An Instructor's Lens into the Role of AI in Teaching Experimental Research via Gamification

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ABSTRACT

In higher education, while there's an emphasis on training students in diverse research methods and offering hands-on experimental research experience, traditional textbooks often miss real-world intricacies, especially with human subjects. Recently, gamified techniques using interactive narratives have emerged as a popular teaching tool, allowing students to design experiments within a storyline and gather real-world data. Despite their promise, challenges persist in conveying complex terminology, biases, and methods, and in seamlessly integrating research questions into these narratives. Additionally, ensuring aesthetic coherence and tracking variable manipulations add layers of complexity. With the advent of AI tools like feedback providers, question generators, and chatbots in classrooms, this paper, based on workshops and instructor interviews, seeks to outline the potential of AI in enhancing the teaching and learning experience of experimental research using interactive narratives.

CCS CONCEPTS

• **Applied computing** → **Computer-assisted instruction**.

KEYWORDS

Artificial Intelligence, Education, Gamification, Research Methods

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1 INTRODUCTION

Designing robust research experiments is foundational to the scientific community. In graduate and undergraduate courses, students are often taught how to design these experiments. While textbooks provide theoretical knowledge, they often fail to provide the practical experience of designing experiments for human subjects, collecting data from human subjects, data cleaning and other research methods. However, recently interactive narratives have become a favored tool in classrooms [4, 8] for teaching experimental research. Interactive narratives encourage students to design experiments within an engaging storyline. This approach creates a simulation where human subjects can participate, gather data, and help answer research questions, as noted in [5].

Tools such as StudyCrafter [4], Twine, and Scratch are now being used in the classroom to allow students to create gamified research questionnaires [3, 5] and research social issues [2, 6]. These interactive narratives are often branched and have more than one path a player can finish the game. The path a player takes through the interactive narrative, along with the choices made at different stages, enables student researchers to answer research questions and gain insights.

Interactive narratives offer students a hands-on approach to data collection, analysis, participant recruitment, and presentation of findings. However, the expansive nature and myriad branches of these narratives make evaluation and constructive feedback challenging for instructors. Likewise, students often struggle with the terminology related to research methods, understanding these methods, designing experiments, and integrating these experiments into interactive narratives. While many AI tools in current classrooms assist in providing feedback [9] and evaluating papers [10], there's a research gap in understanding how instructors, who teach experimental research through interactive narratives, perceive AI's role and how AI can further support their classrooms. Within this paper, we illuminate the instructors' perspectives on how they believe AI

tools can bolster both their own and their students' experiences in employing interactive narratives for teaching and learning experimental research. This poster's contributions include outlining system requirements for future designers, researchers, and developers. These requirements are intended to facilitate the creation of AI tools that enhance learning and assessment of experimental research taught through the building of interactive narratives.

2 PREVIOUS WORK

Several authors have incorporated interactive narratives in their classrooms to teach experimental research and research methods. Melcer *et al.* [8] introduced a game called 'Academical' to instruct students about the 'Responsible Conduct of Research' (RCR), a pivotal component of experimental research. Harteveld *et al.* [5] discussed methodologies where creating interactive narratives aids in crafting gamified surveys. Matuk *et al.* [7], after examining student-created interactive narratives for learning research design, assert that principles underlying interactive narrative game design parallel those of robust research design. They highlighted the similarity between compelling interactive narrative games, which immerse players in realistic storylines and practical choices, and effective research designs that encourage participants to act within the research context even when aware of the simulation. Amato *et al.* [1], through pre and post surveys, demonstrated that graduate students acquired greater proficiency and confidence in designing research experiments. Previous studies underscore the significance of utilizing Interactive Narratives in classroom education, yet they don't delve into the tools and support that can enhance the experiences of both students and teachers. In this paper, we further the field of interactive narratives for teaching research methods by using a UX approach (workshops and semi-structured interviews) to identify the requirements for AI tools that enhance learning in experimental research.

3 METHODOLOGY

To better comprehend the areas where instructors believe AI tools can enhance their instruction, especially in teaching experimental research through interactive narratives, we adopted a two-fold strategy. We organized an online workshop and subsequently complemented this with semi-structured interviews.

For our workshop, we extended invitations to 7 faculty members from 5 universities, who teach research design in their courses, which included Mixed Methods Research for Games, Experimental Methods, and Statistics, and user-centered research and evaluation. This session was conducted via Zoom, where participants were divided into breakout rooms, with each room comprising two instructors and one researcher-facilitator. During the session, we presented the instructors with demonstrations of cutting-edge AI tools, including LLMs and Text-to-Image Generation (DALL.E-2). To facilitate real-time feedback, we provided instructors with digital jam-boards. Here, they could deposit their thoughts and insights using digital post-its.

After the workshop, two researchers categorized the comments and feedback from the instructors. Five distinct themes emerged around instructors' ideas for how AI could support their students' learning of experimental design. These include (a) Concerns about using AI in class, (b) Using AI to offer formative feedback to students, (c) Using AI to provide IRB training, (d) Supporting research design competencies and (e) Prompt critical perspectives and analysis.

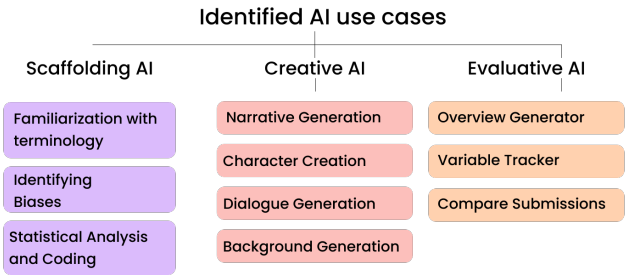


Figure 1: Different applications of AI identified by instructors for classrooms using interactive narratives to teach experimental research.

Six of the seven instructors who attended the workshop committed to co-designing and implementing a gamified research project using StudyCrafter in their classes. Each instructor then participated individually in a 1-hour semi-structured interview. Our semi-structured interview involved a team of three researchers: one to lead the questioning, one to document responses, and another to address any queries related to interactive narrative creation tools. These interviews aimed to delve deeper into the themes identified previously in the workshop by allowing the instructors to provide a more comprehensive understanding of instructor perspectives. The interviews were transcribed, and researchers convened together to discuss and identify themes related to instructors' attitudes about and perspectives on using AI tools and their preferences on what kind of tools would benefit them in teaching experimental research through the development of interactive narrative games.

4 RESULTS

Our discussions with instructors resulted in identifying ten feature requests classified into three major groups as illustrated in Figure 1. The three themes - (a) Scaffolding AI, (b) Creative AI, and (c) Evaluative AI in classrooms are discussed in the subsequent sections.

4.1 Scaffolding AI

Instructors have observed that students often struggle with experimental research, particularly in understanding key terminology, like "independent" and "dependent" variables, and distinguishing between quantitative and categorical variables. To address this, they currently use examples to clarify these terms. However, they believe AI systems could be more effective, allowing students to independently explore and understand these concepts at their own pace.

Another challenge is teaching students about biases in developing personas, a technique from User Experience. Instructors suggest AI-driven interactive exercises to help students identify biases in personas and research narratives, with the AI offering continuous feedback and by developing fictional personas.

Instructors mentioned students who take research methods classes are often unfamiliar with statistical methods and coding, essential in experimental research classes. Instructors propose using AI tools to provide hands-on exercises with small datasets for calculations, and to convert these exercises into code blocks. This method would aid in understanding statistical values and demonstrate the connection between manual calculations and coding processes.

4.2 Creative AI

Instructors typically break down the process of crafting interactive narratives for experimental research into three stages: (a) Comprehending and establishing research goals, (b) Constructing the interactive narrative game, and (c) Undertaking data collection and evaluation. While the Scaffolding AI assists students in becoming acquainted with the terminology and methodologies necessary for developing research objectives, instructors noted that students often find it challenging to conceive narrative ideas that encapsulate their hypotheses and facilitate data collection for their research queries.

Instructors highlighted the potential of AI in guiding students to craft compelling narrative plots. The aesthetic dimension of these narratives, which includes the backdrop, dialogue, and imagery, is paramount. Here, instructors emphasized that AI tools could be instrumental in generating diverse settings, dialogues, and character visuals for these narratives. However, it's vital to recognize that while AI offers various advantages in designing interactive narrative games, instructors also expressed reservations. These stemmed from concerns about potential biases, ethical implications, and the risk of stifling students' critical thinking. In that regard, instructors suggested introducing classroom policies governing the use and citation of AI tools in student submissions for evaluation.

4.3 Evaluative AI

Instructors expressed a significant pain point: Large class sizes lead to numerous submissions, making feedback provision a cumbersome process. They believe AI tools could significantly aid the evaluation process for interactive narratives. While instructors can play through submitted games once, interactive narratives come with multiple branches, potential endings, and various scenarios. These scenarios can appear randomly or based on logic set by the creators. Evaluating every permutation becomes challenging. Consequently, instructors suggest that AI systems could simplify complex game code, presenting it as an easily understandable node-edge visualization. This visualization would give a comprehensive overview of the entire game. Moreover, instructors believe that an AI system, with a complete understanding of the game, could highlight differences across various narrative branches, making evaluation easier for instructors. For each branch, they would like the AI system to pinpoint how and why the research variables change. Additionally, as students often create multiple interactive narratives based on identical research questions, instructors hope AI tools can differentiate between these projects. Such distinctions would facilitate classroom discussions and peer feedback.

5 CONCLUSION

In this poster paper we present how instructors envision the role of AI to teach experimental research via interactive narratives. Through focus groups and semi-structure interviews we present requirements for an AI system that would benefit the teaching and learning experience of experimental research. As future work, we anticipate to use these findings to help our research team in the development of AI systems to support classroom learning. We intend to introduce these platforms in classrooms to assess their effectiveness in enhancing the teaching and learning of experimental research.

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