Journal of Literacy and Technology: Volume 26, Number 2: Summer 2025

Journal of Literacy and Technology
Volume 26, Number 2: Summer 2025
ISSN: 1535-0975

Pre-Service Teacher Education in the Age of AI: Exploring Knowledge, Attitudes, and Classroom Integration Strategies

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Abstract

This mixed-methods study investigates the impact of an instructional module that integrated artificial intelligence (AI) into pre-service teacher education. The study participants included 93 undergraduate teacher education students taking an introductory instructional technology course at a large university in Florida, United States. The study examined changes in pre-service teachers' (PSTs) knowledge and attitudes toward AI after participation in the instructional module. Also, it explores PSTs perceptions about using AI in their future classrooms and the strategies they propose for incorporating AI into teaching. Pre- and post-test surveys were utilized to collect the data, and paired t-tests confirmed significant changes in self-reported knowledge, attitudes, and comfort in using AI in future classrooms. Qualitative findings based on open-ended survey responses reveal that PSTs commonly explain AI as computers mimicking human intelligence, emphasizing machine learning, problem-solving, and recognizing AI as a classroom tool. The findings have implications for teacher practice, highlighting the importance of targeted educational interventions to enhance PSTs' understanding and preparedness to integrate AI into the academic landscape.

Keywords*:* *artificial intelligence, curriculum integration, instructional strategies, teacher education*.

Introduction

Artificial Intelligence (AI) is rapidly transforming education and has the potential to revolutionize teaching and learning practices. Research suggests AI has the potential to make a positive impact on students and teachers; for example, teachers can utilize AI to personalize the learning process, match it to students' needs and learning styles, simplify administrative tasks, save time to focus more on the creative and critical aspects, and provide real-time feedback on student performance (Younis, 2024). At the same time, AI is disrupting educational settings, making it almost impossible to discern carefully constructed AI papers from student-created papers. As AI continues evolving and becoming an integral part of education, its influence sparks concerns and opportunities. Plagiarism is often a focus when discussing the use of AI in education. However, Spector (2023), using Stanford survey data, found no significant increase in student cheating since GenAI became widely available.

As educators strive to prepare students for the demands of the digital age, it becomes crucial for pre-service teachers (PSTs) to develop knowledge of AI and incorporate it into the classroom. However, the successful implementation of AI hinges upon educators' knowledge, readiness, and ability to leverage its potential effectively. This mixed-methods study investigated the impact of integrating AI into instruction on PSTs' knowledge, attitudes, and strategies related to AI in their future classrooms. PSTs, being at the threshold of their teaching careers, provide a unique perspective on incorporating AI into classroom practices. As such, the research presented here can help PST educators gain insights into the current state of AI literacy among PSTs and identify areas for instructional improvement.

Literature and Background

Artificial intelligence has served a dual role in education, one as a teaching/learning tool and another as a subject matter to be taught and experienced. Researchers and education technology advocates have long been speculating about how AI may shape the future of K-12 education, including ways AI may shape classroom instruction, the role of the teacher, and how students learn (Murphy, 2019). More recently, the introduction of freely available generative AI tools sparked widespread discussion over how AI will impact the future of teaching and learning. With the rapid expansion of available AI tools, teachers need to be educated on what they are and how to use these evolving tools themselves. In the following literature review, we discuss AI as a tool for teaching and learning, how it is being integrated into the K-12 curriculum, and AI in teacher education.

AI as a Tool for Teaching and Learning

Some of the earliest examples of using AI as an educational tool were intelligent tutoring systems (ITSs). These tutoring systems are a type of rule-based expert system that "mimic the decision-making ability of human experts" and can help teachers meet diverse student needs through individualized learning activities (Murphy, 2019, p. 3). Furthermore, Murphy noted that for subjects such as math, physics, language, and literacy, ITS-based instruction resulted in higher test scores than traditional learning formats and learning results similar to one-on-one tutoring and small-group instruction.

Robots are another example of how AI can be used as a teaching tool, as they offer the possibility for individualization and adaptation to student needs (Hrastinski et al., 2019). Specifically, educational robots have been successfully employed in classrooms to teach computational thinking (Powers et al., 2020) and AI concepts (Sklar et al., 2007). Sklar et al. also note that instructors have used robotics-inspired projects to teach AI and robotics courses.

In a study by Holstein et al. (2019), researchers used a participatory speed dating approach, where students and teachers were rapidly given hypothetical scenarios to respond to with immediate reactions. The researchers examined what teachers and students see as the role of human versus AI instruction (Holstein et al., 2019). The data was then synthesized from the transcriptions of the reactions. While the research looked both at what participants preferred and did not prefer in AI-enhanced classrooms, teachers showed a preference for AI capabilities such as real-time feedback to determine if their student comments were constructive, ranking students by a need for teacher help, and invisible hand raises, among others (Holstein et al., 2019).

Concerning the teacher's role, AI's goal is not to replace teachers but rather to help them do their jobs better and more efficiently (Bryant et al., 2020). The McKinsey Global Institute's 2018 Report suggests that 20 to 40% of teachers' time on activities can be automated using currently available technology (Bryant et al., 2020). Moreover, this research also showed that work hours have grown, yet teachers spend less time in direct instruction and have more time for preparation, evaluation, and administrative duties (Bryant et al., 2020). AI could enhance teacher productivity by taking on some of these activities, allowing them to focus more on student instruction. AI can also aid teachers in instruction by freeing them from the burden of possessing all knowledge and information, shifting to a support role, and guiding students in discussions and collaborative processes (Roll & Wylie, 2016).

At a symposium hosted by Mid Sweden University, teachers expressed various concerns and attitudes about their evolving roles in K-12 classrooms amidst the integration of AI in education (Hrastinski et al., 2019). These included teachers' concerns about their future roles in the K-12 classroom. At the same time, teachers expected that AI education would make individualized teaching easier, function as a digital assistant, and be a resource to provide opportunities for students who need more information at school. Teachers also saw the potential for AI education to simplify the work in the classroom. Regarding educational robots, a key focus of the discussions was the relationship between educational robots, teachers, and students (Hrastinski et al., 2019).

AI in the Curriculum

Globally, efforts to expand computer science education, including teaching AI concepts in K-12 education, are quickly growing (Touretzky et al., 2019). China, for example, has mandated that all high school students learn about artificial intelligence (Jing, 2018). In Australia, AI researchers have collaborated with K-6 teachers to provide a curriculum covering basic AI concepts and vocabulary (Heinze et al., 2010). In the United States, private companies and various associations and organizations have supported and encouraged students to learn computer science throughout their K-12 education (Touretzky et al., 2019). In 2018, the Association for the Advancement of Artificial Intelligence (AAAI) and the Computer Science Teachers Association (CSTA), along with the nonprofit AI4ALL, developed a joint initiative called "AI for K-12" led by Professor David Touretsky to create national guidelines for teaching K-12 students about AI, machine learning, and robotics based on CSTA's national standards for K-12 computing education AI4ALL Team, 2018). The group is also working to provide online resources for teachers to find materials, software, and lesson plans and to deliver free workshops directly to teachers (AI4ALL Team, 2018; AAAI, 2018).

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The International Society for Technology in Education [ISTE] is known for creating educational standards for teacher educators. In 2023, ISTE merged with the Association for Supervision and Curriculum Development (ASCD) to form a new education nonprofit organization. Consequently, the ISTE standards were updated to incorporate AI, and the question of how best to combine the strengths of human and AI instruction received increased attention. The white paper Evolving Teacher Education in an AI World (ISTE, 2024a) stresses the urgency and importance of integrating AI into the current classroom and teacher preparation programs. ISTE also offers many curricular resources for using AI in education (ISTE, 2024b). These resources include lesson ideas, videos, podcasts, blogs, and online courses.

In articulating what every child should know about AI, Touretzky et al. (2019) suggested teaching five "big ideas" about AI to K-12 students, with increasing levels of complexity based on grade level. These big ideas are:

1. Computers perceive the world using sensors. Students should understand that computers "see" and "hear" information. They should know how to interact, modify, create, and show the limitations of voice-based and vision-based computer applications.
2. Agents maintain models/representations of the world and use them for reasoning. Students should understand that computers construct representations using data. They should know how to examine and create these representations with increasing levels of complexity as they progress through the grade levels.
3. Computers can learn from data. Students should understand that "machine learning is a kind of statistical inference that finds patterns in data" (Touretzky et al., 2019, p. 9797). They should experience, modify, measure, and code machine-learning applications.
4. Making agents interact comfortably with humans is a substantial challenge for AI developers. Students should understand that it is difficult for computers to understand and interact with humans at even a child's level (Touretzky et al., 2019, p. 9798). They should recognize these challenges in creating and understanding language and eventually learn to work with language processing and sentiment analysis tools.
5. AI applications can impact society in both positive and negative ways. Students should understand how AI contributes to their lives, identify the ethical and societal impacts of AI, and be able to evaluate the impact of AI applications critically.

In summary, these five "big ideas" provide a comprehensive framework for introducing K-12 students to the fundamental concepts of AI, paving the way for a more AI-literate generation.

Companies such as Google and Microsoft have also aided the expansion of AI curricula (Touretzky et al., 2019). For example, ISTE and General Motors partnered to develop AI guides for elementary, secondary, elective, and computer science educators and an AI ethics guide (ISTE, 2024b). AI4ALL has received a large grant from Google to develop an AI curriculum (AI4ALL Team, 2018). Further, various AI software tools have been developed and made available to younger students (Touretzky et al., 2019). There are also nonprofits such as Code.org, which is supported by various corporations and provides K-12 computer science curriculum to schools while increasing diversity and access to computer science education (Code.org, 2024). Other

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curricula expose students to robotics as a component of AI and machine learning and prepare them for the future (Zimmerman, 2018). The term "robot" can cover different phenomena, from software expert systems to autonomous physical robots (Serholt et al., 2017). LEGO robotics, for example, has been used to improve students' computational thinking skills (Shute et al., 2017). The representation of code through robotics helps students understand abstraction, an important component of computational thinking (Adler & Beck, 2020). Working with educational robots can also help enhance students' cognitive and social skills (Ioannou & Makridou, 2018). As educational applications of AI in the classroom continue to grow, researchers are investigating how AI and ChatGPT may be utilized in educational settings to help teachers and students while ensuring responsible and ethical use (Adiguzel et al., 2023).

Few efforts have been made to involve teachers as AI curricula designers (Zhou et al., 2020). Implementing technology and software and training teachers to adapt to it can be difficult (Bryant et al., 2020). Information garnered from group discussions at the symposium on Digitalization, Education, and Design: The Role of the Teacher reflects some of these concerns. One of the most common themes in the discussions about AI education was teacher knowledge and professional development (Hrastinski et al., 2019). Comments focused on the need for knowledge about AI education and how to use AI education in the K -12 classroom (Hrastinski et al., 2019).

AI in Teacher Education

Research suggests a substantial need for professional development if AI education is to be integrated into K-12 classrooms for teaching and learning (Hrastinski et al., 2019). Many teachers need help to imagine how to use AI education in the classroom because they express a limited understanding of AI (Hrastinski et al., 2019). This may be attributed to the limited curriculum for teaching AI literacy and the fact that teachers often need more experience teaching AI (Zhou et al., 2020). There is also a need for more robotics teaching materials for K-12 educators (Mataric, 2004). Teachers know little about what AI is, what educational robots are, or how they can be used in the classroom (Hrastinski et al., 2019). More K-12 teachers need to be trained in computer science or computational thinking, which could be helped with effective pre-service training (Mason & Rich, 2019). A lack of knowledge in content, technology, or pedagogy could lead to barriers to teachers' understanding of computing concepts (Mason & Rich, 2019), and there is a need for more knowledge about digital technologies and how they may be used (Hrastinski et al., 2019).

Digital competencies can provide teachers with a practical framework for learning how to use digital technologies in a way that seamlessly connects technology, pedagogy, and content (Hrastinski et al., 2019). One of the foundational concepts of technology integration is the Technological, Pedagogical, and Content Knowledge (TPACK) framework. TPACK is an extension of Shulman's (1987) concept that pedagogical content knowledge should be integrated with technology into the practice of teaching. TPACK describes "an understanding that emerges from an interaction of content, pedagogy, and technology" (Koehler & Mishra, 2009, p.17). Recent studies have focused on applying the TPACK Model to AI. Mishra et al. (2023) highlight the qualities of generative AI that make it like other digital technologies, which are often protean, opaque, and unstable. However, they also note that it is revolutionary because it is generative and socially based. These researchers go on to discuss how generative AI changes many basic educational elements, including basic assessments.

Recently, a few studies have examined the integration of AI education in teacher training for both in-service and pre-service educators. Regarding AI knowledge, research indicates that both pre-service and in-service teachers often possess a limited amount, which can impede their ability to integrate AI into their instructional practices effectively (Ayanwale et al., 2024; Celik, 2023; Yue et al., 2024). This knowledge gap exists in both the theoretical understanding of AI and its practical applications within the classroom. Some studies have demonstrated that specific AI instructional interventions can enhance PSTs' AI literacy and knowledge. Ayanwale et al. (2024) explored AI literacy among PSTs, finding that a profound understanding of AI predicts positive outcomes in AI use. Celik (2023) also emphasized the importance of teachers' AI-specific technological and pedagogical knowledge for effective AI integration.

Regarding PSTs' attitudes toward AI, some research suggests that it can significantly influence their intentions to use AI-based educational applications (Ayanwale et al., 2024; Zhang et al., 2023). Factors such as perceived usefulness, perceived ease of use, and AI anxiety play a role in their acceptance of AI (Zhang et al., 2023). Other research suggests that PSTs recognize AI as a potential classroom tool and propose strategies for its incorporation, such as using computers in lesson plans (David & Maroma, 2025; Guan et al., 2025; Sun et al., 2024). For example, David and Maroma (2025) explored the integration of ChatGPT in PST education. Guan et al. (2025) investigated PSTs' perceptions and capabilities for AI-integrated education. Studies emphasize the importance of preparing pre-service teachers to integrate AI into their future classrooms. In another study, Sun et al. (2024) found that factors such as Technological Pedagogical Content Knowledge (TPACK), Perceived Usefulness (PU), Perceived Ease of Use (PE), and Self-Efficacy (SE) influence pre-service STEM teachers' willingness to integrate AI into STEM education. The current study adds to the body of research by extending it to the infusion of AI education into teacher preparation coursework.

Methodology

This mixed-methods study had two overarching objectives. First, we added a module that integrated AI into instruction to explore how PSTs' knowledge and attitudes toward AI might change. Next, we explored participants' perceived comfort in using AI in their future classrooms and the strategies participants described that could be used to incorporate AI into their teaching.

In doing so, the following research questions were asked:

1. Is there a significant change in PSTs' knowledge and attitudes toward AI?
2. Is there a significant change in PSTs' comfort in using AI in their future classrooms?
3. How do PSTs explain the concepts of AI after participating in the lesson?
4. What strategies do PSTs describe that could be used to incorporate AI into their future classroom teaching?

In order to answer the questions, an explanatory mixed methods design was utilized, as described by Fraenkel et al. (2012). Following up the quantitative analysis with qualitative inquiry, the researchers gained a deeper insight into the qualitative findings by painting a picture of PSTs' understanding of AI and its integration into classroom instruction.

Description of the Lesson

In the fall of 2019, two instructional technology faculty members from the site of this study collaborated with a computer science professor from another university to develop the learning module. The instruction was delivered via distance learning during the spring, summer, and fall semesters of 2020 at a large public university in Florida. Two instructors were teaching the course using the same Canvas course materials, one of whom was a research team member.

The AI lesson in this study was embedded in a module named Solving Problems & Designing Solutions through Coding, Makerspaces & Serious Games (Plugged in CS Activities). This module also includes resources and assignments on computational thinking and robotics. AI is introduced with a series of resources from ISTE. The students then explored Code.org and were given two assignments named "AI for Oceans" and “Computational Thinking, Artificial Intelligence, and Robotics Integration Lesson." These activities allowed the PSTs to experience an AI curriculum that could be integrated into their future classrooms.

Data Collection

Data for this study were collected using a pre-and post-test survey designed and delivered through Qualtrics software. The survey contained 16 items, though not all were used in this analysis. Items included demographic and background information about the participants. Also, items adapted from the instrument Yadav et al. (2014) used to assess perceived knowledge and attitudes toward AI in four categories: Definition, Comfort, Interest, and Use in the classroom. These items were measured on a scale of 1 to 7 with endpoints "strongly disagree" to "strongly agree." Finally, a few open-ended items were included to gather qualitative data. A summary of the survey is presented in Appendix A.

After gaining institutional review board approval, the surveys were administered electronically within the course through the Canvas learning management system. This was accomplished by providing students with a link to the pre-test survey in the course before the AI instructional module and the post-test survey after the instruction. All of the students in the course were directed to complete the surveys as part of the coursework, but participation in the research was voluntary. Therefore, only those students who consented to participate in the research were included.

Participants

The study involved 93 students enrolled in an undergraduate instructional technology course at a Florida, United States university. The majority of participants (N=79) identified as female, while 14 identified as male, which is typical in education courses. Most participants fell within the 18-22 age range, which is typical for traditional college students (86%). The remaining 13.4% of participants were aged between 23 to 32 years old, with 3.2% being over 30. Additionally, a large proportion of the students (83.8%) were pursuing degrees in education, including majors such as early childhood, elementary, chemistry, English, mathematics, social studies, and exceptional student education, as shown in Table 1.

Table 1

Participants by Degree Program

Degree Program	N	%
Bachelor in Early Child Care and Education	18	19.4
Bachelor of Arts in Exceptional Student Education	9	9.7
Bachelor in Chemistry Education	1	1.1
Bachelor in Elementary Education	31	33.3
Bachelor in English Education	7	7.5
Bachelor in Math Education	2	2.2
Bachelor in Social Science Education	10	10.8
Pursuing a different degree or course of study	15	16.2
Total	93	100

As is common among education courses, the majority of the participants were female at 86.4% (N=51), seven were male (11.9%), and one participant preferred not to answer the survey item regarding gender (1.7%). The age distribution of the participants indicated that most fell within the 18 to 22 age bracket (62.7%), and some belonged to higher age ranges, including 23 to 27 (30.3%), 28 to 32 (11.9%), and 30 years or older (5.1%).

Quantitative Analysis

The quantitative data were entered into SPSS® 27 software for analysis. The survey items regarding knowledge, attitudes, and future classroom use of AI were summarized by calculating descriptive statistics. Next, a one-sample paired t-test was conducted to determine whether there was a statistically significant difference between participants' self-reported ratings of each knowledge, attitudes, and future classroom use of AI survey item between the pre-test and post-test. Furthermore, the differences in means of the paired values were calculated and plotted on histograms to assess the validity of the paired t-test results. An examination of the histograms showed that the values were roughly bell-shaped, satisfying the assumption that the values are normally distributed for one-sample paired t-test validity. Finally, the effect size of any statistically significant findings was evaluated by examining Cohen's d. Walker (2008) noted that determining the difference between the means of two samples d is calculated by dividing the difference in means by the average of their standard deviations. SPSS® 27 generates this value automatically when a paired t-test is run. An effect size of 1 indicates that the means differ by one standard deviation; a d of 0.2 can be categorized as a small effect size, 0.5 as a medium effect size, and 0.8 as a large effect size, as per Walker's (2008) recommendations for effect size assessment.

Qualitative Analysis

Qualitative analysis seeks to uncover categories, themes, and patterns that appear in qualitative data (Patton, 1980). In this study, qualitative methods were used to analyze open-ended survey items that were organized into tables in electronic word processing software and coded by two researchers. A list of a priori codes that relate to the research questions was used as a starting point. Later, the code list was adapted to accommodate unexpected findings. In doing so, additional coding categories were developed by reading over all of the data and searching for regularities, patterns, and topics the data covered, and then writing down words and phrases that represented the topics and patterns that were not included in the initial set of codes (Bogdan & Biklen, 2007). The researchers then systematically sorted the data into the final set of coding categories (Bogdan & Biklen, 2007). Finally, the researchers examined the categorized data to identify any overarching themes or thematic findings (Bogdan & Biklen, 2007; Merriam, 1998). A list of the a priori and additional codes is presented in Table 2.

Table 2

Code List

A Priori Codes	Additional Codes
AI as teacher helper (TH)	Machine that completes tasks for/normally done by humans (CT)
AI Tools (Alexa, chatbots, etc.) (AIT)	Teaching Aide (TA)
Computer with human intelligence (CHI)	
Machine learning (ML)	
Online apps and websites (AOW)	
Problem-solving machine (PS)	
Robot design (RD)	

Results

Quantitative Results

Descriptive Statistics

Nine survey items were used to measure PSTs' reported AI knowledge, attitudes, and future classroom use on both the pre-and post-test surveys. Descriptive statistics for these items, as measured on a scale from 1 (strongly disagree) to 7 (strongly agree), are summarized in Table 3.

Table 3

Descriptive Statistics of Pre- and Post-Test Survey Items

	Pre-Test	Post-Test

	Mean	Std. Deviation	Mean	Std. Deviation
AI involves designing machines that can perform tasks commonly associated with intelligent beings (AIK1)	5.88	1.058	6.38	.881
AI involves designing machines that have the ability to interpret data, learn from such data, and use the information to achieve specific goals through adaptation (AIK2)	6.08	.902	6.43	.780
I do not think I can apply knowledge of AI to interact with machines that can adapt and learn (AIA1)	3.22	1.527	2.58	1.499
I can learn to understand AI concepts (AIA2)	5.38	1.241	5.79	1.204
I do not use AI skills in my daily life (AIA3)	4.04	1.722	3.56	1.716
The challenge of interacting with machines that can adapt and learn using AI appeals to me (AIA4)	4.68	1.564	5.13	1.400
I think AI is interesting (AIA5)	4.99	1.503	5.37	1.426
AI can be incorporated in the classroom by using computers in the lesson plan (AIFC1)	5.39	1.215	5.86	.104
AI can be incorporated in the classroom by allowing students to design robots (AIFC2)	5.47	1.153	6.06	.976

As shown in the table above, the level of agreement for most of the items was higher on the post-test than on the pre-test. For instance, the item "AI can be incorporated in the classroom by allowing students to design robots" (AIFC2) yielded a mean of 5.47 on the pre-test survey and 6.06 on the post-test. These suggested participants tended to agree with this statement before the AI instruction but agreed even more strongly after. It should be noted that a few of the items were measured on a reverse scale (AKA1 and AKA3) and yielded lower ratings on the post-test, which was promising because this indicated the participants generally did not agree with these statements as much after participating in the lesson. For instance, the item "I do not use AI skills in my daily life" went from 4.04 down to 3.56, a relatively small decrease but representing a shift from the neutral "neither agree nor disagree" to somewhat in disagreement with this statement.

To provide a visual representation of the changes in means from pre- to post-test surveys, a series of line graphs depicting the change for each item is presented in Figure 1.

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ISSN: 1535-0975

Figure 1

Line Graphs of Pre- and Post-Test Survey Items

AI Knowledge and Attitudes

Research question 1 asked, "Is there a significant change in the PSTs' knowledge and attitudes toward AI?" The results of the paired t-test for PSTs' self-reported level of knowledge and attitudes toward AI are presented in Table 4.

Table 4

Results of Paired T-Test of Knowledge Towards AI

					95% Confidence Interval					
	Item	Mean	SD	SEM	Lower	Upper	t	df	Sig.	Cohen's d
Knowledge	AIK1	.500	1.192	.126	.250	.750	3.979	89	.000 *	.419
	AIK2	.356	.998	.105	.147	.565	3.380	89	.001 *	-.374
Attitudes	AIA1	-.644	1.724	.182	-1.006	-.283	-3.546	89	.001 *	-.374
	AIA2	.411	1.315	.139	.136	.686	2.967	89	.004 *	.313
	AIA3	-.489	2.068	.218	-.922	-.056	-2.243	89	.027 *	-.236
	AIA4	.456	1.677	.177	.104	.807	2.577	89	.012 *	.272
	AIA5	.378	1.362	.144	.092	.663	2.631	89	.010 *	.277

Note: $^{*}p < .05$

The results indicate that two AI knowledge items and all five AI attitude items yielded significant differences ($p < .05$). As knowledge toward AI was measured on a scale of 1 to 7, on average, participants' post-test self-reported levels of the knowledge items increased by 0.500 (AIK1) and 0.356 (AIK2). Regarding AI attitudes, the two survey items that were worded in the negative (i.e., "I do not think I can apply knowledge of AI" or "I do not use AI") decreased, while levels of the items that were positively worded increased as shown in Table 4 above. However, the effect sizes for all of the dimensions of AI knowledge and attitudes were relatively small, as indicated by Cohen's d values lower than 0.050.

AI in Future Classroom

The second research question posed in this study was, "Is there a significant change in PSTs' comfort in using AI in their future classrooms?" The results of the paired t-test for PSTs' self-reported levels of future classroom use of AI are presented in Table 5.

Table 5

Results of Paired T-Test of Future Classroom AI

	Item	Mean	SD	SEM	95% Confidence Interval Lower	Upper	t	df	Sig.	Cohen's d
Future Classroom	AIFC1	.467	1.220	.129	.211	.722	3.630	89	.000 *	.383
	AIFC2	.589	1.235	.130	.330	.848	4.523	89	.000 *	.381

Note: $^{*}p < .05$

For two items regarding future classroom use of AI, significant differences were found ($p < .05$). Participants' levels of self-reported future classroom use of AI items increased by 0.467 (AIFC1) and 0.356 (AIFC2). As indicated by Cohen's d values below 0.050, effect sizes were relatively small for both items.

Qualitative Results

This study's qualitative findings are categorized according to research questions and themes and are supported by the input obtained from open-ended survey responses and student reflection.

How do PSTs Explain the Concept of AI?

Research question 3 inquired, "How do PSTs explain the concepts of AI after participating in the lesson?" The analysis of the open-ended survey items unveiled the most common explanations provided by the respondents.

The most prevalent response centered around the notion of computers possessing human intelligence. Respondents described computers as "mimicking," "developing," or "simulating" human thinking, among other similar terms. Following closely after was the concept of machine learning. These responses emphasized computers' ability to "interpret data" and "learn" in order to independently "make decisions," for instance. Slightly less frequent than machine learning was the idea that AI involves machines performing tasks that are typically done by humans. Additionally, some respondents expressed the notion that AI is about solving problems or "making things easier." Several participants also acknowledged AI as a tool to assist in the classroom.

Overall, these qualitative findings shed light on PSTs' explanations of AI concepts, highlighting their understanding of computers imitating human intelligence, machine learning capabilities, task automation, problem-solving, and the potential of AI as a classroom tool.

Future Classroom Strategies

Research question 4 asked, "What strategies do PSTs describe that could be used to incorporate AI into their future classroom teaching?" The analysis of responses revealed the most frequently mentioned strategies.

The strategy that emerged with the highest frequency was the utilization of AI as a teacher assistant or helper. Respondents highlighted tasks such as grading papers and assessments, providing expertise, and assisting in lesson planning. Many of these respondents emphasized the potential for individualized tutoring using AI. The next most common strategy mentioned was related to robot design. Respondents expressed interest in incorporating robots into their classrooms, potentially as educational tools or aids for various tasks. Closely following robot design, the use of online websites and apps was suggested as a strategy for incorporating AI. Respondents recognized the value of AI-powered online resources and applications in enhancing student learning experiences. While several respondents mentioned AI tools as potential strategies, a larger number of participants indicated that they either needed to learn or were unsure how to effectively utilize AI in their future classrooms. In summary, these qualitative findings indicate that PSTs described strategies such as utilizing AI as a teacher assistant, exploring robot design, incorporating online websites and apps, and utilizing AI tools in their future classroom teaching. However, it is worth noting that several respondents expressed uncertainty regarding implementing AI in their teaching practices.

Limitations

Like any research, this study has limitations that affect the generalizability of its findings. First, students were required to complete the instructional module in this study as part of regular coursework. While consent for participation in the research was optional, this could introduce potential bias, as students might have felt obligated to consent, impacting their responses. Also, the findings could have differed if additional data samples were collected from other universities. The external validity of this study is limited, as it concentrated solely on PSTs at one university. This issue highlights the need to recognize that the findings may not be generalizable across populations or settings. Future research focusing on integrating AI into instructional contexts could benefit from examining larger and more diverse sample sizes. Another limitation is the participants who engaged in the instruction may have different educational backgrounds and varying levels of exposure to AI concepts and the online learning modality in general. Therefore, some participants might have had more background or experience that influenced students' ability to build on prior knowledge of AI or navigate an online course effectively. Lastly, it is important to note that one of the four researchers on this project also served as an instructor in the courses examined. This dual role influenced how students responded to the survey items, potentially causing response bias.

Discussion

This mixed-methods study explored the impact of an instructional module that integrated AI into PSTs' education, focusing on their knowledge, attitudes, comfort levels, and strategies for incorporating AI into future classrooms. The study's findings have several implications that can guide teacher education practices related to integrating AI into teacher education.

Changing Knowledge and Attitudes Towards AI

This study found significant differences in PSTs' self-reported levels of knowledge and attitudes toward AI after participating in the instructional module. PSTs reported feeling more knowledgeable about AI concepts after the instruction and were more willing to apply AI knowledge. These findings suggest that integrating AI education into teacher education can enhance PSTs' understanding of AI and its potential applications in education. This finding supports Roll and Wylie (2016) and Hrastinski et al. (2019), who found that teachers felt they would benefit from more knowledge of AI. However, it's important to note that the effect sizes were relatively small, indicating that while there was improvement, it might not be substantial. This highlights the need for continued, in-depth AI education for future teachers.

Comfort in Using AI in Future Classrooms

This study also found a significant increase in PSTs' comfort levels when using AI in their future classrooms. It is important to note this outcome because teachers' comfort and confidence with AI tools are essential for effective integration. The fact that PSTs reported greater ease with using AI in their classrooms after instruction suggests that exposure to AI concepts and practical applications can positively influence their readiness to embrace AI as an educational tool.

Explanations of AI Concepts

The qualitative analysis shed light on how PSTs explain AI concepts. The most common explanation of AI centered on computers mimicking human intelligence. This perception aligns with the traditional notion of AI as machines that exhibit human-like cognitive abilities, as noted by Murphy (2019). The findings also indicate that PSTs may see AI as a tool that can make tasks easier and enhance problem-solving.

Strategies for Incorporating AI in Future Classrooms

PSTs in this study provided several strategies for incorporating AI into their future classrooms. The most prevalent strategy was the utilization of AI as a teacher assistant, which aligns with the idea of AI supporting educators rather than replacing them. This finding is consistent with Bryant et al. (2020), who asserted that the goal of AI is not to replace teachers but to help them in doing their jobs. Robot design emerged as a strategy PSTs would use to implement AI in their future classroom, and the mention of online websites and apps suggests that PSTs recognize the value of AI-powered resources for creating interactive and engaging learning experiences. However, not all PSTs were sure how to use AI in their future classrooms, as many expressed uncertainties about effectively integrating AI into their teaching practices.

Conclusion

While AI is becoming a highly discussed and studied topic, more needs to be researched on how we can effectively prepare current and future teachers to incorporate it into their classrooms. Many teachers have difficulty imagining using AI in their classrooms because of their limited understanding of it (Hrastinski et al., 2019). This study adds to research on AI by demonstrating that exposing future educators changes their knowledge, attitudes, and teaching strategies. As future teachers are trained to go into classrooms, it is necessary for them to develop their knowledge of AI so that they can leverage its potential effectively. However, future research is needed and welcomed to expand upon this study in light of the recent releases of open-access generative AI tools and ongoing discussion about the benefits and concerns regarding AI in education.

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ISSN: 1535-0975

Appendix A

AI Survey Questions

Demographic and background information

1. Consent
2. Gender
3. Age group
4. Degree enrollment
5. Progress toward a degree

Please rate your attitudes regarding each of the statements about AI using the following scale: Strongly agree (1), Agree (2), Somewhat agree (3), Neither agree nor disagree (4), Somewhat disagree (5), Disagree (6), Strongly disagree (7).

6. AI involves designing machines that can perform tasks commonly associated with intelligent beings.
7. AI involves designing machines that have the ability to interpret data, learn from such data, and use the information to achieve specific goals through adaptation.
8. I do not think I can apply knowledge of AI to interact with machines that can adapt and learn.
9. I can learn to understand AI concepts.
10. I do not use AI skills in my daily life.
11. The challenge of interacting with machines that can adapt and learn using AI appeals to me.
12. I think AI is interesting.
13. AI can be incorporated in the classroom by using computers in the lesson plan.
14. AI can be incorporated in the classroom by allowing students to design robots.

Open-ended Questions

15. How would you explain the concepts of AI?
16. Describe the strategies you can use to incorporate AI into your future classroom teaching.

Journal of Literacy and Technology
Volume 26, Number 2: Summer 2025
ISSN: 1535-0975

Today's Educational War: Artificial Intelligence vs. Academic Integrity

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Abstract

Artificial intelligence (AI) is a powerful tool increasingly utilized across professional fields. As software that mimics human thinking, AI has the potential to assist individuals in various aspects of daily life. However, an important question arises when applying AI in education: Will students use AI ethically? While AI offers valuable support in education, it also presents challenges, particularly in relation to academic integrity.

This paper explores the ongoing tension between the use of AI and the principles of academic honesty. As society continues to shift toward more computer assisted education and online education, understanding the integration of AI in learning environments becomes increasingly important. This research aims to expose the complexities of AI integration in education and highlights the need for clear guidelines and policies. Drawing on the insights gained from this research; educators can make better informed decisions about the effective and ethical integration of AI in educational environments.

Introduction

Artificial intelligence (AI) is here to stay and is ever-present in students' lives. As a result,

AI has become increasingly embedded in school systems. Educators must recognize that this technological advancement can be used both ethically and unethically. The key question we must now address is: *Will students use AI ethically?* Ideally, AI should serve as a supportive tool that enhances the educational experience rather than undermine it.

A useful analogy is the introduction of calculators into education. When first introduced, calculators sparked significant controversy. The use of calculators in education gained popularity in the 1970s, as the decreasing cost of pocket calculators made them more accessible to students. At the time, many educators viewed this emerging technology as a threat to students' mathematical understanding and development. However, a segment of the educational community recognized the potential benefits calculators could offer in enhancing mathematics instruction (Banks, 2011).

Over time, calculators evolved from a controversial tool to an essential element in education. In 1986, Connecticut became the first state to require calculators on a state examination (Banks, 2011). By 1994, the College Board allowed calculator use on the SAT math section (Banks). There were widespread concerns that calculators would inhibit students' ability to develop foundational math skills (Banks). While some of these fears proved to be partially valid, calculators are now widely accepted as powerful educational tools. Importantly, their adoption opened the door to exploring higher-order thinking skills, as calculators were integrated not as crutches, but as tools to deepen learning (Sheets, 2007). Today, calculators are recognized as vital educational tools in classrooms, reflecting broader trends in how technology can be thoughtfully integrated into pedagogy to enrich student learning.

In the late 1980s and early 1990s, as personal computers became increasingly accessible in educational settings, the introduction of word processors began to significantly transform the writing process in schools (Streibel, 1986). These tools shifted students' attention away from the mechanical constraints of writing, such as legibility and spelling, and toward the development of content, structure, and expression. Research has shown that the use of word processors supported more extensive revision, encouraged longer and more complex compositions, and improved overall writing quality, particularly when paired with instruction on effective drafting and editing strategies. Although some educators initially voiced concerns about students becoming overly dependent on technology, the prevailing consensus emerged that word processors enriched the writing experience by making it more fluid, interactive, and engaging (Snyder, 1993).

The evolution of educational technologies, such as the calculator and the word processor, illustrates how innovations initially met with skepticism can transform into important tools in education. Both were once criticized for potentially undermining foundational skills, but now they are widely recognized for enhancing instruction and supporting higher-order thinking. In a similar way, artificial intelligence (AI) should not be viewed as a device to shortcut or to avoid learning, but as a powerful tool to support it. This paper examines the complex relationship between AI and academic integrity, asking: Will students utilize artificial intelligence (AI) as a constructive tool to enhance their educational interactions, or will they use it in ways that raise ethical concerns?

Artificial Intelligence vs. Academic Integrity

Defining the War

In essence, artificial intelligence (AI) is a technology designed to simulate human intelligence. The rising popularity of tools like ChatGPT marks the beginning of a new phase in AI development; one that has the potential to significantly disrupt traditional educational processes. ChatGPT's widespread adoption has inspired other companies to create their own generative AI platforms. While AI can be misused, it also has the potential to be a powerful educational resource. For example, students can use ChatGPT as a virtual coach to improve writing, grammar, and comprehension. It can also help explain complex topics and support deeper understanding in challenging subjects (Hulick, 2023). With responsible use, AI offers promising opportunities for teaching and learning, both now and in the future, by enhancing education and improving access to knowledge (Hulick).

Academic integrity involves adhering to ethical principles such as honesty, trust, fairness, respect, and responsibility. The roots of AI trace back to 1955, when John McCarthy introduced the term (McCarthy et al., 1955). Just four years later, AI was being used in educational programs at Stanford, including PLATO, a system that taught basic math and science (Ray, 2023).

At its inception, AI was embraced as a valuable educational tool. Today, however, educators using AI as a tool for learning is viewed as both a helpful resource and, by some, as an unfair advantage for students who rely on it to bypass genuine learning (Currie, 2023). Some individuals perceive the use of artificial intelligence (AI) in academic settings as equivalent to contract cheating promoting the opportunity to violate academic integrity (Baarlaer, 2023). When evaluating the relationship between artificial intelligence (AI) and academic integrity, it is essential to examine the different methods by which AI is used unethically in academic settings. The chart below outlines the most common violations of academic conduct associated with AI tools.

Common Violations of Academic Integrity using AI (Balalle & Pannilage, 2025)	
Plagiarism	Students using AI to generate essays, research papers, or other assignments without proper attribution. This is the most common abuse of AI in education.
Cheating on Assessments	Students using AI to answer questions during exams, potentially compromising the fairness of assessments.
Data Fabrication	Students generate fake data or research findings using AI, which can lead to inaccurate conclusions and compromise the integrity of academic research
Unfair Advantages	Students having access to AI tools while others do not, potentially creating an unequal learning environment.

Ongoing research continues to evaluate the prevalence of academic dishonesty involving AI among students in online classes versus those in face-to-face settings is continuing. One study summarized findings from eight separate investigations on this issue. Of these, two studies reported that online students engaged in more cheating, two found no significant difference, and four indicated that online students cheated less frequently than their in-person counterparts (Adzima, 2020). The study concludes that further research is needed to better understand academic behaviors between the use of AI as a form of dishonesty with interaction to the delivery modality of online. Students enrolled in online courses are often perceived to have greater opportunities to misuse AI, largely due to reduced supervision during assessments compared to face-to-face environments. This perception, identified in this study raises important concerns regarding equity and academic integrity across different instructional modalities (Adzima, 2020).

Despite these concerns, AI will continue to play a constructive role in education. It can function as a tutor, a supplemental resource, or a personalized support tool. For online learners, who may have less real-time interactions with educators, AI can help bridge the gap by providing supplemental guidance, similar to what a teacher might offer in a live classroom (Alqahtani, 2023).

At the same time, students receive messages that AI is a good tool to use to compose and use in many non-academic settings. Combined with the ease of use for academic tasks, student use of AI for assignments contributes to academic misconduct in educational settings. Many students now inappropriately use AI to write essays, solve mathematical problems, and complete assignments, sometimes in violation of academic standards (Xie et al., 2023). Without clear guidelines, students may continue to misuse these tools, not out of malice, but due to unclear boundaries (Balalle & Pannilage, 2025). While AI was developed to assist with thinking, it can prevent students from developing critical thinking skills if used improperly. It is essential for educators and institutions to set clear policies and promote responsible use to ensure that AI remains a tool for learning, not eliminating the learning process.

The Battlefield, Spies, and Inside Sources

A recent study examining academic dishonesty across various types of high schools (public, private, and charter) focused on the impact of artificial intelligence (AI) tools, particularly following the global release of ChatGPT in 2022. The findings indicated a significant increase in academic dishonesty after ChatGPT became widely accessible. According to the study, between 60% and 70% of students admitted to engaging in some form of cheating both before and after the introduction of ChatGPT. Prior to its release, 45% of students reported collaborating with peers on assessments or assignments in ways that violated academic policies. In ChatGPT's first year, 7% of students admitted to using AI tools in ways that breached academic integrity rules. Interestingly, after a short period of time, the use of AI for academic dishonesty rose to 15%, the rate of peer-to-peer information sharing decreased from 45% to 15% (Lee et al., 2024).

Another case study conducted at the higher education level further explored the prevalence of academic dishonesty in the context of AI. The percentage of students who admitted to cheating ranged from 40% to 80%, with male students reporting higher rates of cheating than their female classmates (Lee et al., 2024). The study found that one of the primary reasons students engaged in dishonest behavior was the low perceived risk of being caught (Nartgün & Kennedy, 2024). Additionally, faculty members were observed to exhibit low effort in preventing cheating, which contributed to the issue. Other contributing factors included poorly designed examinations, inadequate proctoring procedures, and overcrowded classrooms, all of which created conditions

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that made it easier for students to exploit AI tools to gain an unfair academic advantage (Nartgün & Kennedy, 2024).

Declaring War

The invention of dynamite had a profound impact on the world, enabling civil engineers to construct monumental structures previously thought impossible. However, dynamite also facilitated the development of destructive methods used to harm others (Sachs, 2024). Similarly, artificial intelligence (AI) presents its dual nature. It can be harnessed for constructive educational purposes or used in ways that may be harmful. Tech-savvy educators tend to view AI as a valuable tool for enhancing education, while more experienced educators argue that it has diminished the quality of education (Johanek, 2024). Both perspectives raise valid concerns.

A critical question arises: when does the use of AI in education cross the line into cheating or unethical behavior? To ensure that AI is utilized appropriately in educational settings, clear and concise rules, and policies (referred later in this research as "treaties of the war") must be established.

Currently, educators grapple with the challenge of determining whether a student's work or assessment is original or if it was completed with AI assistance (Nazaretsky et al., 2022). This growing conflict between viewing AI as a helpful tool and as a potential means of cheating is becoming increasingly prominent. Moreover, teachers who are unfamiliar with the full capabilities of AI may continue to be deceived by students, underscoring the need for educators to gain a deeper understanding of AI (Fleckenstein et al., 2024). The ongoing tension between intelligence and integrity is emerging as a significant issue in education worldwide.

Weapons of the War

A growing abundance of generative AI tools are available to our students today. Online educators must remain vigilant and aware of the various "opportunities" these tools present for student use for both constructive and otherwise. While most AI tools are developed with positive intentions, their misuse poses challenges to academic integrity. For example, *Khanmigo*, an AI chatbot developed by Khan Academy, is intentionally designed the AI to not provide direct answers, but rather to support students in their learning processes and promote deeper understanding (Khan Academy, n.d.). Many AI-based educational tools aim to enhance students' critical thinking skills and foster independent learning. Ideally, this reflects the core principle of how AI should be integrated into educational settings.

However, conflict arises when students use AI to bypass the learning process rather than engage with it. Relying on AI in this manner can lead to a decline in students' critical thinking and problem-solving abilities. This paper seeks to expose the "weapons of the war" in academic integrity. Therefore, the "weapon" needs to expose the academic integrity violation. The table below highlights both the generative AI programs commonly used by students to engage in dishonest practices and the AI detection tools / defensive measures employed by educators to maintain fairness and academic standards. The following table present a comparative overview of these tools, illustrating the most popular programs used offensively (by students) and defensively (by educators) in the context of AI in education.

The Offensive: Popular Devices used for Academic Dishonesty		**The Defense: Popular AI Detectors**	
ChatGPT (OpenAI)	A conversational AI that can generate essays, summaries, and answers, often used by students to complete assignments or exams dishonestly.	**Turnitin**	A plagiarism detection and academic integrity tool. It compares a student work to published works, websites, and other students' work.
CheatGPT	A tool designed specifically for cheating, it auto-generates answers for a wide range of subjects, helping students bypass academic tasks.	**Originality AI**	A tool primarily used by content creators to detect AI generated content. Turnitin is gear towards an educational setting. This tool is focused towards professional writing.
QuillBot	An AI writing assistant that paraphrases text to avoid plagiarism detection, allowing students to rewrite existing content to appear as their own work.	**GPTZero**	An AI tool to identify text generated by large language models, such as ChatGPT.
Copy.ai	AI-based tool that generates content like essays, summaries, and reports, making it easy for students to complete assignments without doing the actual work.	**CopyLeaks**	A plagiarism and content authenticity detection tool. Used in education, businesses and content creators.
Jasper (formerly Jarvis)	An AI writing assistant used to generate essays, articles, and other academic content, often utilized by students for completing assignments.	**Winston AI**	An AI content detection tool designed to identify AI generated text with high accuracy.
Scribbr (AI Essay Generator)	Known for helping students generate essays or parts of essays by using AI, which may be misused for cheating.	**Smodin AI Detector**	A tool use to detect AI generated content. Uniquely, it can support over 100 languages.
Writesonic	An AI content generator used by students to quickly produce written material for assignments or projects.	**GPT-2 Detector**	Designed by OpenAI, it is a tool used to distinguish between human written content and GPT-2 generated content.

Simplified AI Writer	A tool that generates high-quality writing automatically, which students can use for essays, summaries, and other academic work.	**GLTR**	Developed by researchers at Harvard and MIT to detect AI generated content. This provides a color-coded visual analysis of the text pattern generated by AI.
EssayBot	This AI-powered tool assists in writing essays by generating content based on provided topics and keywords, often misused for cheating.	**Sapling AI Detector**	An AI content detection tool designed by researchers from Berkeley and Standford.
Rytr	Another AI content generation tool that helps students generate essays, articles, and more by inputting brief prompts or ideas.	**DetectGPT**	Designed by researchers from Stanford, an AI content detection tool that identifies text generated by large language models by analyzing the statistical properties of the text.

** This chart was created using information from ChatGPT and Google Search (OpenAI, 2025).*

No magic wand exists for detecting AI-generated content. Despite the availability of AI detection tools, students often find ways to manipulate AI-generated material to evade these systems. Once a method of academic dishonesty is identified and addressed, students often develop new strategies to circumvent these preventive measures, reflecting a continuous cycle of adaptation in response to detection.

A recent case study, evaluating five prominent AI detectors, revealed significant limitations in their effectiveness (Nartgün & Kennedy, 2024). According to a recent study, detection accuracy ranged from just 48% to 77%, highlighting considerable variability and an urgent need for more reliable and sophisticated detection technologies. The limitations of AI detection tools encompass several key areas. First, there is the issue of detection accuracy. These tools often produce high rates of both false positives and false negatives. Another critical limitation is the lack of specificity; many detection systems struggle to reliably differentiate between human-written and AI-generated code. This challenge becomes more pronounced when AI-generated code closely mimics human coding styles. Additionally, error rates tend to increase when the AI-generated code is derived from diverse domains or programming contexts. These findings challenge the assumption that technological solutions can uphold academic integrity alone (Pan et al., 2024).

William Kerney of Clovis Community College published a paper titled *Treachery and Deceit: Detecting and Dissuading AI Cheating*, in which he outlines four strategies used to combat AI-facilitated academic dishonesty in his classroom environment (*). The methods he describes are: (1) exploiting the weaknesses of AI, (2) embedding traps for AI, (3) implementing a "Nega-Grade" disciplinary system, and (4) detecting stealth AI use.

Exploiting the weaknesses of AI involves leveraging the predetermined errors that AI may generate. Educators can identify common incorrect responses produced by AI and embed these responses as distractors in assessment items. When a student selects such a distractor, it signals potential AI use, serving as a form of detection.

Dropping traps for AI is a creative method that involves inserting hidden text into assignments or assessments using extremely small font sizes, sometimes even a font size of zero. This text is invisible to human readers but detectable by AI programs. When an AI processes the hidden text and incorporates it into a response, it reveals that the tool was used, therefore triggering suspicion of misconduct.

The Nega-Grade Disciplinary System is a policy designed to create strong deterrents against AI cheating. Under this system, students caught using AI dishonestly receive a negative score, typically a deduction of 10%, which is worse than not attempting the assignment at all. Kerney reports that after implementing this system, the incidence of cheating in his online courses dropped to below 2%.

Detecting stealth AI use, the fourth method, involves using AI-detection software such as GPTZero. While this approach is less effective than the other three, it still serves as an example of how technology can be employed in efforts to preserve academic integrity.

Kerney's framework demonstrates that educators must proactively respond to the evolving challenges presented by generative AI. A wide range of innovative strategies has emerged, and with proper training and a deeper understanding of AI tools, instructors can foster more equitable and honest learning environments (Kerney, 2025).

Ultimately, maintaining integrity in the educational environment cannot depends only on AI detection tools, but on the proactive role of educators. Instructors have the responsibility to develop a culture of honesty and design assessments that discourage misuse of AI (Oravec, 2023). Furthermore, institutions must implement clear and enforceable standards, policies, and ethical guidelines regarding AI use in academic work (Oravec, 2023). By doing so, the potential for academic dishonesty can be minimized.

Battles won and Battles lost

This examination of AI use in education uses the ideologies inspired by *The Art of War*, highlighting the ongoing "battle" between the constructive and destructive uses of artificial intelligence (AI) in education. On one side, AI serves as a powerful learning tool, and on the other, it can be misused as a mechanism for academic dishonesty. The rapid emergence of AI technologies has created a significant gap in understanding among educators, many of whom are experienced in pedagogy but unfamiliar with the capabilities of AI (Langreo, 2024). In contrast, students, often more technologically savvy, are quick to recognize and exploit these gaps to their advantage (Jane et al., 2024).

ChatGPT was introduced in November 2022 (Gordijn & Have, 2023), prompting immediate reactions from educational institutions. Initially, several schools and school districts implemented immediate bans on the use of artificial intelligence (AI) tools, such as ChatGPT, due to uncertainties surrounding their impact on student learning and concerns about academic integrity (Williamson et al., 2024). Notable institutions that imposed such bans include the University of Hong Kong, Sciences Po in France, New York City Public Schools, Seattle Public Schools, and the Los Angeles Unified School District (Marr, 2023; Vincent, 2023). At the time, AI was perceived more as a threat to academic development, potentially encouraging plagiarism and reducing critical thinking, rather than as a tool for enhancing learning (Williamson et al., 2024).

However, as understanding of AI's educational potential evolved, many of the mentioned institutions revisited their initial positions. The bans were eventually released, often replaced with carefully crafted policies and guidelines aimed at promoting ethical and constructive use of AI in teaching and learning (Williamson & Eynon, 2023). This shift reflects a broader recognition of AI's capacity to support personalized learning, improve student engagement, and streamline administrative tasks, provided that its use is aligned with clear educational objectives.

These rapid responses were largely driven by uncertainty and concern, as many educators had not received training on the appropriate or effective use of AI tools in academic settings (Dunnigan et al., 2023). At the time ChatGPT was introduced, significant number of faculty members lacked both the technical knowledge and awareness of the potential educational benefits AI could offer. Rather than exploring the constructive applications of AI, some institutions chose to prohibit its use entirely, effectively removing it from the learning environment without fully examining its academic potential (Williamson et al., 2024).

The War Treaty

Today, most educational institutions have established policies or guidelines regarding the use of artificial intelligence (AI) in academic settings. While some institutions implement centralized, institution-wide policies, others delegate the responsibility to individual educators, allowing them to set their own classroom rules on AI use (Schiff, 2022). If the ongoing conflict between the ethical and unethical uses of AI is to reach resolution, a unified policy or agreement must be developed and implemented (Ghimire & Edwards, 2024). This "treaty" may take various forms: some institutions require students to adhere to a technology use agreement (Nartgün & Kennedy, 2024), while others integrate these expectations into syllabus quizzes or classroom policies (Beardsley et al., 2024). Regardless of the method, a few foundational elements are essential to minimizing academic dishonesty. First, a culture of honesty must be fostered (Nartgün & Kennedy). Second, rules regarding the acceptable use of AI should be clearly stated. Third, consequences for misuse must be communicated (Xie et al., 2023). Lastly, both educators and students should be educated on how to use AI responsibly and effectively within academic contexts

Discussion

The primary focus of this paper has been on the negative implications of artificial intelligence (AI) in education, mainly its misuse in academic dishonesty. However, it is important to acknowledge that, when used ethically, AI has the potential to significantly enhance learning and promote educational growth. The studies reviewed in this research have illustrated various methods and techniques by which AI can be misused, ultimately hindering student learning and development. In the absence of clear rules, institutional policies, and well-defined consequences, many students are unlikely to follow proper academic practices.

Conversely, the research also identified a range of strategies that institutions have implemented to ensure AI is integrated into education responsibly. These include policy frameworks, student agreements, and faculty-led initiatives that establish boundaries and expectations for AI use. As AI remains in its early stages within educational settings, it is imperative that educators should become familiar with its capabilities and develop an understanding of how to utilize it as a constructive educational tool. Without careful guidance and purposeful integration, a risk exists that students will prioritize convenience and efficiency over deep, critical thinking, potentially evolving into good information retrievers rather than skilled thinkers and researchers. This is a direction that educators and institutions must work actively to avoid.

Conclusion

Artificial intelligence will undoubtedly continue to serve as a powerful tool in education. However, as with any advancing technology, great power demands great responsibility. Similar to the invention of dynamite, which is capable of both creation and destruction, the ethical and unethical uses of AI must be addressed simultaneously. This research, guided by the conceptual framework of *The Art of War*, emphasizes the importance of preparation and strategic planning in integrating AI into educational systems.

The evidence presented highlights the dual nature of AI: it offers immense potential for enhancing learning, yet it can just as easily be misused for academic dishonesty. Current AI detection tools have proven to be unreliable, reinforcing the need for proactive, rather than reactive, measures. The most effective way to "win" this battle is through preparation. This is done by establishing clear rules, consistent policies, and meaningful consequences before issues arise. Equally important is the creation of an academic culture that embraces AI as a positive force for learning.

In the future, the focus must shift from viewing AI as a threat to academic integrity toward building a future centered on *Academic Intelligence* where students, educators, and institutions alike harness AI ethically to foster deeper thinking, creativity, and lifelong learning.

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A Case Study: Measuring success or failure of using virtual communication in a college class

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Abstract

This study analyzes college courses from 2019 to 2023 and whether their use of virtual communication positively or negatively impacts communication and thus learning. The objective is to analyze the success or failure of the virtual communication taking place, in a traditional in-person class versus a synchronous class versus a hybrid class using a specially designed Virtual Communication Evaluation device. The results show virtual communication can enhance any learning environment including the three modalities studied.

Keywords: face-to-face vs hybrid in higher education, virtual communication in college classrooms

Introduction

The debate continues about which is better face-to-face or hybrid classes? Even with the major increase of hybrid/synchronous classes in education during the pandemic and the transfer of millions of classes and students to remote, researchers can't put this argument to rest. Many studies in this area of research were and are being conducted that display a variety of findings from multiple perspectives. For example, Almuarik and Alangari, (2024) study found students' viewed hybrid positively, but still believed face-to-face education as higher quality; while (2023) studies by Baxter and Hainey as well as Belt and Lowenthal found learning remotely online was beneficial for instant feedback, supported motivation and fostered communities of practice. A (2022) study by Besalti and Satici found, "online learning students experienced excessive internet use due to the closure of schools, which resulted in lower learning satisfaction during the outbreak" (p. 880). While Chandler, et al., (2020) study showed, "multiple communication channels appear to relate to higher engagement" (p. 11). In addition, a Curry et al. (2022) study found that designing a new model for technology integration into the learning process was the key. While a Flynn-Wilson and Reynolds (2021) study showed, "satisfaction with delivery of course content and interaction among students and faculty was significantly more positive with the synchronous platform" (55).

Further, a Mentzer et al. (2024) study found a HyFlex (synchronous and flexible schedule) environment compared to a face-to-face only environment does not have a dramatic impact on student academic performance one way or the other. The research appears to support multiple sides of the issue and confirms that a learning gap is growing for students both in the U.S. and globally when technology is not utilized properly in the learning process. In the U.S., students in the K-12 system, moved to all online classes during pandemic and this change has given researchers a unique opportunity to study modality and how it impacts learning. Although, some researchers continue to blame the modality, multiple studies (Edouard, 2023; Ibrahim et al., 2020; Reigeluth et al., 2017; Lowell & Yang, 2023) have shown a lack of teachers and students trained in the use of this technology (Vogels, 2021) coupled with lack of access to WIFI may be the main reason this education gap occurred especially among the most marginalized communities (Carstens et al., 2021; Golden et al., 2023; Haleem et al, 2023). In fact, hybrid modality may be the answer to bringing higher quality education to marginalized communities by bridging the digital divide with mobile technology and bringing synchronous college classes to populations that have not had access to this level of education. Thus, the debate must continue with studies (Ha & Yoo, 2024; Jarrah et al., 2025; Ye, 2022) that measure the success or failure of synchronous/virtual classes as well as in-person classes because it is through this research that we may finally conquer the digital divide.

In a review of the current research in this area, it is evident that the instructor is key to the success of learning in any setting especially when the learning relies more and more on technology As Ye discovered in a (2022) study on instructor's impact on success in the learning process, "the development of technology-based learning shows a trend of shifting from relying on the intelligence of the system alone to a combination of intelligence of the system and the instructional expert" (p. 613). Shemshack's study concurred and also stated, "it is essential that teachers feel supported, so they are motivated to integrate instructional technology effectively", (2021, 24). In a majority of the studies (Almuarik & Alangari, 2024; Baxter & Hainey, 2023; Beatty, 2019; Belt et al., 2023; Chandler et al., 2020; Curry et al., 2022; Flynn-Wilson & Reynolds, 2021; Mentzer et al., 2024), the instructor played a vital role in the improvement of academic performance and that success appears to be grounded in their use of communication technology in the learning environment.

Relevant Literature Review on Virtual Communication in Higher Education

The field of communication technology research continues to expand with the increased use of virtual communication in education including the use of Zoom, MS Teams, and Blackboard, especially since the pandemic in 2020. Several studies (Almuarik & Alangari, 2024; Baxter & Hainey, 2023; Beatty, 2019; Belt & Lowenthal, 2023; Chandler et al., 2020; Curry et al., 2022; Goodridge et al., 2017; Flynn-Wilson & Reynolds, 2021; Mentzer et al., 2024; Ng, 2007; Peterson et al., 2018; Yamagata-Lynch, 2014) have analyzed the use of synchronous/virtual communication in college classrooms and have found this modality beneficial or improved learning in college classrooms. However, other studies (Besalti & Satici, 2022; Bond et al., 2020; Layng, 2008) have found this modality can hinder or reduce learning in college classrooms as well as studies (Bower et al., 2014; Ha & Yoo, 2024; Szeto, 2014) which have found no difference in the academic performance of the two modalities. In addition, several other studies (Chen et al., 2015; Detyna et al., 2023; Meade & Parthasarathy, 2024) have had mixed results in academic performance when using in-person or synchronous/virtual communication in college classrooms. What is becoming evident in this area of research is that more study is needed that focuses on the use of communication - in particular the use of virtual communication in college classrooms and its impact on learning.

Multiple studies have found a key component of improved academic performance in the use of synchronous or virtual classes was successful communication. Study after study (Baxter & Hainey, 2023; Bower et al., 2014; Belt & Lowenthal, 2023; Curry et al., 2022; Flynn-Wilson & Reynolds, 2021) discussed how major elements of communication played a role in students' ability to learn the material such as instant feedback, access and more interaction with the instructor, fostering communities of learning and a collaborative environment. Chandler et al. study stated, "multiple communication channels appear to relate to higher engagement" (2020, 10). Six years earlier a Yamagata-Lynch study stated, "synchronous online whole class meetings and well-structured small group meetings can help students feel a stronger sense of connection to their peers and instructor and stay engaged with course activities" (2014, 191). And yet, it is still believed that synchronous/virtual classes are not as successful as in-person classes. The two modalities are not the same experience but that does not mean that synchronous/virtual classes cannot be as successful or even more successful than in-person learning.

Look at the study of Guevara-Otero et al., (2024) that used flipped learning to compare in-person, online and synchronous classes and found that regardless of the modality students' performance and satisfaction was the same. According to this analysis the instructional design was key, not the modality. Flipped learning relies heavily on the successful use of communication between the student and the instructor. A Jia et al., (2023) study found no difference in student learning and engagement in synchronous classes but flipped learning was more effective in supporting students' behavioral engagement in synchronous college classes. This research shows when proper instructional design of course material is coupled with proper integration of synchronous technology, learning outcomes and/or academic performance can be the same or better than in-person college classes (Mentzer et al., 2024; Ragni et al., 2024). One could argue that the same can be said of face-to-face college classrooms with the proper instructional design and use of technology, learning will improve in that setting as well. Then, it is not a case of one modality being better than the other, it is a case of instructional design and technology integration. For the purpose of this study, the researcher focused on the use of virtual communication in the design and integration of synchronous/virtual technology in college classrooms. Of course, other factors that can impact academic performance including proper instructor/student technology training, the technology support for these classes, and access to updated functioning technology. Those areas will also be reviewed for this case study, but the focus will be on the success or failure of using virtual communication in a college classroom.

Most of the studies (Almuarik & Alangari, 2024; Baxter & Hainey, 2023; Beatty, 2019; Belt & Lowenthal, 2023; Chandler et al., 2020; Curry et al., 2022; Goodridge et al., 2017; Flynn-Wilson & Reynolds, 2021; Mentzer et al., 2024; Ng, 2007; Peterson et al., 2018; Yamagata-Lynch, 2014) reviewed stated more research is needed in this area and additional models and decoding devices should be developed. Researchers also need to conduct more studies on if a measurement device could aid in identifying which media rich technology is successfully impacting learning in college classrooms and if a decoding device could be of use to current educators. In addition, analysis should be conducted at a microlevel of the educational process to ensure more accurate findings and thus improve communication technology practices and the learning process. The pandemic has given this researcher a unique opportunity to apply the Virtual Communication Evaluation device or (VCE) in a case study on the use of virtual communication in college courses. Originally, the VCE was developed in a 2016 study to analyze virtual communication in the workplace but this could also be vital tool in education. After all what are college classes but a series of meetings and what is synchronous college classes but a series of virtual meetings, in both settings people are learning and exchanging information to meet certain outcomes. The (2016) study found, "that a definite pattern of criteria was being used when successful virtual communication is utilized in the workplace", (Layng, 173). Thus, if communication is key to the success of learning in synchronous/virtual college classrooms and this device measures the success of virtual communication in the workplace then it can also be utilized to measure the success or failure of virtual communication in the virtual college classroom as well.

In reflecting on today's global environment, trying to turn back education to the way it was five years ago before the pandemic seems outdated and a waste of valuable skills and knowledge gained on the use of technology to the learning process during that time period. No matter how hard administrations and higher educational institutions try, college courses are no longer limited by physical boundaries, nor should they be after the lessons learned from thousands of colleges going totally online and taking over 14 million college students along for the ride (Hess, 2020). Instead, universities increasingly are requiring instructors and students to conduct classes, pursue projects, and hold meetings without ever being in the same room or the same country. However, using this communication technology is not the same as using technology effectively (Layng, 2016). To be adequately prepared to participate effectively in this virtual arena, it is imperative that researchers analyze and discover how organizations and educators effectively function in this setting. Today students may be sitting alone at home attending a virtual class with other students they have never met, each of them in separate places at different geographic locations and time zones.

Research has given us many strategies to improve virtual learning over the last decade from Yamagata-Lynch, (2014) study that found more synchronous delivery brought more learner engagement and the instructor impacts academic performance, which Ibrahim et al. (2020) study also confirmed. To Peterson, et al., (2018) study which found, “asynchronous cooperative learning may not work as designed due to students’ lack of perceptions of interdependence” (p. 7). However, Dinh’s (2023) study found a direct link between improved cognitive engagement and improved academic performance and that synchronous online teaching activities in relation to student learning engagement needed further study. There are also extensive literature reviews of successful virtual teams where researchers found trust-building was the key factor in that success and consistent virtual communication was the factor that builds that trust (Garro-Abarca et al., 2021; Layng, 2016). A study by Elsayary et al., (2024) discovered effective virtual communication can improve teachers’ learning outcomes and attitudes. This study’s researcher asks, “if teachers’ learning outcomes can be improved by the successful use of virtual communication in the classroom then why not student’s learning outcomes as well”. The majority of these studies develop models and strategies but very little research has used any measurement instrument in analyzing the virtual communication taking place that identifies the “successful” techniques that aid in the learning process. The regular use of a decoding device could be utilized to measure if “successful” criteria are being used to manage virtual communication in the college classroom and thus may transform the learning process and help instructors improve learning in their courses.

The courses selected for study are offered at a mid-sized midwestern university and were always taught face-to-face because it is a performance-oriented course. This college course was traditionally taught in person in 2019 and then the modality was moved to totally online synchronous/virtual in 2020 and 2021 because of the pandemic. Finally, the course was then offered as a hybrid class that is both in person and synchronously/virtual in 2022 and 2023. The VCE helped analyze if a synchronous/virtual course was successfully using virtual communication or not. In other words, are consistent successful practices in the utilization of virtual communication taking place in college classrooms and can the VCE help to identify these practices.

Methodology

This study’s research questions include: Are successful virtual communication strategies or criteria being used in this case study’s synchronous/hybrid college classrooms and if so, what are they? And how does the case study’s synchronous/hybrid students’ academic performance compare with the in-person students’ academic performance on the same assignments and the overall course? This study used triangulation mixed methodology to improve the validity and reliability of the results. Researchers (Creswell et al., 2003; Creswell, 2006; Flick, 2018; Jarrah et al., 2025) have used this analysis to produce robust findings in various fields of study from education to the sciences. As Creswell stated, “This design is used when a researcher wants to directly compare and contrast quantitative statistical results with qualitative findings or to validate or expand quantitative results with qualitative data” (2006, 62). This study uses both qualitative and quantitative data by comparing and contrasting the VCE device findings with academic performance (grades) and student surveys. As Elsayary et al., found this type of methodology can extend the breadth and depth of the data collected “to seek clarification of the results from one method with the results of another” (2024, 82). This analysis allowed the researcher to collect data using the VCE device, which measured the use of virtual communication and compared it to the academic performances of individual assignments and the overall course scores to quantitative/qualitative student surveys of the courses studied. Thus, “Qualitative research and quantitative research can mutually support each other and provide a fuller picture of the issue under study” (Flick, 2018, 21). This analysis is based on similar mixed methods inquiry used in Goodridge et al., (2017) as well as Baxter and Hainey’s, (2023) study.

Procedure

The study involved a post analysis of students across six distinct classes at a mid-sized midwestern university in the United States spanning five academic years from 2019 to 2023. These six cohorts were students enrolled in the same subject in a performance-oriented course. Different modalities were implemented within each class. The initial two 2019 classes, known as the pre-pandemic group, used the traditional in-person approach and used Blackboard for instructional support. The next two classes offered in the fall of 2020 and 2021, referred to as the pandemic group, adopted a synchronous modality and used Zoom to conduct virtual classes and Blackboard for instructional support. Finally, the fifth and six (fall 2022 and fall 2023) classes, were designated the post-pandemic group, and used the hybrid modality where students attended both in person and synchronously using Zoom and Blackboard for instruction.

The same assessment and curriculum including five assignments and learning objectives were used throughout the six assessed periods. Except for the final assignments, which were different in the 2019 and 2020 courses because the mini-newscast assignment required the students to perform the assignment in the lab. This could not occur during the pandemic, so the final assignment was changed from the in-studio newscast to the online cover letter, resume and virtual interview assignment for the 2021, 2022, and 2023 courses. The same learning objectives were assigned with both versions of the final assignment in all six courses and still provided enough data to properly analyze the academic performance. To gather the students’ perceptions of their experience with these courses, the university’s standard student evaluations were reviewed (Price & Kirkwood, 2014). These were voluntary questionnaires that are administered by the university through Blackboard. The students’ overall academic performances were also analyzed and the VCE device was applied to measure the success or failure of the virtual communication taking place in these college courses. A total of 104 students were enrolled in the six courses with 45 females and 58 males. In the pre-pandemic groups, 36 students participated, comprised of 50% male ad 50% female students with ages ranging from 17 to 22 years old. The pandemic groups had 34 students with 64% male and 36% female with ages spanning 17 to 22 years old. The post-pandemic group included 33 students with 60% male and 40% female with ages between 17 to 31 years old.

These courses were analyzed in the summer of 2024 beginning with the assignment and academic performance data, which was collected, sorted and analyzed. Next, the VCE device was applied measuring all communication taking place including verbal (face-to-face), text-based (email and discussion posts), video/audio (Zoom meetings and phone calls), and social media (Using group chats on Backboard/Zoom). The quantity of communication taking place as well as the accountability of the students were also measured using the VCE device. Finally, the student evaluation survey's data was collected, sorted and analyzed. Once all the data was collected and analyzed from the three procedures, the results of the academic performance, VCE and student surveys were compared and contrasted utilizing triangulation mixed methodology. The data was gathered and analyzed in the summer of 2024 after all the courses had been completed and IRB approval was sought and approved before the data was collected.

The six courses selected to be studied took place during the fall semester under the guidance of the same instructor over a five-year period from 2019 to 2023. The subject was delivered over four months for each course, that spanned 15 weeks for a total of 30 sessions, each lasting one hour and twenty minutes. In the pre-pandemic groups, traditional learning modality was employed, students met in-person in a lab. The instructional approach included instructor-developed materials, complemented by videos and supplementary reference materials within the classroom setting (Guevara-Otero, et al., 2024). Twenty sessions consisted of instructor lectures, activities, Q & A, as well as lab work contextually linked to real-world applications. Interactive classroom assignments were conducted over ten sessions, throughout the semester and each assignment was used to create a foundation of learning for the next assignment. The assignments included performing a 30-second radio commercial, a 60-second VO-SOT news story, and a 2-minute sports play-by-play in the studio and the scripts and content were provided by the instructor. In the second half of the semester, the assignments consisted of the students producing and performing a live shot in the studio as well as producing and performing a mini-newscast in the studio and handing in a script to the instructor in-person.

In the pandemic group, synchronous/virtual modality was employed, students met completely online using Zoom. The instructional approach included instructor-developed materials, complemented by videos and supplementary reference materials provided using Blackboard. Twenty sessions consisted of instructor lectures, activities, Q & A, as well as Zoom lab work contextually linked to real-world applications. Interactive classroom assignments were conducted over ten sessions, throughout the semester and each assignment was used to create a foundation of learning for the next assignment. Pre-class activities facilitated the grasp of basic theory and practice, facilitated by video and interactive resources. Subject materials underwent a transformation into interactive virtual content. Online in-class activities were focused on supporting comprehension through both individual and collaborative efforts (Guevara-Otero et al., 2024; Baxter & Hainey, 2023). The assignments included a 30-second radio commercial, a 60-second VO-SOT news story, and a 2-minute sports play-by-play, all performed virtually using Zoom with online teleprompter software for the scripts and content was provided by the instructor. In the second half of the 2020 semester, the assignments consisted of the students producing and performing a live shot remotely in the field using their smart phones and uploading their videos to Blackboard discussion boards and as well as writing a mini-newscast and emailing the script to the instructor. In the second half of the 2021 semester, the assignments consisted of the students producing and performing a live shot remotely in the field using their smart phones and uploading their videos to Blackboard discussion boards and writing a cover letter and resume that is emailed to the instructor as well as taking part in a virtual interview for a media job.

In the post-pandemic group, both in-person and synchronous/virtual modality was employed, students met both face-to-face and virtually using Zoom. The instructional approach included instructor-developed materials, complemented by videos and supplementary reference materials provided using Blackboard. Twenty sessions consisted of instructor lectures, activities, Q & A, as well as in-person and Zoom lab work contextually linked to real-world applications. Interactive classroom assignments were conducted over ten sessions, throughout the semester and each assignment was used to create a foundation of learning for the next assignment. Pre-class activities facilitated the grasp of basic theory and practice, facilitated by video and interactive resources. Subject materials underwent another transformation into interactive audiovisual content that could be used in the hybrid setting. Both online and in-person activities focused on supporting comprehension through both individual and collaborative efforts (Guevara-Otero et al., 2024; Baxter & Hainey, 2023). The assignments included a 30-second radio commercial, a 60-second VO-SOT news story, and a 2-minute sports play-by-play, all performed either in the studio or virtually using Zoom with online teleprompter software for the scripts and content was provided by the instructor. In the second half of the semester, the assignments consisted of the students producing and performing a live shot remotely in the field using their smart phones and uploading their videos to Blackboard discussion boards and writing a cover letter and resume that is emailed to the instructor as well as taking part in a virtual interview for a media job. The post-pandemic group's class was designed to give the students versatility of being in-person and/or virtual allowing the student to choose the modality and how they engaged in the learning process.

For the three groups (in-person, synchronous/virtual, hybrid), the measured variables included the average scores of assignments and overall course academic performances, VCE scores for the course, and students' perceptions from the standard university's student evaluations. This triangulation collection of data should ensure the validity of the findings via various data collection sources on the same topic. It allows the researcher to capture different dimensions of the same issue to provide a more complete picture of the phenomenon of interest (Baxter & Hainey's, 2023;

Goodridge et al., 2017; Guion et al., 2011). The methodology involved in this case study consists of applying a decoding device that measures defined “success criteria”. Success can be defined in many ways depending on the situation but for the purposes of this study the term success or successful will be defined as completing or accomplishing a goal (Layng, 2016, 177).

A case study analysis was conducted, and the virtual communication content (email, discussion posts, chat rooms, Zoom meetings and phone calls) and technology was decoded utilizing the measurement device called the Virtual Communication Evaluation or VCE (Layng, 2016) for this study based on virtual communication research. Case study analysis is a method of studying and analyzing communication in a systematic, objective, and qualitative manner for the purpose of measuring variables, and thus the best choice for discovering the application of “success criteria” from the VCE. The researcher used the VCE to decode each individual course use of virtual communication and the decoding tool divides the “success” criteria into categories such as trust-building (TB), routine communication (RC), media richness (MR) and accountability (A) (Layng, 2016, 200).

Course demographics, technology literacy, and efficiency of technology channels were also evaluated. The subsequent analysis identified which of the decoding devices variables contributed to success in virtual communication and learning. The VCE was applied to each course content and all six courses student academic performance were compared to see if there is any significant difference of the averages and VCE scores. Finally, the university’s student evaluations were reviewed to observe the students’ perceptions of the learning taking place in these six courses. As stated earlier, the data was gathered and analyzed in the summer of 2024 after all the courses had been completed and IRB approval was sought and approved before the data was collected.

Results

Course and Assignment Averages

The assessment for all assignments and course academic performances were based on a 4.0 scale. The traditional in-person pre-pandemic group 1 assignment averages and overall academic performances were: radio assignment was a 3.5, VOSOT (voice-over & sound on tape) assignment was 3.16, play-by-play assignment was 2.7, live shot assignment was 3.27, with a total assignment average of 3.15 and the overall course average at 3.33. The traditional in-person pre-pandemic group 2 assignment averages and overall academic performances were: radio assignment was a 3.5, VOSOT assignment was 3.56, play-by-play assignment was 3.81, live shot assignment was 3.51, with a total assignment average of 3.51 and the overall course average was 3.33. The synchronous/virtual pandemic group 1 assignment averages and overall academic performances were: radio assignment was a 3.8, VOSOT assignment was 3.81, play-by-play assignment was 3.75, live shot assignment was 3.62, with a total assignment average of 3.74 and the overall course average was 3.01. The synchronous/virtual pandemic group 2 assignment averages and overall academic performances were: radio assignment was a 3.58, VOSOT assignment was 3.7, play-by-play assignment was 3.47, live shot assignment was 3.05, , with a total assignment average of 3.45 and the overall course average was 3.63. The hybrid post-pandemic group 1 assignment averages and overall academic performances were: radio assignment was a 3.37, VOSOT assignment was 3.56, play-by-play assignment was 3.56, live shot assignment was 3.87, with a total assignment average of 3.59 and the overall course average was 3.35. The hybrid post-pandemic group 2 assignment averages and overall academic performances were: radio assignment was a 3.5, VOSOT assignment was 3.55, play-by-play assignment was 3.5, live shot assignment was 3.05, with a total assignment average of 3.4 and the overall course average was 3.43.

The overall averages show that except for a slight dip from the 2019 in-person pre-pandemic group to the synchronous/virtual pandemic in 2020, the course averages were same or higher in the synchronous/virtual and hybrid courses. The slight dip in the overall course academic performances from the 2019 to 2020 courses could be an effect from the pandemic shift from in-person to all classes online and students were still making the adjustment to the modality change as well as major life changes at that time. The assignment averages show a similar pattern with the radio assignment average the same or higher in both synchronous/virtual only courses and in one hybrid course than in the in-person class. In addition, the 2022 hybrid course radio assignment average was not significantly different and was only slightly under the in-person course radio average. The VOSOT assignment averages display that both synchronous/virtual and hybrid courses averages were the same or significantly higher. The play-by-play assignment averages in five of the six courses show that both synchronous/virtual and hybrid courses averages were same or significantly higher. Only the 2019 in person group 2 scored higher than the synchronous/virtual and hybrid courses. This score was also much higher than the other 2019 in person group 2 class, which could be another anomaly. The live shot average is similar in both synchronous/virtual courses and in the in-person class, however, the 2021 synchronous/virtual course and the 2023 hybrid course was significantly different but was less than .22% under the 2019 in-person courses' live shot average. However, the 2020 synchronous/virtual course and the 2022 hybrid course live shot averages were significantly higher than the 2019 in-person courses.

When analyzing the three groups (pre-pandemic, pandemic, post-pandemic) overall assignments and course academic performances there appears to be no significant difference between the three modalities or learning impact from the pandemic on these courses, according to the results of this case study. Table one shows the scores (based on a 4.0 scale) of the assignments and overall course averages, and it is evident from the data that the pandemic synchronous/virtual only classes and the post-pandemic hybrid classes' academic performances were the same or higher than the pre-pandemic in-person classes in a majority of the assignments. Only two assignments appeared to show the 2019 pre-pandemic in-person classes doing better than the other modalities and that was in the 2021 synchronous/virtual course and 2023 hybrid course live shot and Play by Play assignments. This appeared to be an anomaly and is only slightly lower than the pre-pandemic in-person courses for the live shot. And only one pre-pandemic course assignment, the play by play scored higher than the 2021 synchronous/virtual course and 2023 hybrid courses. The VCE decoding device and the university's student evaluation surveys may help to explain these exceptions to the academic performance data, which answered one of the research questions of this case study, how does the case study's synchronous/hybrid students' academic performance compare with the in-person students' academic performance on the same assignments and the overall course? The case study data displays synchronous/hybrid college classes appeared to help students achieve the same or better academic performance than the traditional in-person setting. The overall course score averages include the assignment scores plus participation points. To demonstrate these findings more clearly, Table 1 displays the averages based on a 4.0 scale.

Table 1: Course and Assignment Averages

Assignment Averages	2019/In person Group 1	2019/In person Group 2	2020/Virtual only	2021/Virtual only	2022/Hybrid	2023/Hybrid
Radio	3.50	3.50	3.80	3.58	3.37	3.50
VOSOT	3.16	3.56	3.81	3.7	3.56	3.55
Play-by-Play	2.70	3.81	3.75	3.47	3.56	3.50
Live Shot	3.27	3.18	3.62	3.05	3.87	3.05
Total Assignment average	3.15	3.51	3.74	3.45	3.59	3.40
Course score average	3.33	3.33	3.01	3.63	3.35	3.43

Virtual Communication Evaluation (VCE) Decoding Device

The VCE was used to measure if successful virtual communication was taking place in these six courses and the researcher applied one VCE decoding device (Appendix A) to each course. The VCE consists of four categories: trust-building (TB), routine communication (RC), media richness (MR), and accountability (A). The categories are worth 25 points each and the total decoding device is based on a one-hundred-point scale. The first category on the VCE is trust-building, which consists of five areas: pre-work, face-to-face contact, virtual communication used, bonding of the group and if a culture or community is built with the group. The second category is RC, which is divided in to five areas: daily, weekly, bi-weekly, monthly, and time quantity spend with group members. The third category is media richness, which is divided into five areas: text-based, mobile, video/audio, social media, and technology interface. The final category is accountability, which is divided into four areas: participation of group members, communication roles of members, productivity of members, goals met for group members and feedback received from leader to group and group members to leader. For the purpose of this case study the group members are the students, and the leader is the instructor. The decoding device scores virtual communication (VC) in each category are 5 for excellence in VC, 4 for good VC, 3 for average VC, 2 for poor VC, and 1 for fail to VC.

The overall group/course score rankings are as follows:

- Extremely Successful (100-90)
    - VC was extremely successful with little or no miscommunication, goals met.
- Successful (89-80)
    - VC flowed well with some miscommunication, but goals were met.
- Moderately Successful (79-70)
    - VC had several issues with miscommunication, but goals were still met.
- Unsuccessful (69-60)
    - VC had major issues with miscommunication and goals were not met.
- Failure (59 and below)
    - VC had total communication breakdown and goals were not met.

The researcher/coder applied the VCE by reviewing the course syllabi and analyzing the Blackboard course sites of the pre-pandemic, pandemic, and post-pandemic courses. The overall instructional design of the course was also looked at as well as all the communication that took place during the courses including email, phone calls, Zoom calls and chat sessions and face-to-face meetings. The results showed the pre-pandemic in-person group 1 overall course score was 70, which means VC was moderately successful, but the group had several issues with miscommunication, still the learning outcome goals were still met. The in-person class group 1 highest score 20/25 was in RC area while the lowest score 14/25 was in MR. In other words, the RC was strong because the group met regularly but the use of technology was limited mostly emailing the instructor outside of class, which is why the MR score was so low. The results showed the pre-pandemic in-person group 2 overall course score was 70, which means VC was moderately successful, but the group had several issues with miscommunication, still the learning outcome goals were still met. The in-person group 2 class was the same as the first in-person group 1 class. The highest score 20/25 was in RC area while the lowest score 14/25 was in MR. In other words, the RC was strong because the group met regularly but the use of technology was limited mostly emailing the instructor outside of class, which is why the MR score was so low.

The results showed the pandemic 2020 synchronous/virtual overall course score was 84, which means VC was successful and the communication flowed well with some miscommunication, and the learning outcome goals were met. The synchronous/virtual fall 2020 class highest score 24/25 was in the MR area while the lowest score 18/25 was in TB. In other words, the MR area was strong because the class met regularly by using multiple technology such as email, Blackboard, Zoom calls and chat sessions, which means the students had more access to the instructor. The lowest score was in the TB area most likely due to the class never meeting in-person, which can impact a group's ability to build trust, and this is also at the height of the pandemic when all classes were meeting virtually. The results showed the pandemic 2021 synchronous/virtual overall course score was 88, which means VC was successful and the communication flowed well with some miscommunication, and the learning outcome goals were met. The synchronous/virtual fall 2021 class highest score 24/25 was in MR area while the lowest score 19/25 was in TB. In other words, the MR area was strong because the class met regularly by using multiple technology such as email, Blackboard, Zoom calls and chat sessions, which means the students had more access to the instructor. The lowest score was in the TB most likely due to the class never meeting in-person, which can impact a group's ability to build trust.

The results showed the post-pandemic 2022 hybrid overall course score was 97, which means VC was extremely successful and the communication flowed well with little, or no miscommunication and the learning outcome goals were met. The hybrid fall 2022 class highest scores were 25/25, a tie between the TB and A areas and the lowest score 23/25 was in the RC area. The scores in all four categories improved a great deal by giving students the ability to meet in-person and virtually it helped build trust with the students and thus they were more accountable for their assignments. The reason the RC slightly lower could be that the communication was not on a daily basis. The results showed the post-pandemic 2023 hybrid overall course score was 97, which means VC was extremely successful and the communication flowed well with little, or no miscommunication and the learning outcome goals were met. The hybrid fall 2023 class highest scores were 25/25, a tie between the TB and A areas and the lowest score 23/25 was in the RC area. The scores in all four categories improved a great deal by giving students the ability to meet in-person and virtually it helped build trust with the students and thus they were more accountable for their assignments. The reason the RC was slightly lower is that the communication was not on a daily basis. The VCE data displays synchronous/virtual only and hybrid college classes appeared to help students improve their communication and that the communication was significantly better than the traditional in-person setting. To demonstrate these findings more clearly, Table 2 displays the VCE categories and overall scores in points and on a 4.0 scale.

Table 2: Virtual Communication Evaluation (VCE) Device Scores

VCE Device	2019/In person Group 1	2019/In person Group 2	2020/Virtual only	2021/Virtual only	2022/Hybrid	2023/Hybrid
TB	17/25	17/25	18/25	19/25	25/25	25/25
RC	20/25	20/25	21/25	22/25	23/25	23/25
MR	14/25	14/25	24/25	24/25	24/25	24/25
A	19/25	19/25	21/25	23/25	25/25	25/25
Total score	70 or 2.8	70 or 2.8	84 or 3.36	88 or 3.52	97 or 3.88	97 or 3.88

The VCE decoding device was very helpful in measuring the success or failure of virtual communication in these six courses. It is evident by the scores that as access to the instructor grew through media richness and the virtual communication improved as did trust, routine communication and accountability of both the students and the instructor (Baxter & Hainey, 2023; Elsayary et al., 2024). Thus, positively improving meeting the learning objectives of the pandemic and post-pandemic classes. There was a dramatic increase in the scores from the upper eighties in the synchronous/virtual only courses to the upper nineties in the hybrid courses. It became obvious by looking at the VCE results that the students thrived with more use of virtual technology in class and assignments when paired with the ability to meet in-person (Guevara-Otero et al., 2024; Layng, 2008). The VC helped students who could not physically make it to class when they were sick or had personal issues to not miss course content, which improved their trust, accountability and ultimately their scores. According to the VCE results, the post-pandemic hybrid courses were the most successful at VC, followed by the pandemic synchronous/virtual courses, and the pre-pandemic in-person classes came in last. The in-person course might have placed last because not as much virtual technology was used in that class as in the pandemic and post-pandemic classes but one would still expect the in-person class to have scored much higher in the trust-building and routine communication areas of the device, but that was not the case.

The VCE decoding device results have answered the first research question, that successful virtual communication strategies or criteria were being used in this case study in the synchronous/hybrid college classrooms and help identify them. These successful criteria or strategies include using more virtual communication technology in classes and in assignments to improve trust, access to the instructor and make the students more accountable for their assignments thus increasing engagement and learning (Jarrah et al., 2025; Layng, 2016). The VCE and academic performance data results appear to support that the case study synchronous/hybrid students' academic performance and communication is the same or better when compared with in-person students' academic performance and communication on the same assignments and the overall course. The next step in the gathering of data is to observe if the students' perceptions agree or disagree with the results of the students' academic performances and the application of the VCE device.

Student Surveys

Every semester at this mid-sized midwestern university, voluntary student surveys are conducted in the last three weeks of a semester. Students are sent an email and can access the standard survey through the Blackboard system and their feedback is kept completely anonymous. The instructor is sent a summary of the results with students' comments and there are no identifying elements except for the course number, section, and semester date. Four of the student survey sets from 2020 to 2023 used the exact same questions, and used the Likert system with strongly agree, agree, disagree, strongly disagree or N/A. The score was based on a Likert scale where 4.0 is the highest-ranking score and the questions on survey included:

1. I put forth my best effort in this course.
2. Expectations for performance were clearly communicated throughout the semester.
3. The teaching strategies used motivated me to do my best work.
4. The teaching approaches used supported my learning needs.
5. The course provided a comfortable environment for expressing views and ideas.
6. I received feedback on my work within a reasonable timeframe.
7. The quality of the feedback on my work helped my learning.
8. The grading in the course fairly reflected the quality of my work.
9. Overall, I had a good learning experience in this course.
10. The instructor worked to make the course engaging for all students.

The survey also had three open-ended questions that consisted of:

- Describe activities or assignments that were most beneficial to your learning?
- Suggest way(s) in which the course could be improved (if any)?
- Briefly describe what you thought was the most important thing you learned in the course?

The 2019 student surveys asked 14 questions ranked on a Likert scale with one being strongly agree and five being strongly disagree or N/A. This survey covered the same subject areas as the other surveys and asked the same open-ended questions. This could skew the overall results of the student surveys but when weighed with the other data from VCE and assignment/course averages it should be sufficient to draw several conclusions from the results.

The response rate from the 2019 pre-pandemic in-person group 1 student surveys was only 2 out of 18 students so it is not statically significant data, but it is data none the less. 82% of the responses to the 14 questions were positive, 9% were neutral and 8% were negative responses. Perhaps, the more telling information is the responses to the open-ended questions, "The instructor was so knowledgeable and so relatable and gave us real, practical and useful information regarding television production", and an answer to the how this course could be improved stated, "I don't have anything, I would change". It is confusing that if two students thought so highly of the course then why didn't more students respond to the course survey. The answer may be that response rates for this university's student evaluation surveys decreased once they moved from giving surveys during class time to having the students take them outside of the course time at their convenience. The response rate from the 2019 pre-pandemic in-person group 2 student survey was only 4 out of 18 students so the rate did improve the data collection and yielded similar results. 82% of the responses to the 14 questions were positive, 9% were neutral and 8% were negative responses. Some of the responses to the open-ended questions were, "She is really experienced and provides fun anecdotes in order to tell us what to do and what not to do. She taught us everything well and prepped us before each major assignment. I feel more confident stepping out into the world after taking her class", and an answer to the how this course could be improved stated, "Give a lesson on all the production elements before production days". It is confusing that if four students thought so highly of the course then why didn't more students respond to the course survey. The answer once again may be that response rates for this university's student evaluation surveys decreased once they moved from giving surveys during class time to having the students take them outside of the course time at their convenience.

The pandemic 2020 synchronous/virtual only response rate improved to 25% with 4 out 16 students responding and the summary of the responses to the ten questions were a 3.32/4.0, which is 83% positive responses. The open-ended questions were similar to the responses to the Pre-pandemic in-person course such as, "I enjoyed how the class was set up", and an answer to the question what was beneficial or something important you learned in class stated, "How to write news script and talk on camera". The pandemic 2021 synchronous/virtual only response rate significantly improved to 12 out 16 students and the summary of the responses to the ten questions were a 3.85/4.0, which is 96% positive responses. The open-ended questions were more descriptive and positive then the responses to the pre-pandemic in-person or pandemic synchronous/virtual only courses such as, "I can't think of anything to improve in the course", several students replied, "nothing or N/A", and an answer to the question what was beneficial or something important you learned in class stated, "The assignment in this class were performance based and we received two takes. After the first try we would get feedback immediately on what we did good on and how we can improve. This was super beneficial to my learning as I was improving on the spot and was able to immediately implement my learning”. One student did express the instructor could be a bit more lenient on grading assignments but other than that said the class was just fine.

The post-pandemic 2022 hybrid response rate improved to 14 out 17 students and the summary of the responses to the ten questions were a 3.73/4.0, which is 93% positive responses. The open-ended questions were more descriptive and positive then the responses from the three former student course surveys with statements that include, “The only thing I would suggest is switching the live-shot with the PBP, still have both just change the order”, several students replied “to change nothing or N/A”, and an answer to the question what was beneficial or something important you learned in class stated, “I can’t pick just one, I loved all the assignment we did!”. There were really no negative responses to the open-ended questions. The post-pandemic 2023 hybrid response rate improved to 16 out 16 students and the summary of the responses to the ten questions were a 3.95/4.0, which is 98% positive responses. The open-ended questions were even more descriptive and positive then the responses from the four former student course surveys with statements that include, “I don’t think the course could improve anymore. This course already teaches you all you need to know and will prepare you for other classes and in the future overall”, several students replied, “to change nothing or N/A”, and an answer to the question what was beneficial or something important you learned in class stated, “Every activity and assignments throughout this course were all equally beneficial. The VOST, play-by-play, radio assignment and virtual interview all had me become more comfortable in front of the camera and my speech has 100% improved with my articulating”. There were really no negative responses to the open-ended questions and the positive responses to these questions went on for pages and several students mentioned that the virtual communication was one of the most important skills they learned in the course. The student surveys appeared to support both the results of the student averages and the VCE decoding device that the successful use of virtual communication can improve student learning, academic performance, and student satisfaction. To demonstrate these findings more clearly, Table 3 displays the student survey results in percentages and overall course averages on a 4.0 scale.

Table 3: Student Survey Scores and Course Averages

Student Survey	2019/In person Group 1	2019/In person Group 2	2020/Virtual only	2021/Virtual only	2022/Hybrid	2023/Hybrid
Positive	82%	82%	83%	96%	93%	98%
Negative	09%	08%	00%	00%	00%	00%
Neutral	08%	09%	00%	00%	00%	00%
Survey averages based on 4.0	3.28	3.28	3.32	3.85	3.73	3.95

Discussion

All the results point to the same conclusion over and over again, using virtual communication can enhance any learning environment from an in-person course to a synchronous/virtual only course to a hybrid course. The key is in how technology is integrated into the classroom and the ability of both the instructor (Beatty, 2019; Chandler et al., 2020; Curry et al. (2022); Edouard, 2023; Ibrahim et al., 2020) and student's (Detyna et al., 2023; Flynn-Wilson et al., 2021) utilization of virtual communication. Many past studies support this finding including Baxter & Hainey (2023) study that stated, "The research identified some interesting findings, namely that certain participants considered that learning remotely online was beneficial for instant feedback, supported motivation and fostered communities," (69). Belt & Lowenthal (2023) study concurred, "…the benefits of real-time visual communication outweigh the drawback identified", (p. 4954). Challenges to overcome include getting students more comfortable appearing on camera and understand that some learning styles work better in-person while other learning styles excel in remote classes. One of the keys to getting students more comfortable on camera is having students experience more synchronous courses, which can bolster learner's classroom engagement and thus academic performance as well (Jarrah et al., 2025).

Many of the challenges can be met by, "informing students at the beginning of the semester about the advantages of each modality and how to maximize their learning abilities" (Ha & Yoo, 2024, 299). The more students use properly designed virtual communication for learning the more comfortable they will become, and the more satisfied students will be with virtual classes. This is supported by student responses in a (2021) Flynn-Wilson and Reynolds study that found student interaction with virtual classes was much more positive with synchronous platforms and they felt more competent and satisfied the more virtual courses they had taken. This case study supports that finding because as the students took more virtual classes, they became more adept at working in that educational setting. As long as the instructor is successfully using VC in the classroom and does not just mimic the traditional lecture format in the synchronous/virtual or hybrid course. "Technical knowledge goes beyond having basic technology skills. "Instead, it requires that instructors understand how and why they use technologies" (Edouard et al., 2023, 128). The students' academic performance shows that even though the majority of the assignments in the six classes were the same, the classes that utilized more virtual communication such as discussion board posts, Zoom meetings with the instructor and emailing was integrated into the instructional design, the more the scores increased. The VCE decoding device results were very similar to the averages increase. It displayed that virtual communication was used for more than just the modality of the course but as part of the assignments, which in turn showed the more students trusted the process, the more they became accountable for their work. The student surveys also support these findings by showing that student's satisfaction with the course grew as more virtual communication was integrated into the learning process (Jarrah et al., 2025; Jia et al., 2023).

Simply put, the higher course and assignment scores, the higher VCE scores as well as the higher student course evaluation scores all belong to the synchronous/hybrid courses. These are the courses that used both in-person and synchronous/virtual communication and allowed students choice and versatility. While the in-person class average scores were very similar to the synchronous/virtual only courses, the student surveys and VCE scores were significantly different. The student survey results could be due to the low response rate, but the VCE scores display that the in-person class could have improved its use of VC in the class and assignments. "Student engagement is an important contributor to learning irrespective of delivery mode", (Meade & Parthasarathy, 2024, 10). This case study found the more successfully virtual communication was integrated into the course content; the more learning improved regardless of the modality. Successful VC created more access and engagement between the students and the instructor and that built trust as well as created a community that routinely communicated with each other through multiple technology channels, thus helping the students be more accountable for their work and improving academic performance in a majority of the courses and assignments analyzed.

These results agree with similar findings by several researcher's discussed in the literature review of this article including Baxter and Hainey (2023), Belt and Lowenthal (2023), and Dinh, (2023) studies. Academic performance is not necessarily impacted by the modality of college classrooms but by how certain elements are utilized for successful academic performance to occur and virtual communication has become a key element. The case study's results display that these synchronous and hybrid college classes appeared to help students improve their communication as well as student satisfaction with the course and improve or equal the academic performance over the traditional in-person setting. To demonstrate these findings more clearly, Table 4 shows a summary of the three measurement devices' averages per course based on a 4.0 scale.

Table 4: Summary of Measurement Devices' Averages

Measurement's Summary Scores	2019/In person Group 1	2019/In person Group 2	2020/Virtual only	2021/Virtual only	2022/Hybrid	2023/Hybrid
VCE Device	2.80	2.80	3.36	3.52	3.88	3.88
Academic Average	3..33	3.33	3.01	3.63	3.35	3.43
Student Survey	3.28	3.28	3.32	3.85	3.73	3.95

Limitations

One of the limitations of this study includes all five assignments in all six courses were not the same. Two of the courses were changed due to pandemic social distancing rules and this could have slightly skewed the overall course averages. It might have helped better validate the academic performance averages to include more pre-pandemic courses in the analysis that were virtual online before the pandemic since the actual shift from in person to all synchronous courses had an impact on the learning process. In other words, the shift itself impacted scores and could explain why the 2020 virtual only course had a lower academic average than the 2019 in person courses. Another limitation is that the researcher was the coder for the VCE, which might have influenced the decoding results. It might reduce coder bias if objective coders were trained to apply the device to courses that they have not taught. Finally, the university's student surveys for all six courses were not the exactly the same and this made it more difficult for the researcher to generalize the findings. It would have been more thorough to design a specific survey for this study that could have supplied more focused results, but a general survey given to all students in all classes at this mid-western university did yield some objective results. Although this case study does have some limitation the triangulation mixed methodology collection of the data aided in validating the findings.

Suggestion for Future Studies

Future researchers should focus on doing more experimental studies on the use of virtual communication in learning at both the college and K-12 levels. There should also be more application of decoding devices such as the VCE in different educational settings to help prove or disprove the validity of using such an instrument to measure the success of virtual communication and its impact on the learning process. Finally, there needs to be even more studies conducted on synchronous/virtual classes and hybrid classes to better inform instructors of successful practices in using this technology and to help improve the instructional design when using this technology.

Conclusion

It is evident from past research that online modality (Layng, 2008) was here to stay, and that instructional design was key to using this technology well in the college classroom. However, that study's focus was on asynchronous learning and at the time the findings showed that synchronous learning was not quite ready for "prime time" as they use to say in television. Although video conferencing was available, it was cost prohibitive and the technology at the time could not deliver video and audio content in a clean an immediate manner to the masses. Poor audio, slow or no access to WIFI and lack of non-verbal communication hindered the successful use VC in college classrooms (Bower et al., 2014; Chen et al., 2015). Today, synchronous/virtual technology is more than capable of being used to deliver live high-quality video and audio at a fraction of the cost it was just a few years ago. The pandemic proved that this technology can be successfully and unsuccessfully used in education. Multiple studies found that student engagement is key to improving academic performance (Almuarik & Alangari, 2024; Baxter & Hainey, 2023; Beatty, 2019). Virtual communication is crucial to that student engagement as a recent (2025) study by Jarrah et al. found that university students had more active engagement in synchronous online classes than in face-to-face classes. These hybrid courses force students to get more involved and not just passively sit in a classroom listening to a lecture. Belt & Lowenthal (2023) study also supports these results of increased student engagement, whereas Flynn-Wilson and Reynold's, (2021) study found that student competency and satisfaction of the synchronous course grew the more hybrid courses they completed. In addition, Goodridge et al. (2017) study showed a direct correlation that asynchronous/hybrid students received significantly higher final course grades than the face-to-face students most likely due to the hybrid course better meeting the different learning styles of the students. Thus, more student engagement through multiple channels of virtual communication can improve academic performance. At the very least as a Mentzer et al. (2024) study showed a HyFlex environment does not have a negative or positive impact on academic performance when compared to face-to-face. This study has found that education can be vastly improved when using virtual technology as long as several elements are addressed including: instructor/student technology training, proper instructional design and integration of technology into the course and assignments and access to the software and technology. The pandemic also uncovered that the digital divide still exists and that access to technology for all communities is a necessity for people to learn, work or just function in modern society (Raja & Nagasubramani, 2018).

This case study is another piece of the puzzle on how successful virtual communication in a college classroom can positively impact student academic performance and satisfaction when taking virtual or hybrid classes. As Chandler et al., stated in their (2020) study, "The technological genie has been let out of the bottle in terms or remote learning for face-to-face brick and mortar classroom constituents," (12). It is not a choice of the learning is better if students are in-person or virtual, that choice has already been made by the students. According to this case study, they want both and why not, when the world is hybrid, why should students' education be one dimensional. The debate should not be about which modality is better but should focus on the process and how virtual modality can improve the learning experience and outcomes for present and future college students.

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