recommendations. Research on student learning shows many benefits to the use of reflective writing in problem solving situations [18]. Therefore, rather than restricting access to GenAI tools like ChatGPT, educators should focus on equipping students with the necessary skills to leverage these tools effectively for their academic improvement. This approach underpins the motivation for this work. This paper makes the following contributions:

1. We created a GenAI video module that can be completed asynchronously outside of class time. This makes it useful to online students and to in-person students participating in a flipped classroom. The topics covered include an introduction to GenAI, prompt engineering and the use of ChatGPT to correct quality issues with video game scenes.
2. We created an exercise based on a broken Unity 3D scene and asked students to formulate ChatGPT prompts requesting suggestions for fixing each of the five defects. Students tested each recommendation and performed tradeoff analyses while comparing each of the valid recommendations.
3. Students were asked to reflect on their experience using ChatGPT as a debugging tool. How effective was ChatGPT in suggesting solutions? Did using ChatGPT enhance their understanding of the Unity 3D development environment? What were the challenges or benefits of adding ChatGPT to their debugging workflow?

The rest of this paper is organized as follows: Section II provides an overview of the related work integrating ChatGPT and reflective writing into a video game project class. Section III describes the structure and implementation of the proposed course module. Section IV presents evaluations and observations obtained from module implementation. Section V discusses the study limitations and threats to validity. Section VI concludes the paper and discusses future directions of this work.

II. Related Work and Motivation

In this paper, the authors discuss how they integrate GenAI tool use in the software debugging process. The authors created a module on prompt engineering and used it to introduce students to its use in determining the causes of defects in a 3D video game project. This hybrid-learning class was taught using active learning. The student assignments in CIS 487 routinely incorporate the use of reflective writing.

A. Active Learning

Engineering educators regard experiential learning as the best way to train the next generation of engineers [19]. It is reasonable to believe that the soft skills practiced in active learning classrooms can improve the capabilities of software engineering students and better prepare them for their capstone projects [20]. Active learning is "embodied in a learning environment where the teachers and students are actively engaged with the content through discussions, problem-solving, critical thinking, debate, and a host of other activities that promote interaction among learners, instructors and the material" [21]. Prince defines active learning as any classroom activity that requires students to do something other than listen and take notes [22]. Active learning opportunities can complement or replace lectures to make class participation more interesting to students. Active learning using a flipped classroom approach can also foster developing an attitude of lifelong learning among students [23].

Active learning helps students develop problem-solving, critical reasoning [24], and analytical skills, all of which are valuable tools that prepare students to make better decisions, become better students, and better employees [22]. Raju and Sankar undertook a study to develop teaching methodologies that could bring real-world issues into engineering classrooms [25]. The results of their research led to recommendations to engineering educators on the importance of developing interdisciplinary technical case studies that facilitate the communication of engineering innovations to students in the classroom.

Active learning helps students learn by increasing their engagement in the educational process [26], [27]. The group work that often accompanies active learning instruction helps students develop their soft skills [28]. Some instructors believe that the project activities inherent in real-world software development encourage students to improve their written and oral communication skills [29].

Day and Foley used class time exclusively for exercises by having their students prepare themselves through the study of materials provided online [30]. Research suggests that the success of flipped classroom approaches depends on the nature of the course being taught. The investment in time required for instructors to develop quality out-of-class materials and in-class active learning experiences can be substantial [31]. The instructor time commitment becomes greater if both in-person and online students are in the same course.

The authors chose to make use of a flipped classroom approach for the project course discussed in this paper. Students viewed short video lectures before beginning the class activities.

B. Project-based Learning

Problem-based learning or project-based learning (PBL) has consistently demonstrated it can lead to positive learning outcomes such as self-directed learning habits, critical thinking skills, and deep disciplinary knowledge while engaging students in collaborative, authentic learning situations [32]. While PBL was first incorporated into medical school curricula in 1969, it is currently used in a wide variety of courses [33]. For instance, within the field of engineering, Warnock and Mohammadi-Aragh investigated the impact of PBL on student learning in a biomedical materials course and found that students made significant improvements in their problem-solving, communication, and teamwork skills [34].

PBL has been used in senior level engineering courses with the same positive results [35]. Although students in one PBL software engineering course reported that the projects were more time intensive than a typical course project, they were receptive to the approach since they thought it was related to the professional environment and provided them with opportunities to relate theory and practice. This contrasted with students taught using a traditional lecture and project approach to the course who viewed completing a traditional course project more negatively [36]. Each of our project courses contains a significant group project that requires several weeks to complete.

C. Reflective Writing

Research on student learning shows many benefits to the use of reflective writing in clinical or professional experiences. This suggests its use as an authentic assessment technique. Students asked to reflect on their learning experiences are better able to retain and transfer their learning to new contexts. The act of reflecting requires retrieval, elaboration, and generation of information can make learning more durable for students [37].

Promoting reflective thinking is important to helping learners develop strategies to apply added information to unpredictable situations in real life. Knowledge is created through the transformation of experience. Reflective writing could be one method for promoting reflective thinking that allows learners to consider their experiences and transform them into knowledge that can be applied in new contexts. Reflective writing is an effective method for promoting metacognitive thinking. Reflective writing can be a useful tool for communication between students and mentors in experiential learning activities [38].

Reflection provides opportunities for students to think about their performance, consider which strategies were effective, and contemplate how to improve their process. In work contexts, individuals who engage in reflection have lower error rates when learning new skills [39]. In asynchronous on-line courses, student reflective activities are important since students and instructors do not have opportunities for face to face communication. If gathered over a period of time, student writings can guide instructors in refreshing course content. If reflections are collected over the course delivery, students can use them to monitor their own progress. In face to face classes, reflective writing can be used to initiate in-class discussions in small group activities [40].

In active learning, students working in small groups or by themselves, are required to summarize the lessons learned from each hands-on assignment. If students are assigned to read a textbook before coming to class, it may be helpful to have them summarize their reactions to the reading in writing. Writing critiques of student presentations in-class also encourages the development of critical thinking, which is a valuable lifelong learning skill. It can be time consuming for instructors to grade large numbers of reflection documents, so this effort can be reduced by making use of peer evaluation strategies or allowing the submission of group reflection documents.

D. GenAI in Education

Numerous studies have explored the integration of Generative AI into educational settings, particularly focusing on its potential to enhance learning through immediate feedback and personalized tutoring [41], [42]. However, there are also concerns about academic integrity and the potential of negative impact on critical thinking skills. Studies highlight both the benefits, such as improved learning outcomes, and challenges, including the risk of plagiarism and issues related to GenAI content fabrication [42], [43]

Studies have demonstrated that the use of AI tools such as ChatGPT in programming courses significantly benefits students by enhancing their computational thinking, confidence, and motivation. These findings suggest that such tools can provide crucial support in educational settings [44], [45].

While generative AI tools are valued by students, their adoption by faculty remains relatively low. This low adoption rate is attributed to a lack of training and concerns about academic misconduct. There is a significant need for educational initiatives that help faculty and students effectively use these technologies, with a focus on ethical integration and academic integrity [46]–[48].

Recent research has demonstrated that tools such as ChatGPT are received positively in project-based learning settings, providing significant support in educational processes. Despite these advantages, challenges persist in maximizing the effectiveness of these tools, particularly in enhancing interaction techniques [49], [50]. These studies highlight the critical need for human oversight to ensure quality and manage complex interactions effectively [51], [52].

E. Motivation

GenAI holds great potential to enhance education through personalized support and quick feedback. However, it also introduces challenges such as academic integrity concerns, ethical issues, and the need for improved user interaction. Specialized training programs are crucial for helping teachers and students use AI tools ethically and effectively. These programs can help overcome these challenges and fully leverage the benefits of AI in educational settings.

A major challenge is the tendency of students to blindly trust and overly rely on the responses provided by such tools, which can adversely affect their critical thinking and learning processes. Additionally, the rapid but early-stage growth of this domain has not been fully integrated into university-level course curricula, worsening the situation and leaving educational institutions with no choice but to restrict its use in educational settings.

To bridge this gap, we argue that there is an immediate need for a course modules that can be seamlessly integrated into any university-level computing course. To this end, the authors decided to focus on program debugging and defect removal, rather than code generation. The authors created a module on prompt engineering and the use of ChatGPT to help students determine the causes user experience defects. We required students to document the design trade-offs involved when selecting from competing ChatGPT recommendations. Because we are focusing on defects only observable on the user display screen, the skills learned may help students determine the cause of defects in many types of multimedia applications (games, virtual reality, web apps, mobile apps).

III. Course Overview

The authors created a module on prompt engineering and used it to introduce students to the use of ChatGPT to help them determine the causes of video game defects. The authors chose to deploy the module in the first course of a two course game design sequence (CIS 487 Computer Game Design 1).

The purpose of CIS 487 is to introduce students to the technology, science, and art involved in the creation of computer games. CIS 487 is taught as hybrid active learning class. On our campus hybrid classes have both in-person (FF – face to face) and online (DL – distance learning) students enrolled in single class taught by a single instructor. Project teams in this class contain both in-person and online students on the same teams. The course meets once a week for three hours over a fifteen-week semester (Table 1).

TABLE I. CIS 487 Weekly Topics and Activities

Week	Activity
1	Video game evaluation criteria, intellectual property
2	Game design, storytelling, puzzle design, basic Unity use
3	Game evaluation presentations
4	Game play, balance, prototyping
5	Game design documents, 2D game physics
6	User experience design, agile development, scrum
6	Peer reviews design document and 2D alpha prototypes
8	Sound design, terrain, level design, ***ChatGPT debugging***
9	3D physics, game AI
10	Peer reviews 2D beta prototypes
11	Team organization, game production, playtesting
12	Peer reviews 3D game concept presentations
13	Peer reviews 3D alpha prototypes
14	Game marketing
15	Peer reviews 3D beta prototypes

The laboratory activities make use of just in time learning. The in-person (FF) activities in CIS 487 are taught using a flipped classroom. Students watch lecture videos or Unity game engine tutorials before beginning the class activities. The activities often consisted of small group game design or problem-solving activities. Online (DL) students are asked to complete similar activities at home by themselves. All students are asked to write reflections on all weekly activities. The details of the class activities appear in an earlier paper [21]. Both in-person (FF) students and online (DL) students participate in peer review of work products produced by other students or teams. The creators of the works being reviewed classify the reviews as meaningful or not useful. All students participated in the peer evaluations of the 2D and 3D game prototypes.

The authors created a standalone module consisting of a video lecture on the basics of GenAI and the use of prompt engineering in the debugging process, followed by laboratory exercise asking students to repair video scene defects. The module was designed to have students complete it outside the classroom setting by both online and in-person students working by themselves. This module was introduced to students after they had completed their 2D game project (without the use of ChatGPT) and had been introduced to the process of 3D game level design.

A. *Lecture Content*

A video lecture was closed captioned and posted on the course website for viewing outside of class. The video covered the use of AI in debugging, with emphasis on using ChatGPT 4.0. Prompt engineering use was introduced along with the characteristics of good prompts. Examples of prompts for determining the causes of defects observed in video game scenes were presented. The types of prompts discussed included zero shot, one shot, few shot, and chain of thought.

Zero shot prompts ask ChatGPT to perform a task without providing any examples. One shot prompts contain a single example. Few shot prompts may contain several examples. Chain of thought prompts provide a step-by-step task model with examples for each step.

B. *Laboratory Activity*

The students were given two weeks to correct 5 defects in a broken Unity 3D scene (see Figure 1). Some defects could only be observed when previewing the running program in the Unity editor. Defects in the program included: painting fall off the wall, the candle stick stand has no shadow, a bright pink game object, some objects disappear when player is too close, and green tint to scene.

This debugging exercise was designed to be completed by students working alone in the computer lab or at home. Students used ChatGPT to assist them in generating recommendations for fixing the defects. Students formulated prompts describing the observed problem with enough context to allow ChatGPT to provide several potential causes. Students had access to a broken Unity project and were required to verify which recommendations fixed the defects and which did not. We required students to document the design trade-offs involved when selecting from competing recommendations. Students were asked to answer these questions for each defect.

- What prompt did you formulate for ChatGPT?
- How many suggested solutions did you receive from ChatGPT?
- Did one of them fix the problem?
- How did you fix the problem?

Students were asked to answer the following reflection questions after completing the lab exercise.

- Was ChatGPT effective in suggesting solutions to the issues you encountered in the broken Unity 3D scene? Why?
- Did using ChatGPT to debug your scene enhance your understanding of the Unity 3D development environment? Give an example.
- Were there any challenges or benefits from adding ChatGPT into your debugging workflow? Explain your answer.

Students were encouraged to continue using ChatGPT as a debugging tool while they completed their seven week team-based 3D game project. Student teams were asked to complete two incremental prototypes of their 3D game project.

Fig. 1. Broken Unity 3D Scene

IV. Course Evaluation

The authors used a mixed methods research design to assess the impact of ChatGPT on student performance and attitudes. Mixed methods research combines qualitative and quantitative data collection and analysis within a single study to gain a more comprehensive understanding of a research questions. The authors wanted to answer these five questions.

1) Did the use of ChatGPT affect student perfomance on the final project?

2) Did the use of ChatGPT tools affect in-person and online students differently?

3) Did students feel that use of ChatGPT was effective in suggesting soluitions to issues in the scene?

4) Did students feel that use of ChatGPT enhanced their understanding of the Unity 3D environment?

5) Did the use of ChatGPT impact student perceptions of their levels of engagement in course activities?

A. *Student Performance Using ChatGPT*

CIS 487 was taught without the use of ChatGPT in Fall 2023. During Fall 2024 students in CIS 487 completed their 2D lab work without the use of ChatGPT. The use of ChatGPT was introduced as part of the debugging process introduced for their 3D lab work. One-tail Student t-tests were performed to compare individual student performance on several measures shown in Table II. The prototype scores are based on the individual artifacts contributed to each prototype verified by team mates and the instructor. The course grades were based on 100%. The number of missing and late assignments were based on counts of individual student submissions.

The only significant differences ($p < 0.05$) found were on mean student scores on the average number of missing and late assignments. The students in Fall 2023 had fewer missing and late assignments than students in Fall 2024. Although not statistically significant students in Fall 2023 had slightly higher course grades and slightly lower alpha and beta prototype scores. The prototype score sheet is shown in Fig. 2 at the end of this paper.

TABLE II. STUDENT PERFORMANCE FALL 2023 VS FALL 2024

	Fall 2023 (n = 46)	**Fall 2024 (n = 51)**
Average Score Alpha Prototype (30 max.)	26.72	27.59
Average Score Beta Prototype (40 max.)	31.47	34.29
Average Course Grade	92.28	91.20
Average Number MissingAssignment	0.37	0.78
Average Number Late Assignments	0.63	4.27

B. *Comparing Online and In-person Student Perfomance*

One-tail student t-tests were used to compare student performance between students in the in-person (FF) and online (DL) sections for each semester (Fall 2023 and Fall 2024). Table III shows these comparisons.

TABLE III. STIUDEN PEFORMANCE IN-PERSON (FF) VS ONLINE (DL) FALL 2023 AND FALL 2024

	Fall 2023		**Fall 2024**	
	FF (n = 31)	**DL (n = 15)**	**FF (n = 36)**	**DL (n = 15)**
Average Score Alpha Prototype (30 max.)	28.55	22.93	27.72	27.27
Average Score Beta Prototype (40 max.)	35.21	23.75	35.75	30.80
Average Course Grade	95.23	86.20	92.06	89.11
Average Number MissingAssignme nt	0.19	0.73	0.83	0.67
Average Number Late Assignments	0.61	0.62	3.97	5.00

In Fall 2023 significant differences ($p < 0.01$) favoring the in-person student were found for the individual prototype scores and the course grades. Significant differences ($p < 0.05$) favoring the in-person students were found for missing assignments. In Fall 2024 no statistically significant differences were found between in-person and online students on any of these measures. It should be noted that 5 of 36 in-person students did not do the ChatGPT debugging exercise and 1 of 15 online students did not.

C. *Analyzing the Student Lab Writeups*

We analyzed the details of laboratory writeups for the ChatGPT debugging exercise. Only 31 of 36 FF students turned in the complete exercise writeups for grading and 14 of 15 DL students turned in the completed exercise for grading. Students were allowed to skip one of the 9 graded labs. No statistical analyses were performed on the data summarized in Table IV.

TABLE IV. LAB RESULTS FALL 2024 IN-PERSON (FF) VS ONLINE (DL)

Scene Defect		**Average ChatGPT Suggestions**	**Solved Problem**
1. Painting falls off wall at run-time	**FF**	6.00	100.0%
	DL	4.25	100.0%
2. Candle stick stand not casting shadow	**FF**	9.00	100.0%
	DL	4.83	100.0%
3. Bright pink game object	**FF**	11.5	79.2%
	DL	4.85	23.1%
4. Objects vanish when player approaches	**FF**	6.0	100.0%
	DL	4.85	100.0%
5. Green tinti to the entire sceene	**FF**	5.50	100.0%
	DL	5.08	100.0%

Most students in each group used zero shot prompts. One FF student used few shot prompts to fix the falling painting defect. One DL student used chain of thought prompts to fix the pink object defect. The average number of suggestions generated by ChatGPT were slightly higher for the FF student prompts than the DL student prompts.

With the exception of the bright pink object defect most students found that one of their suggested solutions fixed the problem. The students did not have much experience in working materials and mesh objects before attempting this exercise and may not have understood how to test the suggested solutions in the game world.

The students were asked to answer three reflection questions regarding the effectiveness, enhanced understanding gained, and efficiency of using ChatGPT as part of their debugging work. A sentiment analyses of their responses was completed, using the sentiment intensity analyzer from the Python NLTK library. The results of these analyses for students answering these question (FF n = 30 and DL n = 13) is shown in Table V.

A statement was labeled positive (+) if their sentiment score was [0.1, 1], neutral (0) if the score was close to 0, and negative (-) if their score was [-1.0, -0.1]. The overall sentiment for each group of students was positive, for each question.

TABLE V. SENTIMENT ANALYSES REFLECTION QUESTIONS FALL 2024

Scene Defect		+	0	-
1. Was ChatGPT effective in providing solutions to issues? Why?	FF	29	1	0
	DL	9	2	2
2. Did using ChatGPT enhance your understandting of the development environment? Why?	FF	22	6	2
	DL	12	0	1
3. Were there any benefits or challenges from using ChatGPT in your debugging? Why?	FF	24	3	3
	DL	12	1	0

For both groups of students, ChatGPT seemed to be an effective tool for assisting with the debugging process. Improvements in debugging workflow were acknowledged by both groups of students. The DL students expressed some concerns about the relevance of prompt engineering to the activities created for students working at home.

D. Student Course End Survey

We surveyed the students during the final week of the Fall 2024 course offering, to gather student perceptions of their levels of engagement. The students in both sections were asked a series of anonymous questions designed to elicit their candid responses. Students rated each statement on their perceptions of active learning and their levels of engagement in the survey.

Table VI shows the comparisons between the responses from the in-person (FF) and online (DL) students. The Mann-Whitney U test was used to compare FF and DL student responses. No differences between the FF and DL student responses were statistically significant at the 95% confidence level.

Students were also asked to respond to several open-ended questions. In-person (FF) students valued active learning, real-world applications, and group activities. The FF students also valued the use of ChatGPT as a support tool. The online (DL) students also appreciated the active learning approach with its emphasis on real world application of course material. The DL students also appreciated the project approach used because it allowed for connections with peers in both sections of the course. Most students in both groups preferred group activities to individual course activities (e.g. writing peer reviews).

ChatGPT was considered an effective debugging tool by students in both sections of the course. The students completing the survey (17 of 26 FF students and 6 of 8 DL students) indicated they used ChatGPT for debugging on their final course project. At least one DL student suggested that using ChatGPT was an example of one of the least engaging course activities.

TABLE VI. COURSE END SURVEY STUDENT PERCEPTIONS OF ENGAGEMENT FALL 2024 IN-PERSON (FF) VS ONLINE (DL)

FF (n = 26) vs DL (n = 8) SD = strongly disagree D = disagree N= neutral A = agree SA = strongly agree						
Survey Statement		SD	D	N	A	SA
1. There were opportunities for me to actively engage in learning	FF	0	0	1	8	17
	DL	0	0	1	1	6
2. Course activities were useful way to learn.	FF	0	0	0	12	14
	DL	0	0	0	2	6
3. Course activities let me apply what I learned.	FF	0	0	2	10	14
	DL	0	1	0	1	6
4. Course is an example of active learning.	FF	0	0	0	8	18
	DL	0	0	0	2	6
5. I felt more engaged during activities than lecture.	FF	0	0	0	9	17
	DL	0	0	1	2	5
6. ChatGPT was effective in suggesting game issue solutions.	FF	0	1	3	6	16
	DL	0	0	1	2	5
7. Using ChatGPT to assist with debugging enhanced my understanding of the Unity 3D development environment.	FF	0	2	3	9	12
	DL	0	0	1	2	5
8. Using ChatGPT helped me create a more efficient debugging workflow.	FF	0	2	1	11	12
	DL	0	0	1	3	4

V. THREATS TO VALIDITY

We recognize that one of the limitations of this study was that we did not have a true control group. We acknowledge that the same instructor teaching all course offerings may account for the small numbers of significant differences on the performance measures in CIS 487. The instructor practices mastery learning in project classes, which means students may resubmit their work for regrading after fixing any deficiencies. This tends to result in higher grades for students who exercise this option.

A few Fall 2024 students in both sections (FF and DL) failed to turn ChatGPT assignment. We excluded from analysis any submitted work where the student failed to answer all questions on the assignment sheet. Several students failed to complete the anonymous survey at the end of the course, making it hard to know how many students embraced using ChatGPT for debugging during their work on the 3D game prototypes.

The pairing of an online (DL) section with a face-to-face (FF section students in the same course does not guarantee students receive the same educational experience. The live class sessions were captured, verbatim on video, for later viewing online by the both the FF and DL students. DL students were not allowed to attend in-person sessions in either 2023 or 2024. It is possible the DL students experienced more uncertainty when attempting to complete complex activities alone.

One area of uncertainty when measuring the student responses is the unknown amount of interaction between students in the two sections of the same course. Students in the CIS department know each other from other classes that they have taken together. Even though a student registered in the DL section was not allowed to attend any in-person class meetings, it is quite possible that a friend from the FF course section may have shared their course experiences with them, giving them additional insight into group activities completed in the in-person classroom.

Student engagement can only be measured indirectly in online courses using surveys and course analytics. In previous studies conducted by the authors, direct observation of student behavior was used to provide insight into the levels of engagement of in-person students. We could not include direct observation of students in the DL sections. The average number of late and missing assignments is the best we could do.

VI. Conclusions

In this paper we demonstrated that it is possible to introduce the use of a GenAI tool into the software debugging process without significant loss of student satisfaction or perception of engagement. We credit the active learning components of the classes and the levels of student interaction that accompany them for making this possible. The active learning components of the course, the hybrid project teams, and peer evaluation work also should be credited with the success of the project work.

The use of reflective writing as an alternative to traditional testing was well received by the students. The short, daily lab write ups provided students with many opportunities for the instructor to provide feedback on their work. This also allowed the instructor many opportunities to identify student issues before the end of the semester.

The integration of a GenAI debugging module into a first project-based game design course enhanced student performance measures on the final project, when compared to students in a previous course offering of CIS 487. The students felt the use of ChatGPT as debugging assistant helped them to gain a deeper understanding of the Unity 3D environment. This suggests that use of ChatGPT may help reduce the impact of technical debt during the maintenance process.

The course structure promoted the practical application of GenAI principles to correct user experience design issues. Positive feedback on post-course survey results confirmed improvements in students' abilities to use GenAI tools effectively.

It may be important to continue developing ways in which online students are encouraged to participate in more experiences with face-to-face students outside formal class meetings. While we emphasize agile software development in our courses the assessment and management techniques we used could be adapted to fit other engineering process models.

One of the authors also teaches a game design 2 course using the Unreal game environment. Students have continued to use ChatGPT on their term long projects without prompting by the instructor. The current plan is to make use of the revised modules in the Fall 2025 hybrid offering of game design 1.

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Name:			
Beta Prototype - must earn 10 points from this category			
AI Progammer, Programmer, UI/UX Programmer, 3D Prop Builder, Character Artisit (5)	Points	#	Earned
Programmer - 1 user story implemented - workign by yourself	5	0	0
Programmer - 1 user story implemented - if pair programming is used 3 each	3	0	0
UI/UX - key screen implmented	3	0	0
UI/UX - key screen wire frame	2	0	0
3D Prop Scripted	3	0	0
3D Prop Model Created	2	0	0
Character artist - avatar scripted	3	0	0
Character artist - animation created	2	0	0
Level Designer, 2D Texture Artist, Repository Manager, Document Manager (3)			
Level Designer - level template completed	1	0	0
Level Designer - story board complete	1	0	0
Level Designer - level editing - one hour of work	1	0	0
2D Texture artist - one hour of texture work	1	0	0
Document manger - one hour of work	1	0	0
Repository manager - one hour of work	1	0	0
Audio Designer, Tester, Cinematic Artist (2)			
tester - test case written	1	0	0
tester - written test case executed and documented	1	0	0
audio designer - one hour of audio work resulting in new assests	1	0	0
cinematic artist - one hour of work on video	1	0	0
	(40 max)	Total =	0
List badges earned on the 3D beta project (team must verify)			

Fig. 2. Final Project Prototype Score Card