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Perceptions on the Effectiveness of Using Generative AI and Voice Cloning to Aid in the Development of Online Course Materials

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Abstract

This evidence-based practice full paper describes the perceptions of a university-level academic course development team regarding the use of generative artificial intelligence (GAI) and voice cloning technology in the development of content and lecture videos for an online course. The research, including the analysis of data gathered from course grades, end-of-course evaluations, and interviews with members of the course design team, aimed to explore the perceived impact of GAI and voice cloning technology on the course development process. Results indicated a perception of limited effectiveness of using GAI to assist with content creation, but a high level of effectiveness of using voice cloning to produce spoken lecture videos. Designers and program administrators observed that the time spent in the production of lecture videos was reduced by approximately one-third. Student success indicators showed no significant difference in student perception or performance compared to their colleagues in online courses developed without the use of GAI or Voice-Cloning technologies.

Introduction

The ability of generative AI to comprehend languages and generate human-like text makes it an excellent candidate as a tool that could be used to assist in content development efforts. In addition, emerging capabilities in voice cloning technology provide new options for creating instructional audio and video components. The ability of generative AI to process language and generate human-like text makes it an excellent candidate to assist in content development efforts. In addition, emerging capabilities in voice cloning technology provide new options for creating instructional audio and video components. While the use of such tools may appear promising, it is imperative to carefully analyze the efficacy of these tools to inform future decisions and address any academic concerns of both faculty and students.

In this case, an online graduate engineering course, referred to in this study as "the voice-cloned course", was developed with the aid of generative AI and voice-cloning technology. Based on a recording of the teaching professor's actual voice, AI software was used to generate a cloned voice model. Subsequently, professor-approved text was fed into the model to generate speech resembling the sound of the professor's voice. For this study, the courses in the cohort which were created through traditional methods that did not include AI or voice-cloning technologies, are referred to as the control group. The voice-cloned course was offered for academic credit during the Fall 2023 semester as part of an online, cohort-based, graduate degree program in the field of Engineering. The members of the course development team, plus one other university employee were investigators in the study. The investigators used qualitative artifact analysis and quantitative data analysis.

The course development process commenced with the creation of a prototype to assess the capabilities of the generative AI tools to be used, and to determine the extent to which these tools

can be used to make the course development more efficient. Throughout the process the professor and the instructional designer revised their approach towards and the use of different AI tools to achieve the desired results. While the output from AI was treated as 'raw materials' for the final products, cloned audio was the only product used throughout the project. Text generated by AI was used only in a few instances, but given the focus of the course, in most cases, it did not meet the expectations of the professor.

Background and Related Literature

The impact of ChatGPT has led to a significant increase in awareness and experimentation with generative AI tools among educators since its release in November 2022 [1]. As generative artificial intelligence technologies have emerged onto the landscape of higher education, there has been a healthy research interest in how students are using AI to promote their success in classes, how faculty might integrate AI into their teaching, and how staff employees, in general, might use AI to work more efficiently [2]. The use of generative AI in all these areas is considerably nascent and needs detailed exploration.

Production of digital course materials is a highly complex and time-consuming endeavor that is crucial for creating an effective online teaching and learning experience. To speed up this process, faculty have begun to explore the use of Generative Artificial Intelligence tools to assist in the production of digital course content. Memis [3 p.289] proposed that "ChatGPT can help educators automatically generate topic content. This can help educators save time and provide students with more learning opportunities" and noted further that ChatGPT can be used by engineering educators to prepare questions or assignments in various disciplines. Others [4], [5], [6], [7] expound on the use of generative AI by teaching faculty in the development of their syllabi, assessments, and supplemental instructional content. Faculty and Instructional Designers are beginning to use GAI in developing comprehensive curricula ranging from the creation of learning objectives to authentically generated content in videos and live sessions [8], [9]. Despite these recent advances, there are mixed perceptions about the accuracy of GenAI outputs, with many people sometimes unable to distinguish between correct and incorrect information [10]. Additionally, concerns about academic integrity, bias, and the originality of AI-generated content are significant, [11], [12] and impact the trustworthiness of content produced using GAI.

It is not uncommon for faculty and instructional designers to invest hundreds of hours in the production and refinement of instructional videos for an online academic course. "We estimate that during this six-month period, Joyner spent approximately 750 to 800 hours of his time, and Goel spent about 200 to 250 hours on the course development. This investment of time was needed because we developed all the videos from scratch, and specifically for the online course [13 p.50]."

Recent advancements in generative AI tools have enabled faculty and instructional designers to reimagine procedures and workflows for creating course content and media. By leveraging voice-cloning technology, educators can create synthetic speech that closely resembles a targeted human voice, thereby personalizing and enriching educational content [14]. The application of voice cloning technology during the production of instructional videos offers the potential to enhance the learning experience for students and improve the production time required of SMEs

and Instructional Designers. A recent study [15] found that AI-generated videos not only decreased the cost of educational video production significantly, but it also resulted in reducing the time and effort required for producing and correcting errors.

Students' perceptions regarding the use of generative AI in academic courses at this point are somewhat mixed. Ramirez [11] reported that students perceived generative AI technologies favorably, while Leiker et al. [15] found no difference in perception between traditional instructor videos and AI-generated virtual instructors. Goel and Joyner [13] reported positive student evaluations and comparable performance between online and residential students when AI techniques are integrated into course instruction, suggesting a possible improvement in content quality.

Literature addressing the perceptions of instructors, professors, and teachers regarding the effect of using generative AI (GenAI) on the efficiency of the course development process and the quality of the content produced reveals a cautious optimism. In a 2024 study, [16] nearly half of surveyed faculty members acknowledge the potential of generative AI to improve educational outcomes. Ramirez [11] highlights that educators view AI-based tools as valuable for enhancing various aspects of teaching and learning. Early perceptions of teaching and learning with generative AI indicate its potential to enhance educational outcomes, although concerns about academic integrity remain prevalent [10].

According to Choi et al., [8] Instructional Designers perceive generative AI tools as valuable partners in course development. They appreciate the ability of these tools to generate initial drafts quickly, saving time and resources. However, they also note that AI-generated content requires careful refinement to ensure educational quality and relevance. Overall, instructional designers see generative AI as enhancing their capabilities rather than replacing their expertise.

The perceptions of program administrators are reflected in the literature of several authors [14], [7], [17] who have highlighted their concerns about the potential implications of using AI technologies like voice cloning to create academic content. While these technologies offer significant benefits during the content production process, they also raise concerns about intellectual property (IP) considerations, authenticity, and the potential for misuse, such as the creation of deepfakes. Administrators emphasize the need for clear policies and guidelines to address these issues, ensuring that both creators' rights and the ethical implications of using AI in educational content are adequately managed [18].

Research Questions

The main goal of this study was to contribute to a rapidly growing body of knowledge that could lead to the development of a systematic approach for the integration of generative AI tools in the course development process. This study focuses on the effect of generative AI tools on the efficiency of course development projects and their subsequent student learning outcomes. Specifically, the research aims to answer the following questions:

1. How does the use of generative AI affect the efficiency of the course development process and the quality of the content produced?

a. What are the perceptions of the subject matter expert regarding the use of generative AI tools in course development?

b. What are the perceptions of the instructional designer regarding the use of generative AI tools in course development?

c. What are the perceptions of program administrators regarding intellectual property considerations related to using generative AI for content development?

2. How does AI-generated content affect student learning outcomes?

Theoretical Framework

The Technology Acceptance Model (TAM), has been used extensively to predict the use and acceptance of new technology in various settings. Referencing Venkatesh and Davis [19], [20], Ramirez [2] explains, "The Technology Acceptance Model (TAM) is a widely used theoretical framework in the field of information systems research that explains the factors influencing individuals' acceptance and use of technology. The model posits that perceived usefulness and perceived ease of use are key determinants of users' attitudes and intentions toward adopting a new technology. In other words, individuals are more likely to accept and use a specific technology if they perceive it to be useful in enhancing their job performance or achieving their goals and if they find it easy to use." [2 p.5] In this study the authors used TAM 3 [21] as a theoretical framework. The purpose of using TAM 3 in this study is not to predict the use of technology by an individual, but rather as a guide to identify and explore the factors that played a role in shaping the participants' interaction with the system.

Methodology

This study included both qualitative and qualitative research methods. To address the research question of "How does AI-generated content affect student learning outcomes", investigators analyzed two sources of data.

One source of data was the anonymous end-of-course evaluation that all students were asked to complete as a normal course of action at the end of the semester in which the course was offered. In this analysis, the investigators compared answers from students enrolled in courses in the control group to answers from students enrolled in the voice-cloned course.

A second source of data was the anonymous, aggregate final grades in all courses taken by the students in this cohort. The analysis sought to determine if there was any significant difference in the grade distributions of the voice-cloned course compared to the averaged grade distributions from all the other courses in the cohort using a one-sided, one-sample t-test.

To address the research question of "How does the use of generative AI affect the efficiency of the course development process and the quality of the content produced?", investigators performed a qualitative analysis on a third source of data. The third source of data was the commentary provided by university employees involved in developing and administering the

course, including the faculty/subject matter expert, an instructional designer, a project manager, an academic program manager, and a graduate teaching assistant.

Case Studies

This study employed an exploratory case study approach. Case study is a commonly used research method in social sciences, and education since it is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident". [22 p.13] This definition implies the role of the context and flexibility of study design in the case study approach, both of these factors were essential to not only understand the phenomenon but also explain why and how certain decisions were made during the adoption of Generative AI in the course development process.

Sample

This study focuses on a particular case, for this reason, we used a purposeful sampling technique, with the sample consisting of individuals who were intimately involved with the project. For qualitative studies, Patton [23 p.46] strongly suggests the use of cases that will provide an in-depth and rich description of the phenomenon, which can result in an "understanding of a phenomenon in depth". In such situations, to select the sample, the main focus is "to select information-rich cases whose study will illuminate the question under study". This study focused on the team that was involved in the development of the course, which includes, the professor or SME, an administrator from the academic department, the instructional designer, and the instructional design team administrator.

Data Collection

Data were collected through semi-structured interviews. Due to the uniqueness of the case, it was determined that Semi-structured interviews would give an in-depth understanding of the phenomenon, as it will not only answer the questions drafted by the researcher but also allow for addressing any novel ideas brought up by the participants/respondents. [24] In qualitative studies, particularly case studies it is essential to ensure validity, in this study data triangulation by interviewing the different stakeholders, namely the faculty, administrators, and instructional designers was employed to ensure the validity of the data.

Members of the course development team were asked to participate in a semi-structured interview that lasted about an hour. The study participants gave their consent to be interviewed and to be recorded in a Zoom session. The interviews included questions pertaining to the employee's role in the course development project and sought to gain their perspective on the effectiveness and efficiency of using generative AI and voice cloning to aid in the development of online course materials. All the interviews were conducted online. Students enrolled in the course were not interviewed.

Results and Discussion of Student Evaluations and Course Grades

Findings and interpretations of data from end-of-course student evaluations, course grades, and interviews with members of the development team are presented below.

End-of-course Evaluations

Standardized end-of-course evaluations were administered in all courses in the cohort, including the voice-cloned course. Two questions were selected from the evaluation instrument based on their relevance to the clarity of communication by the professor and to what extent the course helped students learn. The selected questions, their answers, and the student's response rates are presented below.

Question 1.

> Prompt: Based on what the instructor communicated, and the information provided in the course syllabus, I understood what was expected of me.
>
> Possible Answers:
> Q1A1. No, I did not understand what was expected of me.
> Q1A2. I partially understood what was expected of me.
> Q1A3. Yes, I understood what was expected of me.

Of the students in the Voice-cloned course, 96% reported that they understood what was expected of them, compared to only 80.7% of students in the Control Group of all other courses in the cohort.

Table 1. Responses to Question 1.
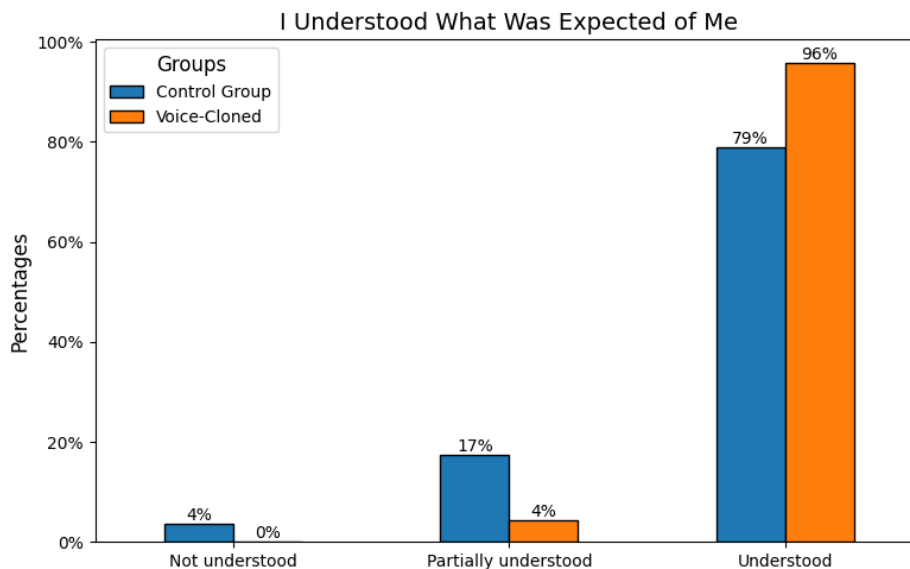
A Chi-Square analysis (value of 3.777 with a p-value of 0.151) indicated no significant difference between the groups. The Cramér's value (V = 0.113) indicates a small association between the responses and the groups. While the association is not statistically significant, the effect size is slightly larger than negligible. A direct comparison of the percentages of students who fully understood what was expected of them in the course would seem to indicate that the AI-generated content and voice-cloned videos likely did not impede the student's understanding of what was expected of them in the course and in contrast, may have contributed to clearer communication between the professor and the student.

Question 2.
Prompt: This course helped me learn concepts or skills as stated in course objectives/outcomes.
    Possible Answers:
        Q2A1 This course did not help me learn the concepts or skills.
   Q2A2 This course only slightly helped me learn the concepts or skills.
        Q2A3 This course moderately helped me learn the concepts or skills.
        Q2A4 This course definitely helped me learn the concepts or skills.

Of the students in the Voice-cloned course, 90.9% reported that the course either Definitely Helped or Moderately Helped them learn, compared to 90.3% of students in the Control Group of all other courses in the cohort.

Table 2. Responses to Question 2.
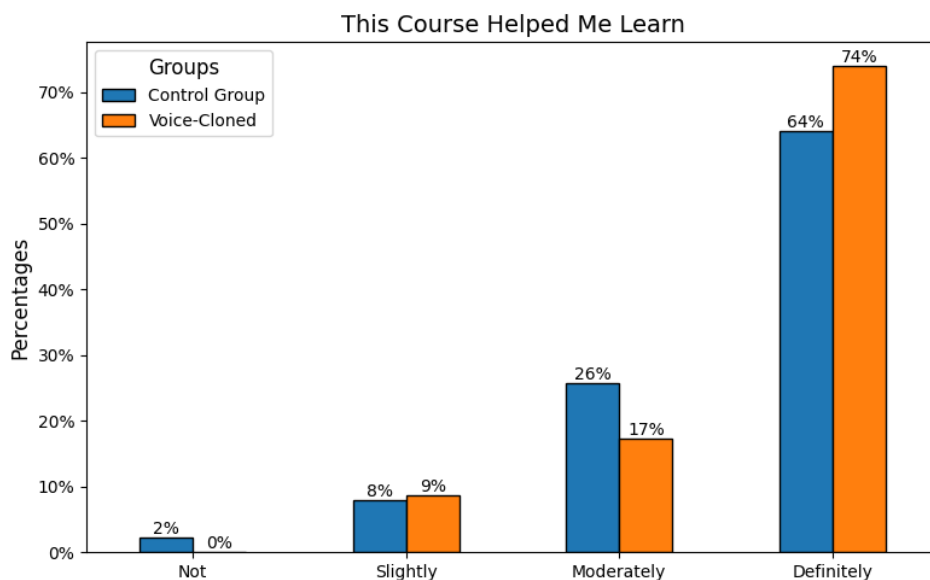
A Chi-Square analysis (value of 1.425 with a p-value of 0.699) indicated no significant difference between the groups. The Cramér's value (V = 0.070) indicates a negligible association between the responses and the groups. These findings would seem to indicate that in this case, the fact that the sample course included AI-generated content and voice-cloned lecture videos was inconsequential in affecting the degree to which the course helped students learn. In other words, in the opinion of the students, the degree to which a course in the cohort helped

students learn was the same, regardless of whether or not the course was created using AI-generated content and voice-cloned lecture videos.

Course Grades

Course grades are a commonly used data source to measure student learning outcomes. The analysis sought to determine if there was a significant difference in the average GPA of the voice-cloned course compared to the combined averaged GPAs from all the other courses in the cohort.

Table 3 shows the grade distribution for all students in all courses of the cohort including 39 enrollments in the voice-cloned course, and 666 enrollments in 11 courses that were offered during the cohort but were created using traditional technologies and methods. The average GPA of all students in the voice-cloned course (highlighted) was 3.872 out of 4.0. The average GPA of all 11 traditionally created courses combined was 3.754 out of 4.0. The rows of the table are sorted according to Class GPA in descending order.

Table 3. Grade Distributions and Average Student GPA of each Course in the Cohort.

Courses	A	B	C	D	F	n	Class GPA
Control-619	63	0	0	0	0	63	4.000
Control-630	46	0	0	0	0	46	4.000
Control-643	69	1	0	0	0	70	3.985
Control-610	71	1	1	0	0	73	3.958
Voice-Cloned	**35**	**3**	**1**	**0**	**0**	**39**	**3.872**
Control-624	60	10	0	0	0	70	3.857
Control-689	17	9	0	0	0	26	3.654
Control-613	48	24	1	0	0	73	3.643
Control-636	48	22	0	0	1	71	3.633
Control-612	45	28	0	1	0	74	3.581
Control-623	41	24	4	0	0	69	3.536
Control-634	18	10	2	1	0	31	3.451

A one-sample, one-sided t-test was conducted to determine if the GPA of the single Voice-Cloned course (3.872) was greater than the average GPA of the 11 other courses in the cohort (3.754).   The t statistic was 1.882 with a p-value of 0.045 indicating that the GPA of the voice-cloned course was significantly higher at the 0.05 level. Cohen's d of 0.567 was calculated for

the difference between the single course GPA and the average GPA of the 11 courses, indicating a moderate effect size. While the GPA of the voice-cloned course was higher, it cannot be implied that using GAI or Voice Cloning necessarily leads to higher course GPAs. For example, there are some courses in the cohort with higher GPAs that did not use generative AI or voice cloning, indicating that there are other factors that contribute to GPA.

Interview Data Collection and Analysis

The interview data was collected using a self-developed, semi-structured interview guide (attached in the appendix). The interviews were conducted during the Summer of 2024, one semester after the culmination of the course. All the interviews were recorded with prior written permission from the participants, with the exception of one participant where permission to record the interview was solicited during the interview. To analyze the data, the transcription of the interviews was downloaded from Zoom. The next step was to remove the time stamps and separate the interviewer and interviewee sections. Once all the transcripts were cleaned, the interviews were carefully reviewed and edited for accuracy as necessary. Each interview was read and reviewed with the audio recording several times to capture the essence of each conversation. Next, codes were developed from the interview statements and relevant literature, corresponding to the constructs of the Technology Acceptance Model, TAM 3. These codes were revised and updated till agreed upon by all the researchers. Based on these codes, relevant statements from the interview were grouped and placed under their respective themes. Once the initial categorization was complete, the researchers reviewed the themes independently, recorded any statement that required recategorization, and finally organized them into a table for each participant. The table below shows an example of the categorization process.

Table 4. An example of the categorization process.

Theme	Codes	Statement
Perceived Usefulness	Efficient, effective, important, useful, essential (to the project)	"...And so we thought, well, maybe [Chat] GPT can help us generate the content".
Perceived ease of use	Challenges, workarounds, mental effort, self-efficacy/knowledge, interaction with interface, user experience, familiarity	"...I don't have a fear of it, or anything like that, ... but trying to figure out where the right productive middle ground of where that was going to be".
Output Quality	Effective, efficient, usable, higher, faster, clear, correct	"...It was now feasible to use voice cloning and AI-generated or synthetic voices, which are indistinguishable from the real voice".

Results and Discussion of Interviews

Findings and interpretations of data from the interviews are presented below and grouped according to the themes of the Technology Acceptance Model, TAM 3.

Results

Perceived Usefulness: The perceived usefulness of generative AI tools in this study pertains to the use of text and audio generators. As all the team members had different past experiences with AI and generative AI tools, the team's expectations varied when it came to text generators, ranging from sentiments such as "…. maybe ChatGPT can help generate some of the content ideas" by an administrator to "I wasn't overhyped about it. I appreciate the limitations because I know what this work kind of looks like" by the Subject Matter Expert (SME). Another important factor was time and efficiency. The SME, being an expert in the field of AI, expressed that "I wasn't sure [if] the cost-benefit ratio was sufficient or not, but by necessity, I wanted to try and see where it could be used versus where it couldn't be used". Since the shortage of time and efficiency was the main reason for adopting these tools, it was necessary to ensure that there is a possibility the project could benefit from the use of these tools. For this reason, before employing any AI tool for the entire project, the team "decided to develop a prototype and to actually try it…. we were trying to develop a proof of concept." which enabled the continued production of the course using text and voice cloning audio generators.

Result Demonstrability: Both the SME and the Instructional Designer believed that the use of generative AI and voice cloning contributed in reducing production time. For example, the ID estimated that their production time was reduced by 20% to 30% overall, whereas the SME also resonated a similar experience by stating "it helped me speed up the process of writing the scripts….from a course production standpoint. It saved me a lot of time, and made it possible to get the course delivered, given my busy schedule and everything." The SME stated, "For lecture video creation easily saved me 50% of my time. I only had to script and didn't have to do all the video recording which I was doing manually recording from home. For script creation it sped up my process by 30% using ChatGPT to help me speed up my narration script creation."

Output Quality: As previously mentioned, the output produced by AI was used as raw input for creating instructional videos. One administrator explained, "[the team] was pleased, not with the initial content that came out of the AI, but pleased with what it gave us to work with". This output was modified by the instructional designer and the SME to create the final product. For example, one of the administrators, while speaking of the cloned audio, exclaimed "It's just in a more polished way, like [the professor] does not make any mistakes in the audio recording, very formal. It's what we're looking for in the high-quality educational video". Similarly, the sentiment was echoed by the instructional designer, "I would not suggest anyone to just go and record a lesson anymore" referring to the quality of cloned audio. However, when it came to text generation, the experience was mixed. The SME explained that "It probably exceeded my expectations, too, in helping me generate my scripts [from an outline] to feed to the voice-cloning software. It was better than I had expected". However, when it came to creating content for the class from scratch, the SME believed that "[the content] was too generic. Generic in terms of what it produced… not quite the focus that I wanted".

Experience: The participants involved in the project were previously exposed to Generative AI to different extents, with some participants having slightly more experience and knowledge than others. However, when it comes to this particular project, the SME explained that "it was a very experimental, agile [and] iterative exercise, and the use of the tools and the purpose for which they were utilized continued to evolve during the course of the project."

Voluntariness: This study was unique in the sense that the team involved in the project was all onboard with using generative AI, as they believed it could potentially improve the efficiency of the course design project. As the instructional designer explained, "I wanted to go beyond the usual instructional development procedure…the technology [has] matured to the point that it could be useful in creating learning objects". Similarly, for the SME, efficiency was the main factor; "It was out of a personal need. It was gonna take a lot of time to put the content together and put everything together, and all. And so I needed to find ways to speed that process up". While there were several different reasons for the adoption of generative AI tools, it is evident that the team considered it essential for this project. According to TAM3, while both Experience and Voluntariness have a moderating effect on "Subjective norm", in this study it did not play a role in affecting the perceived usefulness or the intention to use the AI tools.

Perceived Ease of Use: None of the participants expressed any preconceptions of discomfort or concerns about the use of the system prior to the project, however, once the project started the team did experience some limitations, primarily associated with the nature of the tool itself. Speaking about the obstacles faced during the project, the instructional designer recounted, "Learning how to work with the AI, its limitations, and its workarounds…[and] figuring out how to write the prompts". Additionally, the SME expressed "I don't have a fear of [AI] or anything like that, but trying to figure out where the right productive middle ground of where that was going to be".

Objective Usability: Overall, the team was satisfied with the final output of the cloned audio, however, the interface did not always perform as expected; as recounted by the Instructional Designer "Most of the time, it was exactly what we wanted, what we needed. In a very few cases, I was not able to get the desired outcome".

Discussion

The uniqueness of this case does not allow us to cover the entire breadth of the constructs and determinants of the TAM3, which can be attributed to the differences in the specifics of each case [25]. In alignment with the previous literature, perceived usefulness and its determinants (except Social Norm) were the key factors convincing the team to adopt and continue using the AI tools. While the study participants did reveal that their decision to adopt or the behavioral intention to adopt AI for the current and future courses is entirely based on efficiency and the quality of the content produced, it is important to note that the SME and instructional designer, in this case, were already familiar with the use and capabilities of generative AI. It will be useful to conduct studies focused on teams that do not have prior exposure. Lastly, while no specific issues were reported, perceived ease of use and objective usability did not seem to play a

significant role in the adoption of the generative AI tools, as the team was pretty open to trying and exploring 'workarounds' to get the desired outcome.

Conclusions

Overall, the study participants had a positive experience with the use of the generative AI and voice-cloning technologies that were used in this project, and expected to continue using them in the future. Administrators, the faculty subject matter expert, and the instructional designer were satisfied with the efficiency of the process and the quality of the voice-cloned videos. Student learning outcomes in the voice-cloned course were comparable to those of other courses in the same cohort which used media that had been produced using traditional methods. Text output produced by generative AI cannot and should not be regarded as usable or of high enough quality for use as content in academic courses without significant human input and modification. Voice-cloning technology can reduce the amount of time required to create instructional videos. When properly produced and edited, instructional videos produced with voice-cloning technologies can be as effective in supporting student learning as videos produced through traditional methods. The use of generative AI in the case study provides a clear example of the practical use of generative AI in instructional design, specifically for content development, however, it also highlights the importance of flexibility/agility in the design and development phases of a project, as well as maintaining realistic expectations. Given that this study includes a comparison of a sample size of only 1 voice-cloned course, the authors stress that any conclusions presented be considered provisional. Furthermore, the unique background of this team of practitioners and the time constraints under which the team was working makes this a unique case and the findings from this study may not directly apply to all circumstances. Future research should be done to examine a deeper analysis of student perceptions and ethical issues of using generative AI and voice-cloning technologies to assist in developing academic course content.

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