Macrothink Institute™

International Journal of Learning and Development
ISSN 2164-4063
2024, Vol. 14, No. 3

Using AI-Enabled Tools to Support Minority Students' Success in HE

Janet Hanson (Corresponding author)

Dept. of Educational Leadership, University of North Texas at Dallas

7300 University Hills Blvd, Dallas, TX 75241, United States

Tel: 1- 972-338-1986 E-mail: Janet.Hanson@untdallas.edu

Chong Ho (Alex) Yu

College of Natural and Computational Sciences, Hawaii Pacific University

500 Ala Moana Blvd., WP 4-300-I, Honolulu, HI 96813, United States

Tel: 1- (808) 543-8068 E-mail: chonghoyu@gmail.com

Received: July 19, 2024 Accepted: September 2, 2024 Published: September 15, 2024

doi:10.5296/ijld.v14i3.22263 URL: https://doi.org/10.5296/ijld.v14i3.22263

Abstract

Generative AI and large language models (LLMs) are transforming workplace literacy practices in the fourth industrial revolution. This study explored how master's students in educational leadership and teacher education programs at a minority-serving university in a low SES urban metroplex in the south-central USA perceive and experience using LLMs and AI-assisted software. The focus was on how these tools support their learning and help them demonstrate knowledge. Key themes include equitable access to AI tools, diverse applications in academic and professional contexts, building student confidence through support and training, using AI to enhance academic readiness and skills, identifying individual needs, enabling higher order thinking opportunities, and promoting ethical use and academic integrity.

By addressing various issues of AI usage, institutions can better support underserved students in using disruptive technologies, contributing to their academic success and professional preparedness. Faculty must ensure students' needs are met before requiring the use of new technologies like generative AI and AI-enabled tools.

Keywords: AI enabled applications, Industry 4.0, Education 4.0, LLM, 4th IR, Higher Education, Minority serving institutions, ChatGPT

1. Introduction

The Organisation for Economic Co-operation and Development's (OECD) report (2023) indicated that AI is too important a tool to ignore (Yu, 2023, para.1). In 2017 Russia's President Vladimir Putin predicted, "Whoever becomes the leader in [AI] will become the leader of the world (Krieger et al., 2021, p. 372). Further, Goncharov (2020) believed AI to be "the main driver of the 4th Industrial Revolution" (4IR) (p. 95). According to a poll of 800 tech company leaders, AI will "become the central driver of change" in the future, with 25% expecting AI to participate on the board of directors of corporations by 2025 (p. 101). The challenges of adapting to the disruptive technologies come from "the speed, scale of changes and their effects on the whole system" (p. 96). How will this be accomplished? Through education in the use of language patterns in place of computer code, such that the average person, not knowing computer programming code, can use AI-enabled tools.

A variety of worldwide disruptions have occurred in the past several years that require transformations in our educational systems such as the COVID-19 Pandemic, massification in education, the 4th Industrial Revolution (4IR), and AI enabled applications such as LLMs. For example, the COVID-19 Pandemic was a sudden and drastic interruption in our daily way of life worldwide, resulting in a break from traditional face-to-face models of education to online models (Voyakina, 2022). Generative AI, a large language model (LLM) is a disruptive technology that will change the way our world works. In this vein, Farrell et al. (2020) aimed to gain a clearer understanding of how emerging workplace literacy practices are shaping and contributing to the development of the 4th IR. A rich thick understanding of 4.0 literacy is required to inform the necessary innovations to educational practices and curriculum that can be used to support diverse student populations, especially underserved, low SES, first generation learners. According to Goncharov (2020), "the ability … to adapt to the conditions of the fourth industrial revolution will determine [one's] survival in the new conditions…and withstand the tests of a new technological paradigm of human development" (p. 95).

1.1 Background of ChatGPT an LLM

In November 2022, ChatGPT, a conversational artificial intelligence interface utilizing natural language processing (NLP) and capable of realistic interactions, was released in beta trials for free public use, with backing from Microsoft (OpenAI, 2023, in Tlili, et al., 2023). AI researchers believed this was the best direction to advance the development of this deep learning system (Yu, 2023). Sam Altman, CEO of OpenAI, cautioned against relying on ChatGPT just yet. "ChatGPT is incredibly limited, but good enough at some things to create a misleading impression of greatness," he tweeted. "It's a mistake to be relying on it for anything important right now. It's a preview of progress; we have lots of work to do on robustness and truthfulness" (Ofgang, 2022, para. 18). Exploring the potential use of ChatGPT for educational purposes, Ofgang submitted a prompt to ChatGPT, "What are some ways educators can use ChatGPT to teach?" The LLM reply was, "ChatGPT is a chatbot developed by OpenAI, and it is not intended to be used as an educational tool" (para. 16). However, by 2024, the ChatGPT [version 4o] iteration responded to the same prompt with, *Educators can utilize ChatGPT in various ways to enhance teaching and learning experiences. Here are some practical methods*.

The LLM then proceeded to list a variety of techniques and benefits including developing higher order thinking skills. The response closed with, "By integrating ChatGPT thoughtfully and strategically, educators can enhance the learning experience, making it more engaging, personalized, and effective" (OpenAI, 2024). Popenici and Kerr (2017, in Mohamed et al., 2022) agreed, suggesting "the role of technology in higher learning is to enhance human thinking and augment the educational process" (p. 1)**.** Recently, multiple competitors have released a variety of LLMs, and AI enabled tools and applications into the marketplace offering the general population similar resources, such as Claude, Google Gemini, Meta AI, Perplexity AI, and Microsoft Copilot. When the same question is asked in the Claude platform, Claude offers a list of potential applications, including lesson planning, differentiated learning, writing prompts, conceptual explanations, test generation, feedback simulation, accessibility support, and so on.

It is important to note that the field keeps evolving and thus diverse outcomes are expected. Tlili et al. (2023) performed a social network analysis of online "tweets," to explore the public's discourse on their use of ChatGPT for educational purposes. The researchers reported that most people were undecided about the benefits or disadvantages of using ChatGPT in education (p. 5). Tack and Piech (2022) developed an AI teacher test to determine if generative AI LLMs (ChatGPT and Blender) compared favorably with human teachers. The research results revealed "both Blender and GPT-3 are well behind human performance when it comes to helping the student" (p. 6). Nevertheless, based on a systematic review of 67 studies, Labadze, Grigolia, and Machaidze (2024) found that AI-powered chatbots are transforming education by offering benefits to both students and educators. For students, these tools provide three primary advantages: instant academic support through homework help and study assistance, a personalized learning experience that adapts to individual needs and pace, and opportunities to develop critical thinking, research, and digital literacy skills. Meanwhile, educators benefit from significant time savings as AI handles routine tasks, allowing them to focus on more impactful aspects of teaching. Additionally, AI insights can enhance pedagogical approaches, informing and improving instructional strategies and curriculum design. Together, these advantages create a more efficient and effective learning environment that caters to diverse educational needs.

Matúšová and Kollár (2023) reported three new terms identified by the World Economic Forum linked to the previously discussed disruptions. The new literacies require HE educational innovations to ensure students' needs are met while preparing them to succeed in Industry 4.0 workplaces - "competencies, foundational literacies, and character qualities" (p.13). Elements of each are provided following:

Foundational Literacies include literacy 4.0, numeracy, scientific, ICT including generative AI LLMs, financial, cultural, and civic literacy

Competencies include critical thinking, problem solving, creativity, communication, and collaboration

Character qualities include curiosity, initiative, persistence, grit, adaptability, leadership, social and cultural awareness.

Therefore, HE institutions are moving to teach literacy in LLMs, and AI enabled applications, whose foundations were previously set in computer programming languages. The disruptive innovation is a result of the fact that humans can now use natural language prompts to code/train programming with little prior experience. This innovation will contribute to a transformation of the way we think, live, and act in the rapidly changing worldwide systems of the 4th and 5th IR.

1.2 Problem Statement

A rising gap exists between the ultra-fast development of AI and the meticulous technological application of education. HE institutions must build "the important bridge between technological leadership and the growth of AI in education" (Pham & Sampson, 2022, p.1408). Table 1 provides a framework for understanding the process of disruptive technologies and their effects on educational institutions requiring rapid transformations in systems, especially higher education and the use of AI enabled tools, which is the focus of this paper.

Table 1. Processes of disruption, innovation, and educational transformation related to the 4th and 5th Industrial Revolution

Key Terms	Conceptualizations	Considerations
Disruption	COVID-19 Pandemic- Sudden interruption resulting in a break from traditional models (Voyakina, 2022).	-Student issues with use of technology -Institutional and governmental financial constraints -Roles redefined for stakeholders
	Massification – "Massive access to higher education [in] both developed and underdeveloped countries" (Noui, 2020, p. 93, Tight, 2019)	-IT infrastructure and ICT skills limitations -Digital divide widens -"Maslow before Bloom – ensuring students are safe and have their basic needs met before online learning commences" (Pokhrel & Chhetri, 2021, p. 138)
	4th Industrial Revolution and Industry 4.0 (Avis, 2020) including Artificial Intelligence enabled applications such as Large Language Models released to the public	"...ongoing technological revolution fundamentally alters human life and work processes, integrating information technology into everyday life through digitization" (Ellitan, 2020 in Ibarra, 2023, p. 2).

Innovation	Replacement of traditional modes of teaching with an "unexpected" new way	Digitization to interactivity (sustainable hybrid models) (Ratten, 2024) LT administrative support to create new ways to: -fund financial investments in ICT -develop collaborative cultures -re-envision "university service model" and quality assurance -ensure equitable digital access for all -foster resilience -develop online safety protocols
Disruptive Educational Innovation	"Technological transformation of education …profound changes in teaching methodologies, essential competencies, and assessment methods" (Jensen, 2019, in Garcia-Morales et. al., 2021, p. 2)	"Driving innovation, with a focus on helping to transform educational providers, and training delivery, in parallel with industry. In particular, to promote blended and workplace learning, and a modular curriculum design" (Bonfield et al., 2020, p. 260). Incorporate : -web conferencing -generative AI -digital LMS -micro-learning -social learning embedded in IT - web as a source of curriculum knowledge Teacher's role shifts to students as authority, content producer, and sharer (Bonfield et al., 2019, p. 242)
Outcomes	Re-envisioned teaching methods, learning spaces/materials, and participant roles. Transformations in infrastructure	Various based upon context, most countries improve outcomes with BL model, US and China do not (Cao, 2023, p. 1)

Note: Framework for understanding the process of disruptive technologies and their effects on educational institutions

1.3 Definition of Terms

This section provides further insight into the terms used in the narrative of this current discussion.

Artificial Intelligence: Artificial intelligence, which is intended to simulate human intelligence through machines, is an interdisciplinary field that necessitates the integration between computer science, engineering, mathematics, psychology, and many other domains (Yu, 2023). It "works by combining many [machine learning] ML algorithms together—each targeting a straightforward prediction task—to solve complex problems" (Agrawal et al., 2019; Taddy, 2019, p. 61).

Big data: Big Data entails high volume (a large number of observations and variables), high velocity (e.g., real-time data streaming), and high variety. In terms of high variety, Big Data is viewed as "a collection of massive amounts of data including, not only numerical data and qualitative data, but text and images. Big Data is used by machine learning (ML) algorithms for analysis, which has given rise to artificial intelligence (AI)*"* (Taddy, 2019, p. 61).

Chatbot: A chatbot is an AI-powered software application that engages in human-like dialogue, primarily through text or voice interfaces. These programs leverage natural language processing and AI/machine learning algorithms to interpret user inputs and generate contextually relevant responses (IBM, 2024). Typical examples are ChatGPT, Google Gemini, Claude, Meta AI, and Perplexity AI.

ChatGPT (Generative Pre-trained Transformer): "Initially designed to mimic human conversation, now can create new things including poems, stories, novels, or act like anything" (Taddy, 2019, p. 2).

Education 4.0 is the use of innovative technologies in the teaching and learning process, designed to prepare students for, and respond to the needs of, Industry 4.0 (Matúšová & Kollár, 2023).

Fourth Industrial Revolution (*4IR*) is "digital technological revolution building on the convergence of Robotics, the Internet of Things, and the Internet of Services...also a revolution in the social practice of work" (Farrell, et al., 2021, p. 898).

Large language model (LLM): A large language model (LLM) is an advanced artificial intelligence system that processes and generates human-like text. These models are built on deep learning algorithms trained on enormous datasets, enabling chatbots and other applications to understand context, generate coherent responses, and perform a diverse array of language-related tasks with remarkable proficiency (Almarie, Teixeira, Pacheco-Barrios, Rossetti, & Fregni, 2023).

Literacy 4.0: It "is a social perspective on literacy that encompasses the textually mediated development and maintenance of knowledge, identity and relationships, that can provide a framework for understanding the tasks ahead" (Farrell, et al., 2021, p. 910).

*Industry 4.0***:** It is "...the digitization and the application of digital technologies, associated with

new emerging jobs in the circular economy, artificial intelligence, cloud computing, development, sales of products and services and the focus on human resources" (Matúšová, & Kollár, 2023, p 1).

4IR literacy skills must be viewed differently, " …literacy is a social practice, not simply a technical and neutral skill … It is about knowledge: the ways in which people address reading and writing are themselves rooted in conceptions of knowledge, identity, being (Street, 2005, in Farrell et al., 2021, p. 417).

4IR technological convergence of relationships between technologies and people mediated by "literate practices" (Farrell, et al., 2021, p. 902).

The workplace of the Fourth Industrial Revolution is not a 'place' at all but a network of spaces, converged systems of human workers, smart devices, data collection and analysis applications [such as LLMs and AI enabled applications], cloud platform architecture, and, yes, robots" (Farrell, 2020, p. 2).

1.4 Rationale

The introduction of this current study sets the stage for a rationale supporting the inclusion of AI assisted applications in universities as tools for supporting diverse students' academic readiness for learning and to provide students with skills for success in the future workplaces of Industry 4.0. However, as highlighted by Pokhrel and Chhetri (2021), Maslow comes before Bloom, meaning the innovative redesign of our systems of HE, though required by the disruptive technologies, must also include "ensuring students are safe and have their basic needs met before …learning commences" (p. 139). Teaching Economy 4.0 literacies includes language patterns for expert prompting and use of LLMs, e.g. literacy 4.0 (Farrell, et al., 2021, p. 910). Dogan et al. (2023) identified a gap in the literature in this area, suggesting more research is needed to understand the integration of AI in both online and distance learning.

1.5 Research Purpose

The purpose of this data review is to gain rich insights and understanding of the perceptions and experiences of master's students enrolled in the educational leadership and teacher education programs in a low SES, minority serving, urban university, during the 2024 Spring and Summer semesters, using LLM and AI-enabled tools and applications to support their learning and demonstrations of learning. Key areas of interest included students' perceptions of the challenges and benefits of using AI tools.

2. Literature Review

2.1 Disruptions

A variety of worldwide disruptions have occurred over the last few years. The COVID-19 Pandemic was a sudden, global, interruption resulting in a break from traditional models of education to online tasks and virtual meetings (Voyakina, 2022). Massification of HE degree programs, in both developed and underdeveloped countries, provided wide-spread online access to individuals previously unable to attend face-to-face programs in universities and

colleges including free online courses through major universities (Noui, 2020; Tight, 2019). The move increased equitable access while increasing the pool of applicants for scarce positions. The 4th IR (and a forthcoming 5th IR), is a digital technological revolution, forcing rapid changes in society across the world (Avis, 2020). Matúšová and Kollár (2023) warned that to be equipped to participate in the coming changes, individuals must be educated and skilled in these areas.

Lens for the study. Considerations of a new style of leadership in HE may be in order, "vital leadership promoting open social networks," the development of informal and formal structures that promote students' integration and understanding of the expectations, and successful personal development to autonomous learning is critical, especially for underserved, diverse, and minority populations, who often lack academic skills to advance in the confidence and social integration to acquire competencies leading to autonomous learning and persistence to graduation (Hanson et al., 2020).

2.2 Innovation

With disruption comes the need to innovate and overcome the challenges created by the disruption. Matúšová and Kollár (2023) described innovation as "mostly synonymous with the introduction of digital solutions" (p. 5). However, innovation goes beyond "introducing digital solutions." Innovation requires a "replacement of traditional modes of teaching with an "unexpected" new way. Crawford, et al. (2020) explained "a connectivist framework, the burgeoning growth of a new way of instructing students has emerged" (p 26). While Ratten (2024) described a transition from digitization to interactivity using sustainable hybrid models.

Considerations for creating a new way of teaching and learning in HE institutions requires long term administrative support to fund additional financial investments in ICT, develop collaborative cultures that turn institutions of higher learning into leaning institutions where the knowledge in the institution is shared by its members and becomes embedded in the practices and memory (Hanson, 2017), re-envisioning of the university service model and quality assurance design, ensuring equitable digital access for all, fostering adaptability and resilience, and developing online safety protocols, among many other considerations.

2.3 Disruptive Innovation in Education

When disruptive technologies rapidly change the landscape of society, HE institutions must implement creative solutions, "technological transformation of education …profound changes in teaching methodologies, essential competencies, and assessment methods" (Jensen, 2019, in Garcia-Morales et. al., 2021, p. 2). The main factor for consideration of using AI enabled tools, like LLMS, in HE is to develop creativity and skills in innovation, which are critical for the future because, as Mohamed et al. (2022) explained, we are all "heading towards a sophisticated technological life" (p. 8). Therefore, faculty in HE will need a deep conceptual understanding of the tools of AI and students' emotional and academic needs during the transformation process. Such innovations might include digitization processes that also support interactivity, such as sustainable hybrid models/ blended learning (Ratten, 2024). Generative AI and tools are "[d]riving innovation, with a focus on helping to transform educational

providers, and training delivery, in parallel with industry. In particular, to promote blended and workplace learning, and a modular curriculum design" (Bonfield et al., 2020, p. 260).

2.4 Outcomes for Higher Education

In the era of AI and Big Data, re-envisioned teaching methods, learning spaces/materials, and participant roles are indispensable. As such, transformations in infrastructure, engaging in action research to understand the background, context, and positions of the stakeholders in a particular university are expected. The plans for implementing changes in the teaching and learning processes need to be based upon the context and participant readiness. For example, most countries were shown to improve learning outcomes using BL models, while in the context of participants of the US and China studies they did not (Cao, 2023; Sagor & Williams, 2017).

2.5 Innovations for Supporting Diverse Students

A variety of tools have been shown to support minority and underserved students in HE. For example, hybrid learning models combine online and face-to-face instruction that can be tailored to support diverse students' learning needs such as flexible learning environments, varying schedules, and individualized supports (Power et al., 2015). AI embedded tools, such as customized GPTs, can be used to create personalized learning plans and tutoring for underserved minority students, identify students' strengths and weaknesses, and develop targeted interventions and support. Universities can develop programs that focus on digital literacy, provide curriculum that supports critical thinking, problem-solving, and collaborative learning that are demands of Workplace 4.0. ICT departments are embedding LMS with interactive and engaging educational content to make learning more enjoyable and effective. Faculty and HE administration must include AI enabled data analytics tools, which can provide useful insights for decision support, enabling targeted treatments for at-risk students. Hanson (2017) recommended institutional structures that connect students with faculty, mentors, and peers to develop relationships both face-to-face and through online platforms regardless of their physical location (Power et al., 2015). Finally, creating collaborative learning communities, where students can work together on projects and assignments, fosters peer support, the development of task integration leading to increased confidence, motivation, persistence, and development of autonomous learning (Hanson et al., 2020).

2.6 Summary

The changes in HE to meet the needs of Education 4.0 will require students to develop a rather advanced heuristic of technology use. HE faculty need access to AI enabled tools to practice and learn skills to embed the tools into their courses as well as to develop advanced skills in training and supporting diverse students on the new technologies. Institutional and governmental constraints include financial, security issues, creating policies and procedures, understanding the implications for their institutional use in and outside of the systems such as LMS, grading and regulations related to students use in their coursework.

2.6.1 IT Infrastructure and ICT Skills Limitations

The roles of stakeholders are being redefined. Hegemonies have the power to influence the design of social systems (Avis, 2020), who also often own and manage the AI embedded systems, and will collect user data (work products, queries, training data etc.), potentially resulting in PII violations. There is also a potential for an increasing digital divide and time demands required to break away from current practices/ routines/ processes and to learn/ develop/ implement innovations to keep pace with the rapidly changing educational and workplace environment. These changes might shift attention away from the primary focus of ensuring that students are safe and have their basic needs met before online learning begins. (Pokhrel & Chhetri, 2021).

In sum, Industry 4.0, the "...ongoing technological revolution fundamentally alters human life and work processes, integrating information technology into everyday life through digitization" (Ellitan, 2020 in Ibarra, 2023, p. 2). Institutions of HE can consider how the new digitization of our workplaces and lives, through disruptive technologies, affects students' social and workplace literacies and their use of language. Expertise in the programming of generative AI, using language prompts for finding patterns in Big Data, constitutes one of the new "working literacies as we enter and begin to navigate Industry 4.0" (Farrell et al., 2021, p. 899). An opportunity exists to mobilize resources to support the underserved minority and diverse populations and leverage this new technology for upward socioeconomic mobility through educational innovation in HE and in the workplace.

3. Methods

3.1 Study Design

The study is a triangulated mixed-method design because both quantitative and qualitative data were collected. The purpose of the triangulation design is to bring together different, but complementary, perspectives by placing emphasis on convergence, data transformation, validation, or multilevel models (Creswell & Plano Clark, 2017; Williamson, 2005). Using AI is a fairly recent phenomenon, and many aspects of AI in education are unknown. Therefore, rather than imposing a theory on the phenomenon by using force-option items only, we utilized open-ended questions in order to let ideas emerge.

This study involved a review of student data, from five courses, for the purpose of understanding students' perceptions and experiences on their use of AI-enabled technologies to inform improvements in the design and delivery of the courses and their content. Specifically, data were collected using online Google forms for course feedback/surveys on the topic of student use of AI in the courses. The data were reviewed and analyzed using rigorous research-based methods. The instructor provided teaching demonstrations, embedded videos in asynchronous CANVAS LMS course modules, and office hours for personal support in the use of AI tools in the courses. Students worked in collaborative teams and individual investigation on assignments. The instructor routinely encouraged students during the synchronous class time to use generative AI tools and AI enabled tools for research, development, and presentation of assignments.

3.2 Course AI Use Policy

An AI Use Policy for the course was included in the syllabi of the courses where data were reviewed. These policies were reviewed and discussed during the first week of the course. Examples were provided for citing AI enabled tools throughout the semester. Refer to Appendix 1 for the course policy on the use of AI in the course.

3.3 Participants

Students participating in this study (*n*=39) were enrolled in the master's in educational leadership (EL) program (*n*=35) and master's in teacher education (TE) program (*n*=4). Data were collected from three spring 2024 semester and two summer 2024 semester courses. The context of the study was a Hispanic and minority serving university located in an urban, low SES area of the south-central USA. Students were engaged and successful learners as evidenced by a 95% Educational Leadership cohort (*n*=30) pass rate on their first sitting for the state Performance Assessment for School Leaders exam, during the Spring 2024 semester. Table 2 shows the number of students responding by survey and semester.

Table 2. *Number of students responding to surveys on use of AI in the course 2024*

Survey	Number of Students Responding
Spring Student Survey (3 classes)	25
Summer Student Survey (2 classes*)	14
Summer Advanced Survey (These participants were included in the Spring Student Survey and were separated out in Summer to avoid redundancy of responses)	6
Summer Data Analysis Survey (*2 classes, analyzed separately from above surveys based on content)	25

Tables 3 and 4 provide enrollment by number and percentages of students enrolled in the Educational Leadership Department program for Fall cohort 2022 and as percentages over a three-year period. Numbers were provided from the Educational Leadership Program Self-study dated 2023-2024.

Table 3. Representative demographics of educational leadership department student cohort by race/ethnicity and gender at the case university

Term	Total			African-American			Asian			Hispanic			White			Other		
	All	M	F	All	M	F	All	M	F	All	M	F	All	M	F	All	M	F
Fall 2022	34	11	23	17	4	13	1	0	1	10	5	5	4	1	3	2	1	1

Table 4. Average demographic of students enrolled in the educational leadership department program at the case school, by race and gender, over a three-year period Fall 2020 to Fall 2022

	African-American	Asian	Hispanic	White	Other
All Students	51.4%	2.9%	25.1%	15.4%	5.1%
Male	8.6%	0.0%	12.0%	1.7%	3.4%
Female	42.9%	2.9%	13.1%	13.7%	1.7%

Note. Numbers derived from Educational Leadership Self-study 2023/2024 school year.

3.4 Instruments

The data reviewed in this paper were collected via four voluntary, end of course, self-developed, Google Likert-style, multiple choice, and qualitative item surveys provided in online blended courses (alternating weekly Zoom meetings with asynchronous modules in a CANVAS LMS) of the Capstone Research Project (TE), Introduction to Educational Leadership (EL), Professional Development and Supervision (EL) courses, and Action Research for Educational Leaders (EL) courses. The *Student Survey on the Use of AI tools in the Course* collected first time participants' (in the instructor's courses) responses, the *Advanced Student Survey* was taken by summer semester students who had completed the Spring Student Survey on AI use in the Course. A fourth survey, *Data Analysis Survey,* was provided in the two summer courses collecting students' perceptions and responses regarding an assignment requiring the use of AI to synthesize qualitative data in a case school context and analyze for themes. The assignment required higher-order complex-thinking skills and the ability to deeply analyze the AI output for accuracy and triangulate it with human data. Items for the surveys are provided in the results

section. Refer to Appendix 2 for items on the surveys.

This study triangulated the data by including multiple data sources (five courses) that were compared with the review of relevant research on the topic (Creswell & Creswell, 2018), and ensured the conclusions drawn had validity. The review of the relevant data included document review (survey with quasi-quantitative data, and qualitative data) in which themes and percentages were compared with the literature findings. The quasi-quantitative survey and qualitative survey questions were written to align to both the purpose of the study and to collect data to support the overarching purpose of understanding students' needs and developing insights into providing support and skills in preparing them for success in the changing world.

3.5 Evaluation Methods

Evaluation of the survey data results included calculating percentages of total responding to qualitative themes using quasi-quantitative analysis. Qualitative student responses were coded to identify key words and phrases, then performing a review of the key terms to group coded responses into themes that apply to provide data to inform the next steps for supporting student use of AI in the classroom assignments and supporting students' needs for safety (Creswell & Creswell, 2018).

Software used included Claude [version 3 Opus], ChatGPT [version 4o], and Excel GPT to assist in the qualitative analysis, providing recommendations for codes and themes of the data (Anthropic, 2024; OpenAI, 2024). Charts and graphs were generated by Google forms survey tool and provided under the "Reponses" tab. MS Excel (Microsoft Corporation, 2018) spreadsheet and Excel GPT were used for data visualization.

The review of the data sought to gain a rich, thick understanding of students' perceptions and experiences related to the use of AI in their courses in HE. Additionally, a review of the data collected and analyzed sought insights to identify key areas and strategies for faculty and administration in HE to support minority and underserved students' learning and ensure their wellbeing, safety and basic needs were met before, during, and after innovations and online learning commenced such as the integration of AI-enabled tools in the education processes (Pokhrel & Chhetri, 2021).

In addition to descriptive statistics, sentiment analysis was utilized to analyze qualitative data. Sentiment analysis, also known as opinion mining, is a text mining technique that involves identifying and categorizing emotions expressed in textual data using natural language processing. To be more specific, sentiment means an attitude, or judgment, based on one's feelings (e.g. "I don't like using AI"), whereas opinion is a view or appraisal about a particular matter e.g. "I think AI results might not be accurate"). Nonetheless, they are often used interchangeably. By analyzing the polarity (positive, negative, or neutral) of sentiments in the survey responses, sentiment analysis helps researchers quickly identify conflicting or diverse opinions towards the issue under study. The process of sentiment analysis typically involves several steps: data collection, preprocessing (e.g., tokenization), feature extraction, and the application of machine learning models (e.g., Naive Bayes and support vector machines to determine sentiment (Liu, 2020). JMP Pro version 18 (SAS Institute, 2024) was utilized for

sentiment analysis in this study. In addition to classifying the types of sentiment, the algorithm also assigns a score to indicate the intensity of the emotion. Sentiment analysis is considered more useful when it is challenging for humans to read through a vast number of documents due to fatigue and boredom factors. One may argue that for a small sample of 39 a human coder might be more effective. However, even if the sample size is small, AI-based natural language processing is still valuable because unlike human coders that might project their subjective bias to the text, algorithms are impartial (Yu, 2022).

In addition, linking and brushing was used to investigate the relationships between open-ended responses and perceived usefulness of AI tools. Specifically, when an observation of a particular variable in a graph is selected by brushing, the linked data points in another graphical display are also highlighted (SAS Institute, 2024). This data visualization method is commonly employed in data science to reveal patterns and associations (Yu, 2014).

4. Results

The following section provides the results of the Student Survey on the Use of AI Tools in the Course by survey item number, including graphs of quantitative calculations mean scores, percentages of students reporting per item, and tables with themes identified from the qualitative responses provided by the students, including descriptions of the themes and supporting quotations to provide evidence of the reliability of the themes chosen.

4.1 Results of Spring and Summer Student Survey on the Use of AI in the Course

Survey Item #1 instructed students, "If you used AI tools during this course for coursework, research, idea generation, etc. please indicate the tools you used." Table 5 and Figure 1 show the AI tools students used in the course by percentage and number reporting respectively (responses to Question #1). Students reported using mostly free versions of the AI tools, with usage rates ranging from 59% to 74% depending on the tool used. More students purchased subscriptions to Gamma.app (n=14; 35.90%) and Claude.ai (n=17; 43.59%), than any other tools. AI-enhanced writing review software was reported at 2.56% use compared to the AI presentation and LLM tools, which reported near 100% usage (combining the free and subscription versions). Additionally, the AI-enhanced research tool Elicit was used by 69.23% of students (n=27%), indicating a significant interest in AI tools for research purposes.

Table 5. AI tools students reported using in their coursework by semester

AI Tool	Summer	Spring	Total	Percentage
Gamma.app (free)	8	21	29	74.36%
Gamma.app (subscription)	7	7	14	35.90%
Elicit (free)	11	16	27	69.23%
Elicit (subscription)	0	0	0	0.00%
Claude.ai (free)	4	19	23	58.97%
Claude.ai (subscription)	10	7	17	43.59%
ChatGPT (free)	8	19	27	69.23%
ChatGPT (subscription)	0	2	2	5.13%
Grammarly	0	1	1	2.56%
Otter AI	0	1	1	2.56%
EBSCO	0	1	1	2.56%

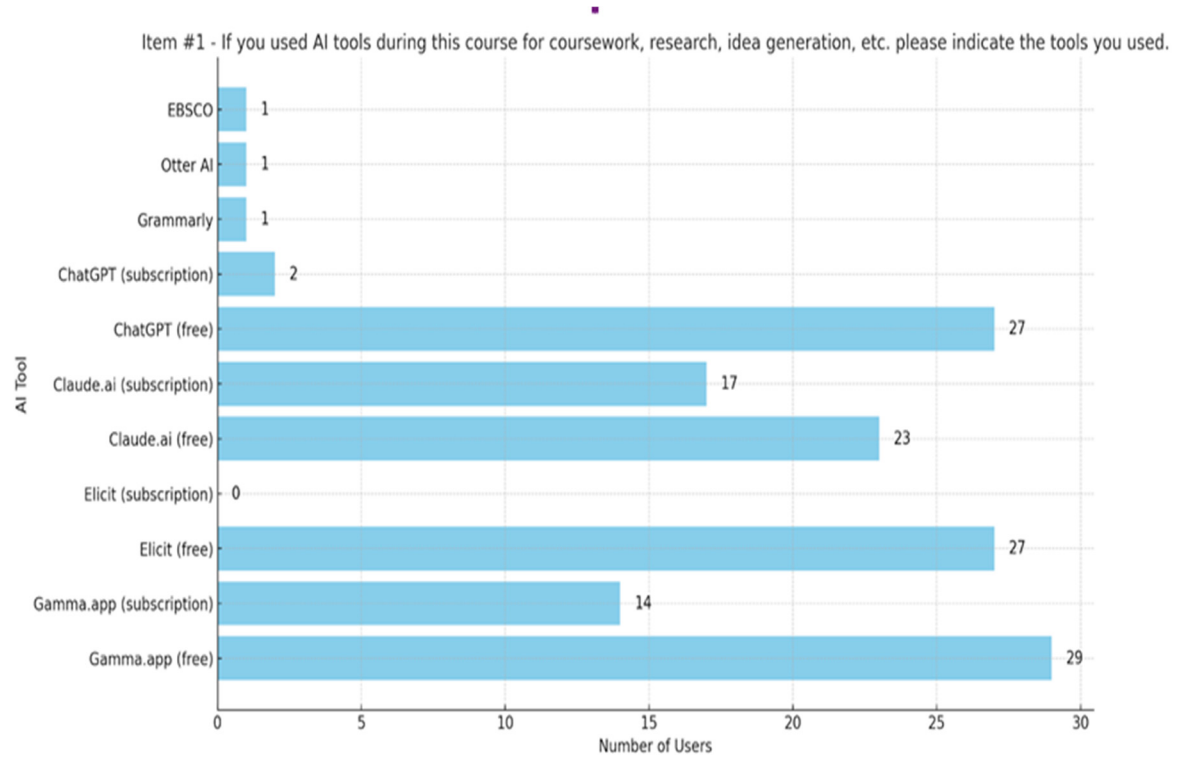

Figure 1. AI Tools Students Reported Using in their Coursework by Semester

Survey Item #2 asked students, "How often did you use an AI tool during the semester on a scale of 1 to 5, 1= never to 5=several times a week." Figure 2 shows 46.2% of students rated their use of AI tools during the week as a 5, on a scale of *1 to 5* with "1" being *Never* and "5" being used AI tools *Several times per week*. Fifty-four percent of students rated themselves as a "4 or 5", with no students reporting *Never* using AI during the week for coursework.

Table 6. Mean Scores for Quantitative Survey Items on a Likert-style scale 1-5 with 5 Being the Highest

Item Number	Question	Number of Students Responding	Mean Score
2	Frequency of AI Tool Use	39	3.85

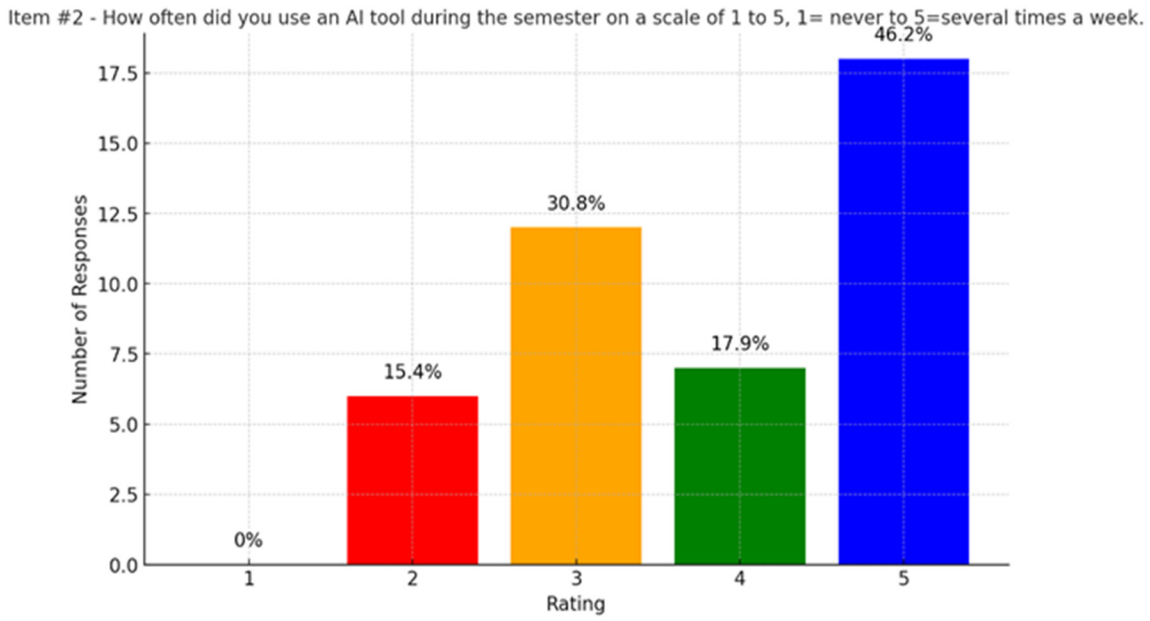

Figure 2. Graph of how often students reported using AI tools during the week

Survey Item #3 was a qualitative question that asked students to "Describe how you use AI tools? School, personal, work, etc." Several themes were identified. Table 7 provides the themes, descriptions, and quotations from participants.

Table 7. Themes and supporting quotations for survey question #3 (*n*=25)

Theme	Description	Supporting Quotations
Enhancing Academic Work (*n*=18; 72%)	Many students reported using AI tools to assist with various aspects of their academic work.	- "I used AI tools for research presentations and brainstorming."
		- "I use them to help refine my ideas and provide additional ideas when planning lessons."
		- "It helped rewrite some of my assignments."
Professional Application (*n*=14; 56%)	Students also utilized AI tools in their professional lives, particularly for tasks such as rewording emails, creating newsletters, and writing outlines for assignments.	- "I primarily use AI for work. I use it to write things that need to be done but do not need to be so refined."
		- "It helped me with my professional responses in my email."
		- "I used AI tools to help me reword some emails for work."
New Learning and Adoption of AI (*n*=9; 36%)	Several students highlighted their learning journey with AI tools, indicating that these tools were new to them and that they learned about them through the course.	- "I learned about AI this semester in this class. I did not know about all this app before this class."
		- "Just for this project. I didn't know about this before this course."
		- "Using AI is all new to me. I usually use it after my professor models it and every time I'm amazed that it works."
Multifaceted Use (*n*=12; 48%)	Students reported using AI tools across different areas of their lives, including school, personal tasks, and professional work.	- "School. personal and work"
		- "I use AI tools for personal school and work use."

Survey Item #4. Figure 3 shows results of how students responded to the question, “How did you learn to use the AI tools?” Students were instructed to select all that apply.”

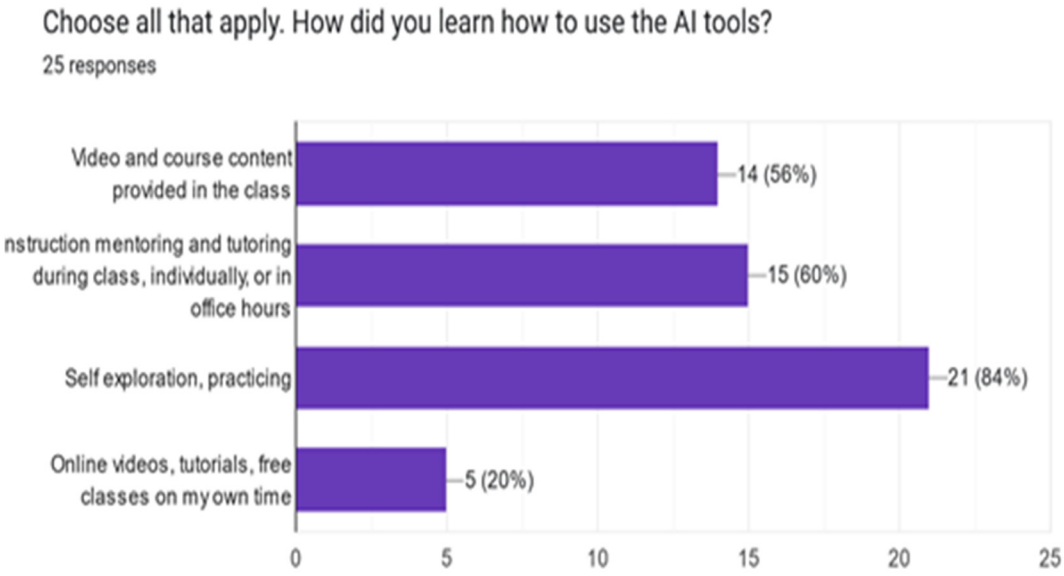

Figure 3. Graph of how students reported learning the use of AI tools

Survey Item #5. Students responded to the question, "Do you feel you properly cite the use of the AI Tools in your class submissions? There is no judgment. The teacher will add training to the courses if you feel more is needed." The proportion of responses by category is displayed in Figure 4.

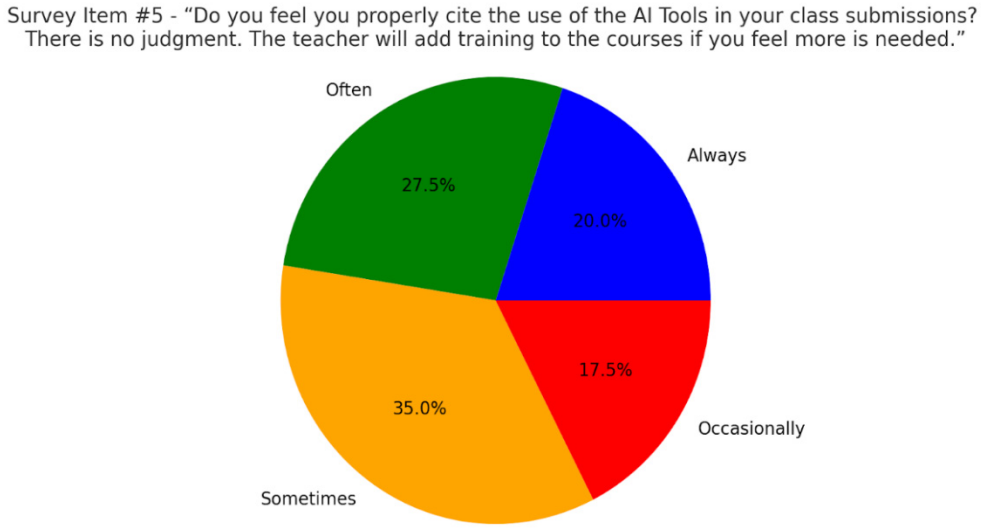

Figure 4. Student self-reports of properly citing their use of AI in their course submissions (by percentage)

Survey Item #6. Figure 5 provides the distribution of the responses to Question #6, "Rate how useful you feel AI Tools have been to you in your coursework," on a scale of *1 to 5* with being the most useful.

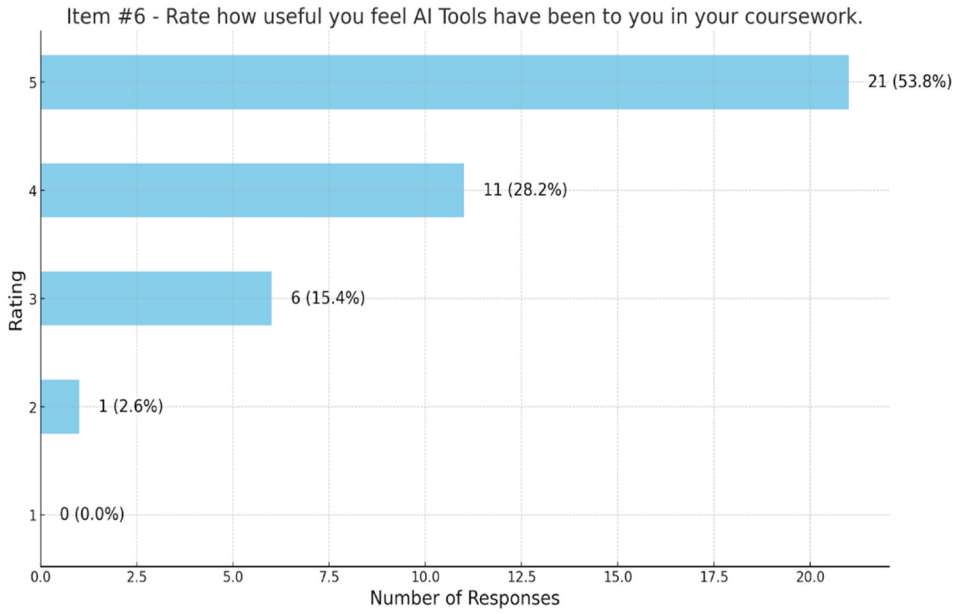

Figure 5. Students' Self-reports of the Usefulness of AI Tools in their Coursework

Survey Item #7. Table 8 provides student responses to Question #7, "Select all the ways that you used AI Tools in the course." Students self-reported high percentages for each of the categories except for *Developing details when I am stuck on a topic*.

Table 8. Ways students use AI tools in the course

Usage Method	Summer	Spring	Total	Percentage
Research articles	11	19	30	76.92%
Get ideas for an assignment	8	16	24	61.54%
Create presentations for submitting in class assignments	13	21	34	87.18%
Save time in formatting and organizing the content of an assignment	9	18	27	69.23%
Review my completed submission to check for errors and improve writing	11	13	24	61.54%
Developing details when I am stuck on a topic	0	1	1	2.56%

Survey Item #8. Table 9 provides student responses to, "Rate how completely you "trained" AI

Tools when you used them?"

Table 9. Students Self-rating of their Ability to Train AI Tools before Prompting (*n*=39)

Response	Count	Percentage
I *always* created lengthy prompts describing how I wanted the AI to act, set boundaries for the data I would allow it to use, and uploaded or pasted explicit guidance in the form of articles, assignment descriptions, document formats, etc. to train the AI	12	30.77%
I *often* trained the AI tool by providing explicit guidance on what I was expecting the response to look like	9	23.08%
I *occasionally* uploaded or pasted an assignment example or rubric to train the AI before prompting	8	20.51%
I understand the importance of training the AI so tried to include guidance, though *sometimes* was in a hurry and *did not* give boundaries or guidance before posting my prompt	6	15.38%
I never provided attachments or pasted examples into the LLM to train the tool before prompting	2	5.13%

Survey Item #9. Figure 6 provides student responses to, "How long have you been using AI?"

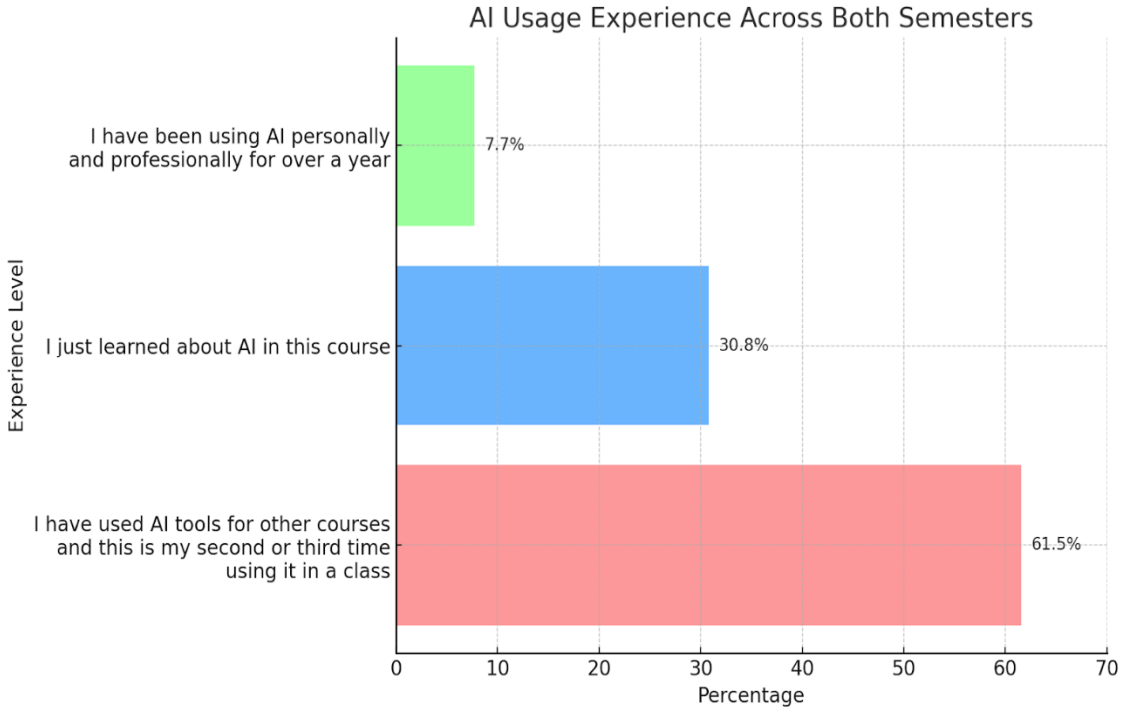

Figure 6. Students' self-report of the length of time they have used AI-enabled tools

Survey Item #10 was a qualitative question asking students to share any benefits they

experienced from using AI Tools for coursework, "Describe the benefits you feel and experience from using AI Tools for coursework. Be detailed and provide examples." Several themes were identified. Table 10 provides the percentages of themes identified from the self-reports. Note the number of reporting participants is very similar per semester suggesting the participant pool has reached saturation point for the themes. Table 11 provides the themes identified in the qualitative responses.

Table 10. Benefits of using AI: Respondent counts for spring and summer courses and the percentages of each benefit category.

Themes	Spring Count	Spring %	Summer Count	Summer %	Total Count
Timesaving	8	32.0%	5	35.7%	13
Improved writing and language skills	7	28.0%	4	28.6%	11
Organization and structure	5	20.0%	3	21.4%	8
Research assistance	3	12.0%	4	28.6%	7
Idea generation and brainstorming	5	20.0%	2	14.3%	7
Presentation creation	2	8.0%	2	14.3%	4
Enhanced learning and understanding	2	8.0%	3	21.4%	5
Feedback and error correction	2	8.0%	2	14.3%	4
Efficiency and productivity	2	8.0%	2	14.3%	4
Work-life balance	1	4.0%	0	0.0%	1
Total Responses	25	100%	14	100%	39

Note. The percentages for each theme are calculated based on the number of responses mentioning that theme divided by the total number of responses in that season (25 for Spring, 14 for Summer). Some responses mentioned multiple themes, so the sum of percentages may exceed 100%.

Table 11. Item #10 - Themes with descriptions and participant quotations describing the benefits of students' use of AI tools in the coursework

Theme	Description	Supporting Quotations
Writing Improvement (*n*=20; 22.99%)	Many students reported that AI tools help improve the clarity and quality of their writing.	- "It helps make my writing clearer." - "It helped me *get better* at writing some assignments." - "Helps *improve* my writing." -"Improved efficiency: AI tools can help students *improve the quality* of their writing." -"I enjoy how AI tools are able to *enhance my auto-corrections* and aid in writing improvement." -"It makes writing *easier* for me."
Time Saving (*n*=18; 20.69%)	Students found AI tools to be valuable for saving time in various aspects of their coursework.	- "Using AI tools for coursework is beneficial as they are *time-saving* resources." - "Saves time on *ideas and formatting*." - "It *saves time*." - "It saves a lot of time but it also helps me to *get my thoughts organized*." - "It saves time with the *formatting* of assignments."

Theme	Description	Supporting Quotations
		- "It saves time and *gives me ideas*."
		- "I love how AI can *check the little details* for me, saving time."
Organization and Structure (*n*=15; 17.24%)	AI tools assist students in organizing and structuring their work more effectively.	- "It helps *organize* my work, especially Gamma."
		- "AI tools are a time saver! They help give me an idea of what an *exemplar* might be."
		- "It is a helpful tool it helps me to organize my *presentations*."
		- "Makes *presentation organization* easier."
		- "It helps organize *my work*, especially with the *structure of essays*."
		- "I use AI for *presentations and research information* organization."
		- "Improved efficiency: AI tools can help students *structure their work*."
		- "Using AI tools for coursework offers efficiency in *organizing content.*"
Learning and Adoption (*n*=12; 13.79%)	Students described their learning process and the initial challenges they faced with AI tools.	- "At the beginning, *it was a headache* because I did not know how to use it."
		- "I learned I should use it as my 'assistant' and *I'm still learning* how to use it effectively."

Theme	Description	Supporting Quotations
		- "I *think AI is a great tool* to get quick ideas on assignments." "Improved efficiency: AI tools can help students *adopt new learning strategies*."
Professional Communication (*n*=11; 12.64%)	AI tools are used by students to draft professional emails and communicate more effectively.	- "In addition to academic work, I've utilized AI to help *draft formal emails to staff*." - "Claude assists me in s*triking the right tone ensuring clarity and professionalism* in my messages."
Work-Life Balance (*n*=9; 10.34%)	Some students mentioned that AI tools help them achieve a better work-life balance by saving time.	- "It's given me a *work-life balance* it's been beneficial for my *mental health* as well." - "AI has *given my family back my personal time."*

Survey Item #11 was a qualitative question that asked students to “Describe any challenges you feel from the use of AI Tools in your coursework. Be detailed and provide examples.” Several themes were identified. Figure 7 shows a pie chart of themes identified and grouped by percentages reporting in the qualitative answers. Table 12 provides a summary of the key themes identified from the qualitative analysis regarding the challenges of using AI tools in coursework, with descriptions and direct quotations that illustrate each theme.

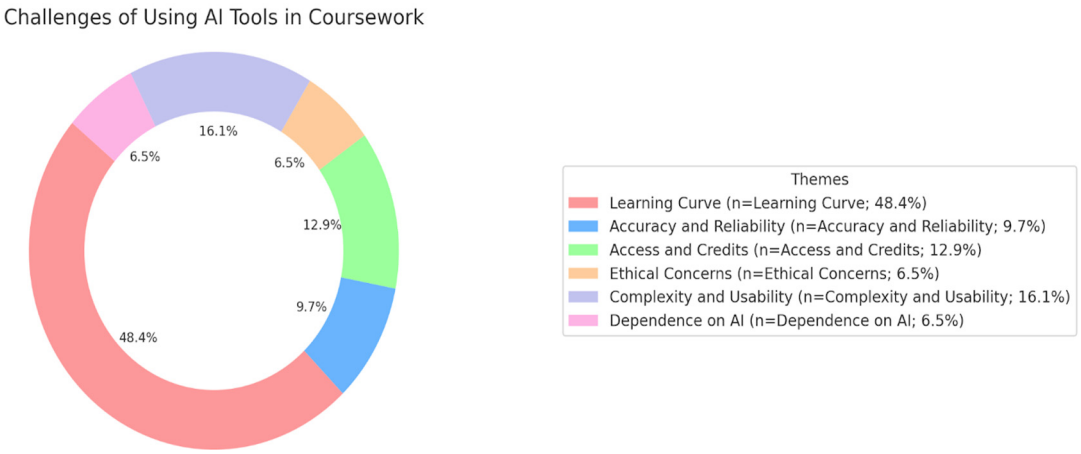

Figure 7. Challenges experienced with AI-enabled tools

Table 12. Item #11 themes, with descriptions, and participant quotations describing the challenges from using AI tools

Theme	Description	Supporting Quotations
Learning Curve (n=15; 48.39%)	Students mentioned challenges related to the initial learning process and understanding how to use AI tools effectively.	- "You have to *be very detailed and specific* as to what you want." - "Just *learning to be more detailed* in what I am asking AI tool to do." - "It was *challenging at first*, but I was able to catch on and specifically learn *how to create prompts."* "I find it *difficult to control* the register of language used by AI." - "Anytime data is required, it can be challenging to get what you want if you are not *trained properly*." - "I just have to catch up and *get used to it."*

Theme	Description	Supporting Quotations
Accuracy and Reliability (*n*=3; 9.68%)	Students expressed concerns about the accuracy and reliability of information provided by AI tools.	- "Sometimes the *information is erroneous."* - "I understand that AI is *not always factual*, it is *important to fact-check."* "It can be *difficult to trust* the accuracy of AI-generated content." - "The AI tools sometimes *provide incorrect information."*
Access and Credits (*n*=4; 12.90%)	Challenges related to accessing AI tools, including issues with credits and account management, were noted.	- "My main challenge with the AI tools was *running out of credits* from the free versions." - "I was *locked out* of my Claude account but with your help, I was able to get my account reset." "The *login process* for Claude gave me more *trouble* than I expected." "It's challenging when I r*un out of credits* for AI tools."
Ethical Concerns (*n*=2; 6.45%)	Students highlighted concerns about the ethical use of AI, including fears of academic dishonesty.	- "I am *scared to get in trouble* for using AI tools." - "We must *educate students* about the importance of *academic integrity* and the consequences of cheating and plagiarism."

Theme	Description	Supporting Quotations
		"I worry about the ethical *implications of relying too much on AI*."
		- "It's important to use AI ethically and *avoid plagiarism*."
Complexity and Usability (*n*=5; 16.13%)	Some students found AI tools complex and difficult to use, especially without proper training.	- "Its a lot that I still don't understand about it."
		- "Anytime data is required! It can be challenging to get what you want if you are not trained properly."
		-"The interface can be confusing at times."
		- "I find the tools complex and not user-friendly."
		- "The challenges I felt from the use of AI tools are *mainly about usability.*"
Dependence on AI (*n*=2; 6.45%)	There were concerns about becoming overly reliant on AI tools, potentially impacting independent thinking.	- "One challenge is the potential for *over-reliance on AI* assistance."
		- "I worry about the *atrophy of my critical thinking skill*s due to this dependence."
		- "It's easy to become *too dependen*t on AI tools."

Note. Italics are provided by the author to highlight key terms.

Survey Item #12 asked students, "What advice would you give to the teacher to assist students in the future when teaching or using AI in their courses? Be detailed and offer examples." Several themes were identified. Figure 8 provides themes identified from the responses by

percentages included in each theme. Table 13 provides a summary of the key themes identified from the qualitative analysis of student advice to the instructor and provides supporting quotations as evidence for the reliability of the themes selected.

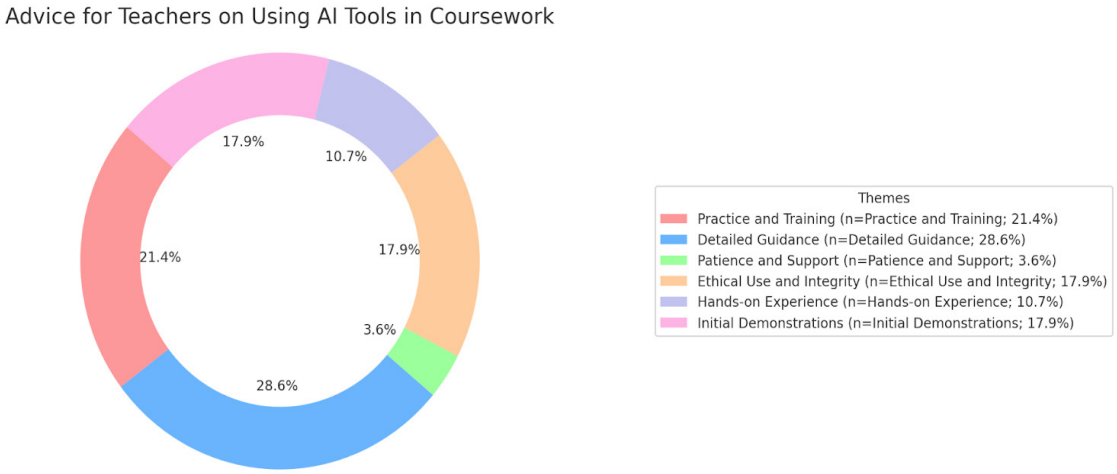

Figure 8. Pie graph of themes identified in students' (*n*=25) qualitative responses regarding advice they would give the instructor

Table 13. Student advice to the instructor to assist students in the future on the use of AI tools in the course by themes with descriptions and participant quotations

Theme	Description	Supporting Quotations
Practice and Training (*n*=2; 21.43%)	Students advised that consistent practice and dedicated training sessions are crucial for mastering AI tools.	- "Let the students practice *using AI all the time."* - "Practice, *practice,* practice." - "*Provide some classes* to teach how to use it properly." "*Provide assignments* that specifically focus on training AI."

Theme	Description	Supporting Quotations
		"Allow students to *practice possibly during class."*
		- "... maybe AI that will construct data graphs."
Detailed Guidance (*n*=8; 28.57%)	Clear and specific guidance on using AI tools effectively is important for students.	- "*Be very specific* when providing guidance to AI tools."
		- "Provide as much *background* as possible."
		- "Stress the importance of *'training AI'."*
		"Using AI helps manage your time *as long as there is proper guidance."*
		"Provide *assignments* that specifically focus on detailed guidance."
Patience and Support (*n*=1; 3.57%)	Providing ongoing support and encouraging students to use AI tools correctly is essential.	- "Continue to *be patient* and provide *multiple opportunities* to use AI correctly and effectively."
		- "Encourage students to *rely on their own thought processes.*"
		"I would *strongly encourage the use* of AI. This tool is helpful."

Theme	Description	Supporting Quotations
Ethical Use and Integrity (*n*=5; 17.86%)	Teaching students the ethical use of AI and the importance of academic integrity is vital.	- "Emphasize the *importance of citing the AI tool."*
		- "*Provide clear expectations* and guidelines while also teaching *how to cite* its use."
		"To effectively integrate AI in courses, t*eachers must know how to use and cite it properly*."
		"Encourage students to rely on their own thought processes and *cite properly."*
Hands-on Experience (*n*=3; 10.71%)	Practical, hands-on experiences help students better understand and utilize AI tools.	- "Provide more *hands-on experiences."*
		- "Provide *assignments* that specifically *focus on training AI*."
		"*Design AI-resistant assignments*. Create tasks that require critical thinking and hands-on interaction."
Initial Demonstrations (*n*=5; 17.86%)	Initial walkthroughs and detailed examples can help new users understand how to effectively use AI tools.	- "An *initial walkthrough demonstration o*f the effective use would be very beneficial."

Theme	Description	Supporting Quotations
		- "Have a *small group tutorial* with the new AI users and give them some very detailed *sample exercises.*" "I would show *more examples* of how you can use AI effectively." "To effectively integrate AI in courses, teachers must provide *initial demonstrations."*

Survey Item #13 asked students, to "Is there anything else you would like to add about the use of AI Tools in education?" Several themes were identified. Figure 9 shows the quasi-quantitative percentages of students' responses by identified themes. Table 14 provides a summary of the key themes identified from the qualitative analysis regarding "Anything else you would like to add about the use of AI tools in education" and provides supporting quotations as evidence for the reliability of the themes selected.

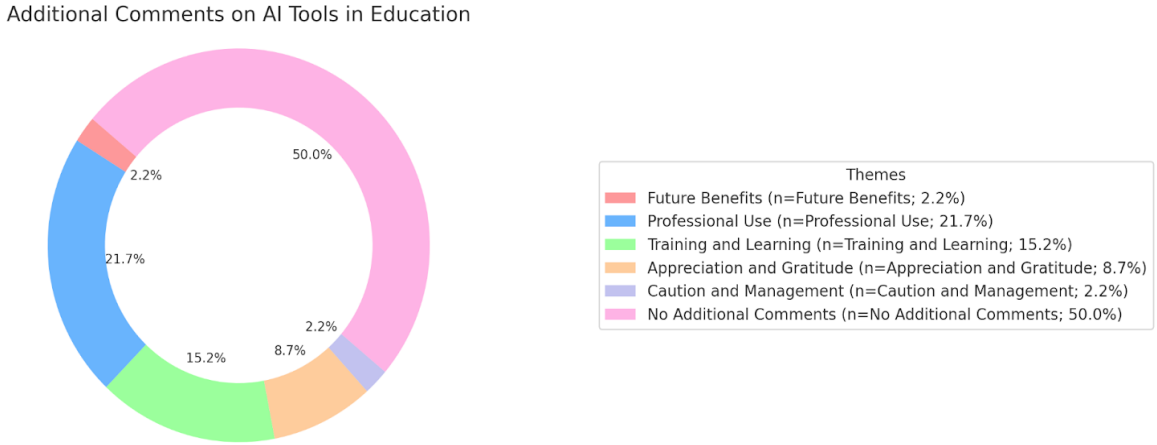

Figure 9. Themes identified from students' qualitative answers for additional comments

Table 14. Themes with descriptions and participant quotations identified from the analysis of students' comments on "Anything else you would like to add."

Theme	Description	Supporting Quotations
Future Benefits (*n*=1; 2.17%)	Students acknowledged the potential long-term benefits of learning and using AI tools.	- "I believe it is *important* to learn because it will be beneficial in the future."
Professional Use (*n*=10; 21.74%)	Some students felt AI tools are more suited for professional use rather than student use.	- "AI should be good for teachers and professionals to use, *not for students."* - "*As a principal*, it could be useful in creating quick presentations." - "I am honestly intrigued at how vastly AI is being *integrated into professional environments*." - "Overall, while AI tools have greatly enhanced my coursework, I see it being *more beneficial in a professional setting*." "I believe that AI is not going anywhere and *if we don't start using it now, we will be left behind."* - "It *should be restricted for only professionals,* not students."
Training and Learning (*n*=7; 15.22%)	There is a desire for more training and learning opportunities to effectively use AI tools.	- "I would *love more training* and insight into the use of AI tools." - "I would l*ove to learn how to use* AI to make better presentations." - "It was *very beneficial*. I did not learn about this technology before and now I feel confident using it." - "I believe it is *important to learn* because it will be beneficial in the future."

Theme	Description	Supporting Quotations
		- "It *should be restricted* for only professionals, not students."
		- "No, not really. I just have to catch up and get used to it."
Appreciation and Gratitude (*n*=4; 8.70%)	Some students expressed gratitude for the opportunity to use AI tools in their education.	- "*Thank you* for introducing this to us."
		- "*I am happy* to have the opportunity to gain access to these tools."
		- "No, *thank you* for your help."
		- "I *really appreciate* using AI tools in class. It has been very helpful."
Caution and Management (*n*=1; 2.17%)	Students emphasized the need for proper management and responsible use of AI tools.	- "Proper management, safety, and responsibility are necessary for success."
		- "It is important to embrace technological advancements but with caution."
		- "AI should be good for teachers and professionals to use, not for students."
No Additional Comments (*n*=23; 50.00%)	Many students had no additional comments or thoughts to add about the use of AI tools in education.	- "N/A"
		- "No."
		- "Not at the moment."
		- "No, maybe AI that will construct data graphs."

Overall, the themes showed saturation by the number of students participating when comparing the Spring 2024 semester with the Summer 2024 semester.

4.2 Themes from Advanced Student Survey of AI Use in the Course

The *Advanced Student Survey* responses revealed that with continued use of AI-enabled tools, new themes emerged that inform the structures of teaching and learning in the context of Education 4.0. Table 15 and the following section summarizes and notes the unique themes for advanced students and triangulates these with the literature. Refer to Appendix 2 for items on the *Advanced Student Survey on the Use of AI in the Course*, and Appendix 3 for survey item responses in tables.

Table 15. Observations and themes from advanced student survey (delivered Summer 2024 semester) compared with themes from the literature

Theme	Description	Key Points	Supporting Quotations	Literature Review Themes
Increased Confidence and Skills	Advanced students reported increased confidence and enhanced skills in using AI tools.	- Confidence Growth - Skill Enhancement	- "My confidence and skill level have both increased significantly." - "I grew more confident with my prompts and information I could extract using AI tools."	- Training and Adoption of Digital Tools (Matúšová and Kollár, 2023)
Consistency in Citing AI Tools	Improvement in properly citing AI tools in coursework over time.	- Diligence in Citing - Consistency in Practices	- "Yes, my citing of AI became more consistent this semester due to continuous practice and feedback." - "I have become more diligent in citing AI tools in my submissions."	- Importance of Academic Integrity in Digital Age (Mohamed et al., 2022)

New Challenges Over Time	Emergence of new challenges, particularly ethical concerns and balancing AI use.	- Ethical Balance - Evolving Challenges	- "The challenge is to find an ethical balance with using AI tools." - "I do not feel that any challenges were encountered that were not resolved."	- Ethical Implications of Digital Transformation (Jensen, 2019, in Garcia-Morales et. al., 2021)
Usefulness of AI Tools	Continued high usefulness of AI tools for various academic tasks.	- Research and Idea Generation - Writing Improvement	- "I found AI tools very useful for generating ideas and structuring my assignments." - "AI tools have been invaluable for checking and improving my writing."	- Transition to Digital Learning and Interactivity (Ratten, 2023)
Advice for Future Use	Suggestions for better integration and training on AI tools.	- Introductory Lessons - Practice Sessions	- "Have a mini-introduction lesson on AI tools at the beginning of the course." - "Maybe allow some practice times to use Gamma to get familiar with it."	- Equitable Access to Digital Solutions (Matúšová and Kollár, 2023) - Developing Inclusive Educational Structures (Hanson et al., 2020)

4.3 Results of Analysis on Student Data Analysis Survey

A fourth survey was provided in the summer courses collecting students' perceptions and experiences regarding an assignment requiring the use of AI to synthesize participants and simulate their responses to interview questions based upon training data and prompts describing the background, context, and demographics of the school and study participants. The assignment required higher-order complex-thinking skills and the ability to deeply analyze the AI output for accuracy. Students were expected to triangulate simulated themes for accuracy

to reflect the case school demographics and triangulate with human data findings, participant check, and the relevant literature reviewed on the chosen issue.

Analysis of the survey data and review of the student submissions revealed the students benefited from the exercise in that the simulation helped students to uncover connections and nuances they might miss through manual coding alone. Engaging with these deeper insights promotes analytical thinking. These were the first steps in using AI-enabled tools to provide opportunities to engage in activities and provide support to expand the students' critical thinking. The AI data simulation exercises for developing themes and implications for schools on identified issues were tested through participant check and literature review to determine the reliability of LLMs to produce valid conclusions when rigorously trained on the context of the case. Refer to Appendix D for tables with results of the analysis and item themes. Refer to Table 16 for identification of students' higher order thinking skills developed by AI use in the course assignments.

Table 16. Identification of higher order thinking skills from AI tool usage

Theme	Description	Implications for Higher Order Thinking Skills
Efficiency and Timesaving	The use of AI tools significantly streamlined the data synthesis process, saving time and effort.	Frees up time for complex analysis and interpretation, fostering critical thinking and problem-solving skills.
Improved Data Comprehensiveness	AI tools enhanced the depth and breadth of data analysis, making it more comprehensive and objective.	Promotes analytical thinking by encouraging exploration from multiple perspectives and consideration of alternative explanations.
Objectivity and Reduced Bias	AI tools helped reduce human biases in data interpretation by providing objective analysis.	Cultivates critical thinking by requiring evidence-based analysis and validation of findings, encouraging intellectual rigor.
Multi-dimensional Analysis	AI tools facilitated the identification of patterns and correlations, providing a more multi-dimensional analysis.	Fosters systems thinking by understanding complex systems and predicting their behavior, promoting holistic analysis.

Theme	Description	Implications for Higher Order Thinking Skills
Challenges and Ethical Considerations	Ensuring AI tools accurately capture context and meaning; maintaining ethical standards.	Develops critical oversight, evaluation, synthesis, and ethical reasoning skills necessary for higher-order thinking.
Implications for Teaching and Learning	Integrating AI tools into research education.	Enhances student engagement in critical evaluation, analytical skills, and ethical reasoning through hands-on experiences.

Note. Themes and table generated from prompting and training ChatGPT [version 4o] on the *Student Data Analysis Survey*.

4.4 Summary of the Survey Results

In sum, the results of the survey, which included quantitative findings and qualitative themes, revealed students in the courses predominantly used the free versions of AI-enabled tools including ChatGPT, Claude LLMs and the Gamma presentation tool in their coursework. The students reported using AI tools for academic, professional, and personal use in that order of frequency.

Students reported a high frequency of weekly use for AI tools, though no students self-reported never using AI. Most of the students reported using AI for the first time during the school year, 2023/2024, having been introduced for the first time in their Fall semester classes by two of the educational leadership department faculty (author included). Students reported a "learning curve" describing challenges to first use of AI tools. Only a small percentage of students felt they were citing their use of AI appropriately or consistently.

Almost all students strongly rated the use of AI tools as helpful for creating their coursework, with very few students reporting the use of AI-enhanced software for reviewing their assignments. Students reported the usefulness of AI tools including improvement in written assignments, time savings, and helping with structuring assignments. Concerns/challenges reported in the use of AI included a "learning curve" in developing quality prompts, concerns about the reliability of the output, and ethical concerns for example, one student reported fear of "getting in trouble" using AI.

Suggestions by students for future course instruction on AI use included providing more hands-on practice, detailed guidance, the development of patience in the process of learning AI tools (e.g. some students felt team members, who were more familiar with AI tools, went too fast in the assignment process for them to participate well). Students also reported the importance of faculty teaching the ethical use of AI. Table 17 organizes the key themes, descriptions, key

points, and triangulation with the key themes identified in the reviewed literature to provide a comprehensive view of the needs and experiences of underserved students in the context of using AI tools for their coursework.

Table 17. Side-by-side comparison of the themes identified in this current study with themes found in the review of relevant literature

Theme	Description	Key Points	Literature Review Themes
Equity and Accessibility	Ensuring equitable access to AI tools and resources for all students.	- Access to Technology - Inclusivity in Training and Support	- Equitable Access to Digital Solutions (Matúšová and Kollár, 2023) - Developing Inclusive Educational Structures (Hanson et al., 2020)
Student Uses of AI Tools	Diverse applications of AI tools in academic and professional contexts.	- Writing and Academic Improvement - Professional Development	- Transition to Digital Learning and Interactivity (Ratten, 2024) - Blended Learning and Modular Curriculum Design (Bonfield et al., 2020)
Confidence and Competency	Building students' confidence and competency in using AI tools.	- Learning Curve and Initial Training - Ongoing Support and Practice	- Training and Adoption of Digital Tools (Matúšová and Kollár, 2023) - Support Structures for Autonomous Learning (Hanson et al., 2020)
Ethical Use and Integrity	Promoting the ethical use of AI tools and academic integrity.	- Understanding Ethical Implications - Proper Citation and Usage	- Ethical Implications of Digital Transformation (Jensen, 2019) - Importance of Academic Integrity in Digital Age (Mohamed et al., 2022)

4.5 Sentiment Analysis

4.5.1 Challenges of Using AI Tools

Sentiment analysis of responses to the prompt "Describe any challenges you feel from the use of AI Tools in your coursework" detected positive or negative sentiment in 9 out of 39 responses while all the rest are considered neutral or lack strong sentiment (see Figure 10). Although the frequencies of positive and negative sentiment are similar (5 vs 4), the intensity score of positive sentiment is higher than that of negative comments (61.4 vs. -45).

	N	Mean Score
All Scored Documents	9	14.1
Net Positive Documents	5	61.4
Net Negative Documents	4	-45.0
No Sentiment Documents	30	0.0

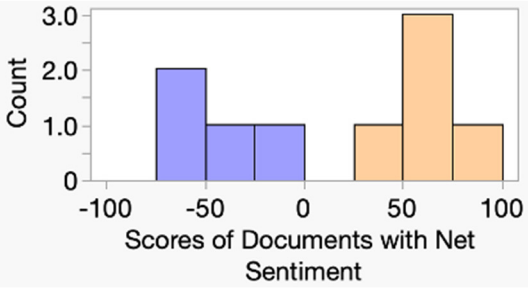

Figure 10. Frequency and score of sentiment pertaining to challenges

For users who yielded positive comments, the challenge is limited access and the learning curve. For example, "I believe the only challenge is the limitation of the free AI Tools. In order to receive proficient work samples, you have to pay - better yet invest for more access of the tools." "The challenges were in the beginning when I was learning how to navigate the use of AI, but I got it down pretty good now. I'm glad I got the experience."

The full text revealed that those users who expressed negative sentiment were concerned with accuracy and reliability of AI. For example, "Sometimes the information is erroneous. There were instances when I felt that using [an AI enabled article search tool, it] did not provide the most reliable resources to include." Some users worried about over-reliance on AI. For example, "Sometimes when I use AI tools in coursework it can sometimes lead to over-reliance, where I may become dependent on AI for problem-solving rather than developing my own critical thinking skills."

4.5.2 Benefits of Using AI Tools in the Coursework

Interestingly, linking and brushing indicates that no matter whether the comments are positive or skeptical, all the users who posted those comments regarded AI tools as highly useful (4, 5), as shown in Figure 11. Probably students perceive that the benefits of AI outweigh the shortcomings.

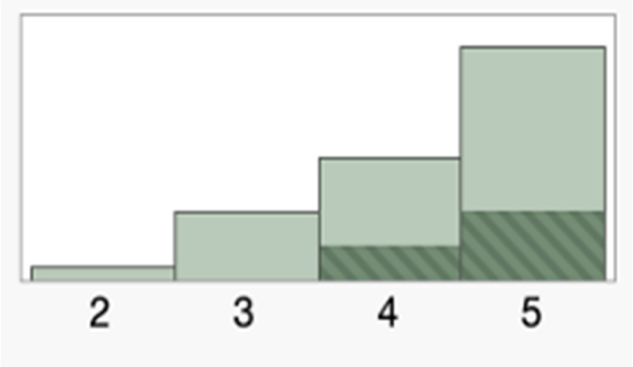

Figure 11. Distribution of responses to "Rate how useful you feel AI Tools have been to you in your coursework" with observations that gave positive and negative comments highlighted

4.5.3 Advice for Using AI Tools

Sentiment analysis of responses to the question "What advice would you give to the teacher to assist students in the future when teaching or using AI in their courses?" detected 11 positive and 1 negative responses. It is noteworthy that in this analysis the score of negative sentiment is much higher than that of positive feeling (69.1 vs. -90) (Figure 12).

	N	Mean Score
All Scored Documents	11	54.6
Net Positive Documents	10	69.1
Net Negative Documents	1	-90.0
No Sentiment Documents	28	0.0

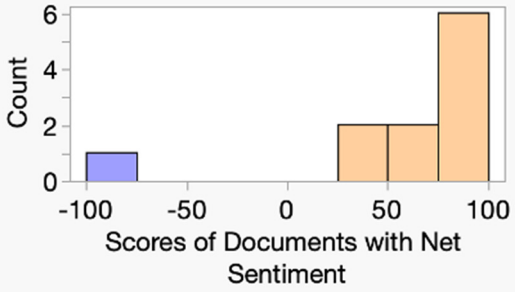

Figure 12. *Frequency and score of sentiment pertaining to advice*

The theme of positive comments center on great training, such as "It will be great to receive more training about how to use AI", "Keep it coming! I loved this part! "The prompts you gave were very helpful." The only negative or skeptical comment is concerned with accuracy of AI results: "The advice I would give would be to use your original work but allow AI to refine it. It's okay for AI to give ideas but be thorough and don't assume that AI has the best suggestion or idea."

Linking and brushing reveals that the spectrum of perceived usefulness of AI is wider among these students. As shown in Figure 13, while most learners selected "4" and "5," one rating is as low as "3."

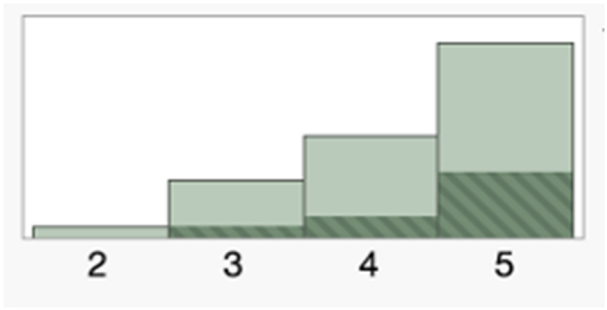

Figure 13. Distribution of responses to "What advice would you give to the teacher to assist students in the future when teaching or using AI in their courses?" with observations that gave positive comments highlighted

The comment of this student is: "[The professor] is great at modeling how to use AI." It seems that the student's positive feeling is more about the instructor than the class or the AI tools.

On the other hand, the student who gave a skeptical response rated usefulness of AI tools highly (Figure 14). Once again, the student might perceive that the pros of AI outweigh its cons.

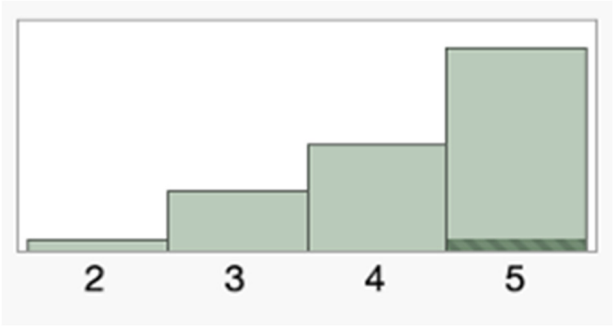

Figure 14. Distribution of responses to "What advice would you give to the teacher to assist students in the future when teaching or using AI in their courses?" with the observation that gave negative comments highlighted

4.5.4 Additional Comments

For the question "Is there anything else you would like to add about the use of AI Tools in education?" all comments are positive, as displayed in Figure 15.

	N	Mean Score
All Scored Documents	6	55.3
Net Positive Documents	6	55.3
Net Negative Documents	0	.
No Sentiment Documents	33	0.0

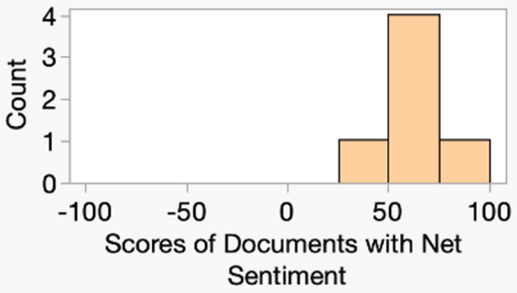

Figure 15. Frequency and score of sentiment pertaining to additional comments

The following are some examples of the comments: "...until I started taking this program and it has been very helpful, as well as has cut my work time shorter..." "No, I am happy to have the opportunity to gain access to these tools..." "...to gain access to these tools to help produce a better product." "...proper management, safety, and responsibility are necessary for success." Unsurprisingly, linking and brushing reveals that all of these students regarded AI as highly useful (4, 5) (Figure 16).

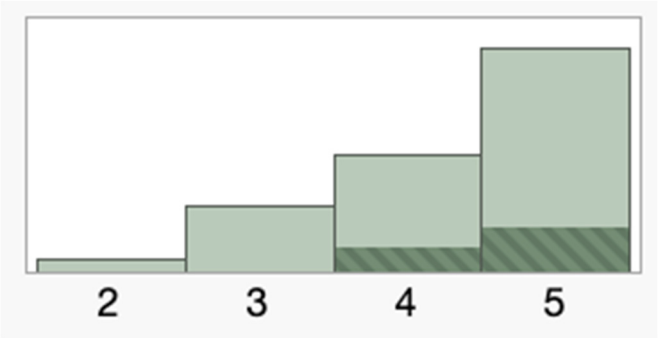

Figure 16. Distribution of "Is there anything else you would like to add about the use of AI Tools in education?" with observations of who gave positive comments highlighted

4.5.5 Benefits of Using AI tools to Synthesize and Analyze Data in the Research Course

Sentiment analysis of the responses to the prompt "Describe any benefits you found synthesizing data using generative AI tools. Be detailed and descriptive so the instructor can learn how to improve student experiences using AI to support the research process" indicates that five comments exhibit positive emotion with the average intensity score of 58 (Figure 17).

	N	Mean Score
All Scored Documents	5	58.0
Net Positive Documents	5	58.0
Net Negative Documents	0	.
No Sentiment Documents	20	0.0

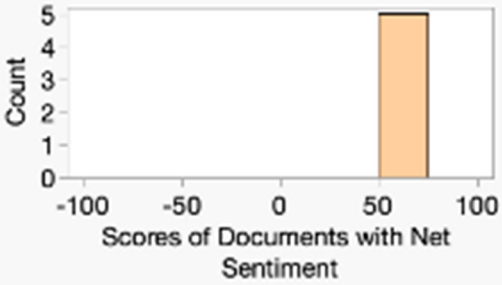

Figure 17. Frequency and score of sentiment pertaining to benefits of synthesizing data using AI tools

The following are some examples: "Instructors can help them leverage these powerful technologies to enhance the depth, efficiency, and reliability...", "...allowed for refinement, making the research process faster and more thorough", and "This made our research results better and more complete."

5. Discussion

These themes highlight the importance of equitable access to AI tools, diverse applications in

both academic and professional contexts, building student confidence through continuous support and training, and promoting ethical use and academic integrity. Addressing these areas can help ensure that underserved students are well-supported in their use of current technologies, ultimately contributing to their academic success and professional preparedness. It is the faculty members' responsibility to ensure students' needs are met before requiring them to use new technologies such as generative AI and AI enabled research and presentation tools.

One student reported feeling "afraid" that they would "get in trouble" using AI. Others reported that they felt "behind" because their introduction to AI tools came in a later semester than their team members, who had more experience and could "go faster." Additionally, one student reported that they would "run out of credits" using the free version of an LLM. There is potential for inequitable access for students, who may not be able to afford a monthly subscription to gain sufficient time on the LLM to perform the tasks required of them. This compares favorably with Sagor and Williams (2017) and Pokhrel and Chhetri (2021) who wrote on the importance of developing processes that are accessible by all students and meet their basic needs before expecting them to engage in online tasks.

Students reported they rarely used LLM for checking their work before submitting. This is an area for improvement. Research has shown that students who become autonomous learners take responsibility for their work and see themselves as having a voice, leading to higher rates of completion of their programs (Hanson et al., 2020). Students were also concerned about the reliability of AI LLMs responses and how to check for correctness. These concerns all concur with Mhlanga (2023), who researched the ethical use of ChatGPT in education and reported "that for ChatGPT to be used in education, it is essential to ensure that privacy is respected, that there is fairness and non-discrimination, [and] that there is transparency in the use of ChatGPT" i.e. citations of its use in coursework (p. 16). These elements must be embedded in direct instruction with explicit examples and directions, with accountability and review processes in place.

HE administration and faculty need to provide appropriate scaffolds to ensure students have sufficient access to the learning tools. Provide clear guidelines for AI tool use to ensure students understand the task (TI). Build team memberships around the understanding that the background and skills using AI tools of their members may vary considerably. Provide scaffolds to ensure social integration occurs (SI) (Hanson et al., 2020). One way to ensure equitable student access is to provide free university software subscriptions to AI tools, such as is commonly provided for applications such as MS Office, Adobe PDF reader, and simple analysis software using an institutional license. It will be necessary for faculty to participate in training for the use and application of AI tools, so they can be prepared to teach and support their students' learning. Ongoing action research processes can ensure leadership and faculty understand the context and demographics of their participants, develop action plans that meet the participants where they are at, and take research-based practices to the next level. Work needs to be done to create rigorous training protocols to ensure all students' concerns are addressed as HE moves forward to integrate the tools of Education 4.0.

6. Summary

This paper explored graduate students' perceptions and experiences of the use of generative AI and AI enabled applications in their coursework over two semesters (Spring and Summer 2024). The discussion flowed from a review of the data collected from four voluntary Google forms surveys used in course evaluations at the end of the semesters and one survey taken after students completed a complex task of synthesizing research data on their case school which simulated human data and triangulating it with the human data, participant check, and the relevant literature on their topic. The results of this study aligned well with the review of the literature. Students' initial introduction and use of the generative AI language models and AI-enabled applications for school, the workplace, and in personal situations was shown to be successful with the vast majority of students reporting their use and the usefulness of the tools. This achievement is important because skills in the use of LLM and AI enabled applications will be required in Industry 4.0 workplaces.

The methods for training students in the use of AI tools included faculty virtual instruction in Zoom sessions during class time, office hours, embedded media demonstrations, examples, students' sharing in team meetings, and individual exploration.

Maslow before Bloom is a critical consideration for faculty and administration when introducing disruptive changes such as AI enabled technologies into teaching and learning (Pokhrel & Chhetri, 2021). However, as one student reported, the use of AI tools in the course improved their sense of wellbeing because it saved time-on-task, which was used to spend with their family. This compares favorably with a review of the relevant literature, which reported on the importance of ensuring students' needs are met before asking them to engage in online learning. When thoughtfully supported, the use of AI tools in online and face-to-face learning can be used to contribute to supporting the psycho-social needs of diverse students. This includes increasing confidence from improved writing skills, organization, and just-in-time support through LLMs.

Results from the analysis of the survey data and review of student work products, revealed there is a strong benefit to students from the use of AI-enabled applications especially generative AI (such as Claude and ChatGPT freeware) and Gamma, an AI enabled presentation application. Some students reported challenges in the first-time use of these tools with the learning curve being one of the main obstacles to their use. Students requested more time in class with demonstrations and hands-on practice, especially in prompting and ethical use. Finally, the number of students in this review consistently citing their use of AI tools in the course submissions stands to be improved. Though 90% of the students reported using AI tools in their work process, more instruction and accountability can be provided in this area.

6.1 Conclusion

Education 4.0 is *sea change* which requires university administrators and faculty to deliver the tools to meet the workplace requirements of Literacy 4.0, including understanding the development of new terminologies, new ideas, new literacies (such as language for training and prompting generative AI and AI enabled tools and higher order thinking skills to triangulate

the results and generate improvements), and new innovations to meet the changing demands of society from the disruptions being experienced. To ensure our diverse student groups in HE are ready for the evolving economy and job market, administrators and faculty can be proactive seekers of knowledge, who respond to the needs of their students as well as those of a changing society. The results of this current study revealed that the use of AI tools can provide our diverse students with increasing skills to meet the needs of the changing workplace and can meet students' personal needs of gaining more time (as AI can facilitate both higher- and lower-level task completion) and improving writing skills. Challenges included the learning curve, cost for subscriptions, fear of using the tools incorrectly, proper citing of the use of LLM, and determining the reliability of the output. Recommendations for overcoming these challenges and structuring university programs for student success are provided.

6.2 Limitations of the Study

This study was performed as a document review of five courses in the School of Education Educational Leadership program (n=35) and Teacher Education program (n=4). The review was limited by time (two semesters/Spring 2024 and Summer 2024), place (a single minority-serving university located in a low SES urban metroplex in the south-central USA). Readers of this review should consider the context of this case to self-select whether the results will generalize to their institution and program.

6.3 Suggestions for Future Research

As the use of AI enabled tools is rapidly changing the HE landscape, future studies could expand on the themes identified in this current study, exploring more deeply specific teaching strategies that meet the needs of diverse students such as providing customized GPTs to individualize learning (study in progress). Surveying a larger sample across multiple higher education institutions is warranted to determine if the study is replicable and identified themes are reliable and to compare results between differing student populations and contexts. Deeper explorations of students' perceptions of benefits, challenges, and usefulness of AI enabled applications could be performed using semi-structured interviews to seek a rich, thick understanding of the students' experiences. A correlational analysis using student demographics on key factors of AI in HE could show relationships between variables. A review of HE policies and practices around AI enabled tools used by faculty and students in the coursework and research and a qualitative study observing teachers in HE institutions to understand how instructors teach and integrate AI tools in their courses both online and face-to-face could provide rich results.

Further, any powerful tool could potentially be abused. Students have been using AI tools to generate essays, solve math problems entirely, and even answer exam questions. It raises concerns about the slippery slope of AI usage in education (Spector, 2023). There's a risk that students might progress from seeking AI assistance to relying on AI to generate entire papers and complete all assignments. Future research will include both the positive and negative impacts of AI on HE.

7. Acknowledgement and Sponsoring information

The University of North Texas at Dallas Center for Socioeconomic Mobility through Education (CSME) in part financed the purchase of AI tools and training for the instructor to create the content on the use of AI-enabled tools in the CANVAS courses where PII redacted, self-report data was reviewed.

Note: This paper was completed with assistance from LLM-based ChatGPT and Claude. The GPT provided clarification on key concepts, suggestions for essay structure, assistance with data analysis and interpretation. All GPT interactions have been cited appropriately throughout the paper, and the final work represents the authors' own analysis and conclusions.

NHSR letter, IRB Committee reviewed.

Informed Consent

Obtained.

Provenance and Peer Review

Not commissioned; externally double-blind peer reviewed.

Data Availability Statement

The data that support the findings of this study are available on request.

Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

References

Agrawal, A., Gans, J., & Goldfarb, A. (Eds.). (2019). *The economics of artificial intelligence: An agenda*. University of Chicago Press. https://doi.org/10.7208/chicago/9780226613475.001.0001

Almarie, B., Teixeira P. E. P., Pacheco-Barrios, K, Rossetti, C. A., Fregni, F. (2023). The use of large language models in science: Opportunities and challenges. Principles of Practical Clinical Research, 9(1), 1-4. https://doi.org/10.21801/ppcrj.2023.91.1

Anthropic. (2024). *Claude* [version *3 Opus*] [Large language model]. www.anthropic.com

Avis, J. (2020). Socio-technical imaginaries and the fourth industrial revolution. In *Vocational education in the fourth industrial revolution*. *Journal of Vocational Education and Training*. https://doi.org/10.1007/978-3-030-52032-8_2

Bonfield, C. A., Salter, M., Longmuir, A., Benson, M., & Adachi, C. (2020). Transformation or evolution?: Education 4.0, teaching and learning in the digital age. *Higher education pedagogies*, *5*(1), 223-246. https://doi.org/10.1080/23752696.2020.1816847

Cao, W. (2023). A meta-analysis of effects of blended learning on performance, attitude, achievement, and engagement across different countries. *Frontiers in Psychology*, *14*, 1212056.

https://doi.org/10.3389/fpsyg.2023.1212056

Crawford, C. M., Moffett, N. L., & Wallace, J. Y. (2020). The C class lesson plan framework: Disrupting lesson strategies and intentions by designing a new style of lesson engagement that deconstructs and reconstructs the future of learning. *International Journal on E-Learning, 19*(1), 25–47. https://www.learntechlib.org/p/173349/

Creswell, J. & Creswell, D. (2018). *Research design: Qualitative, quantitative and mixed methods approaches* (5th ed). Sage.

Creswell, J., & Plano Clark, V. (2017). *Designing and conducting mixed methods research* (3rd ed.). Sage.

Dogan, M. E., Dogan, T. G., & Bozkurt, A. (2023). The use of artificial intelligence (AI) in online learning and distance education processes: A systematic review of empirical studies. *Applied Sciences, 13*(5), 1-12. https://doi.org/10.3390/app13053056

Farrell, L., Newman, T., & Corbel, C. (2021). Literacy and the workplace revolution: A social view of literate work practices in Industry 4.0. *Discourse: Studies in the Cultural Politics of Education, 42*(6), 898–912. https://doi.org/10.1080/01596306.2020.1753016

García-Morales, V. J., Garrido-Moreno, A., & Martín-Rojas, R. (2021). The transformation of higher education after the COVID disruption: Emerging challenges in an online learning scenario. *Frontiers in Psychology, 12*. https://doi.org/10.3389/fpsyg.2021.616059

Goncharov, V. V. (2020). The fourth industrial revolution: Challenges, risks and opportunities. *Eruditio, 2*(6), 95-106. https://www.worldacademy.org/eruditio/files/vol2issue6/Eruditio-V2-I6.pdf#page=100

Hanson, J. L. (2017). *Manage your mindset: Maximize your power of personal choice.* Lanham, MD: Rowman & Littlefield.

Hanshaw, G., & Hanson, J. L. (2019). Using microlearning and social learning to improve teachers' instructional design skills: A mixed methods study of technology integration in teacher professional development. *International Journal of Learning and Development, 9*(1), 145–173. https://doi.org/10.5296/ijld.v9i1.13713

Hanson, J., Loose, W., & Reveles, U. (2020). A qualitative case study of all-but-dissertation students at risk for dissertation noncompletion: A new model for supporting candidates to doctoral completion. *Journal of College Student Retention: Research, Theory & Practice, 0*(0) 1–29. https://doi.org/10.1177/1521025120910714

Ibarra, P. I. R. (2023). Society 5.0, beyond Industry 4.0: A documentary investigation with a national perspective. *Start / Files / Vol. 15 No. 39: Technological, economic, social and cultural megatrends: the disruptive potential of industry 4.0 / Thematic section*. University of Guanajuato. https://doi.org/10.59057/iberoleon.20075316.202339674

IBM. (2024). What is a chatbot? https://www.ibm.com/topics/chatbots

Krieger, M., Garcia, L. C., Riley, J., & Atkins, W. (2021). *American defense policy*. JHU Press.

https://doi.org/10.56021/9781421441498

Labadze, L., Grigolia, M. & Machaidze, L. (2024). Role of AI chatbots in education: Systematic literature review. *International Journal of Educational Technology in Higher Education, 20*, Article ID 56. https://doi.org/10.1186/s41239-023-00426-1

Liu, B. (2020). *Sentiment analysis: Mining opinions, sentiments, and emotions* (2nd ed.). Cambridge University Press. https://doi.org/10.1017/9781108639286

Mhlanga, D. (2023). Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning. *SSRN*, 1-11. http://dx.doi.org/10.2139/ssrn.4354422

Microsoft Corporation. (2018). *Microsoft Excel* [Computer Software].

Mohamed, M. Z. b., Hidayat, R., Suhaizi, N. N. b., Sabri, N. b. M., Mahmud, M. K. H. b., & Baharuddin, S. N. b. (2022). Artificial intelligence in mathematics education: A systematic literature review. *International Electronic Journal of Mathematics Education, 17*(3), em0694. https://doi.org/10.29333/iejme/12132

Matúšová, S., & Kollár, V. (2023). Labour and education markets in Industry 4.0. *Acta Educationis Generalis, 13*(1), 1-25. https://doi.org/10.2478/atd-2023-0001

Noui, R. (2020), "Higher education between massification and quality", *Higher Education Evaluation and Development*, *14*(2), 93-103. https://doi.org/10.1108/HEED-04-2020-0008

Organization for Economic Cooperation and Development [OECD]. (2023). *Development co-operation report 2023: Debating the aid system*, OECD Publishing. https://doi.org/10.1787/f6edc3c2-en.

Ofgang, E. (2022, December 14). What is ChatGPT and how can you teach with it? Tips & Tricks. [Webpage]. Tech and Learning. https://www.techlearning.com/how-to/what-is-chatgpt-and-how-to-teach-with-it-tips-and-tricks

OpenAI. (2024). *ChatGPT* [version 4o]. https://chat.openai.com

Pham, S. T. H., & Sampson, P. M. (2022). The development of artificial intelligence in education: A review in context. *Journal of Computer Assisted Learning, 38*(5), 1408–1421. https://doi.org/10.1111/jcal.12687

Pokhrel, S., & Chhetri, R. (2021). A literature review on Impact of COVID-19 Pandemic on teaching and learning. *Higher Education for the Future*, *8*(1), 133-141. https://doi.org/10.1177/2347631120983481

Power, L., Millington, K. A., & Bengtsson, S. (2015). *Capacity building in higher education topic guide*. Health & Education Advice & Resource Team (HEART). https://www.heart-resources.org

Ratten, V. (2024). *Entrepreneurial Business Venturing: Digitalisation Trends*. Springer Nature. https://doi.org/10.1007/978-981-97-1935-8

Sagor, R., & Williams, C. (2017). *The action research guidebook: A process for pursuing equity*

and excellence in education (3rd Ed.). Corwin.

SAS Institute. (2024). JMP Pro 18 [Computer software].

Spector, C. (2023, October). What do AI chatbots really mean for students and cheating? *Stanford Graduate School of Education*. https://ed.stanford.edu/news/what-do-ai-chatbots-really-mean-students-and-cheating

Tack, A., & Piech, C. (2022, July). The AI teacher test: Measuring the pedagogical ability of Blender and GPT-3 in educational dialogues. In A. Mitrovic & N. Bosch (Eds.), *Proceedings of the 15th International Conference on Educational Data Mining* (pp. 522–529). International Educational Data Mining Society. https://doi.org/10.48550/arXiv.2205.07540

Taddy, M. (2019). The technological elements of artificial intelligence. In A. Agrawal, J. Gans, & A. Goldfarb (Eds.), *The economics of artificial intelligence: An agenda* (pp. 61-68). University of Chicago Press. https://doi.org/10.7208/chicago/9780226613475.003.0002

Tlili, A., Shehata, B., Adarkwah, M. A., et al. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. *Smart Learning Environments, 10*(15), 1-24. https://doi.org/10.1186/s40561-023-00237-x

Tight, M. (2019). Mass higher education and massification. *Higher Education Policy, 32*(1), 93–108. https://doi.org/10.1057/s41307-017-0075-3

Voyakina, E. Y. (2022). Coronavirus pandemic reality in mass media discourse: A comparative analysis of English-Russian onomastic metaphors. *Научный результат. Вопросы теоретической и прикладной лингвистики, 8*(1), 105-121. https://doi.org/10.18413/2313-8912-2022-8-1-0-7

Williamson, G. R. (2005). Illustrating triangulation in mixed-methods nursing research. *Nurse Research, 12*(4), 7–18. https://doi.org/ 10.7748/nr2005.04.12.4.7.c5955

Yu, C. H. (2014). *Dancing with the data: The art and science of data visualization*. LAP.

Yu, C. H. (2022). *Data mining and exploration: From traditional statistics to modern data science.* CRC Press. https://doi.org/10.18413/2313-8912-2022-8-1-0-7

Yu, C. H. (2023, October 26). Artificial intelligence, machine learning, and psychology. *Oxford Bibliographies Online*. https://doi.org/10.1093/obo/9780199828340-0323

Glossary

AI: Artificial intelligence.

HE: Higher education.

10. Appendix

10.1 Appendix 1

Policy for Student Use of AI in the Course

> This course requires the use of artificial intelligence (A.I.)-enabled tools. It is the student's responsibility, as a scholar, to follow the explicit APA 7th edition requirements for citing work that is not your own. Therefore, the student will provide text citations for conversations quoted from generative AI tools included in the work. Appendices are required at the end of all assignments using the AI tools including student's prompts and AI responses. The reference section of the assignment requires full APA 7th edition references for AI -enabled tools used in the assignment.
>
> Finally, students are required to check all A.I.-generated output for accuracy including proper citations for materials generated by A.I. using other authors' work. Ensure that references have actual DOIs, and that authors and titles are real and accurately cited.
>
> Information literacy requires students to understand how to access, evaluate, and use information. For example, when referring to A.I. generated output, use phrases such as "[your name] via DALL-E 2" (for images) refer to the reference guide. Please review the instructions in each assignment for more details on specifically how to evidence the authorship of content in your submitted work.

10.2 Appendix 2

List of Survey Questions from Each Survey

10.2.1 Spring 2024 Student Survey on AI Use in the Course

Title: Spring 2024 Student Survey on AI Use in the Course
Term Distributed: Spring 2024

Quantitative and Multiple-Choice Questions:

1. If you used AI tools during this course for coursework, research, idea generation, etc., please indicate the tools you used.

o Options: Gamma.app (free/subscription), Elicit (free/subscription), Claude.ai (free/subscription), ChatGPT (free/subscription)

2. How often did you use an AI tool during the semester on a scale of 1 to 5, 1=never to 5=several times a week.

3. How did you learn how to use AI tools?

- Options: Video and course content provided in the class, Instruction mentoring and tutoring during class, individually, or in office hours, Self-exploration, practicing, Online videos, tutorials, free classes on my own time

4. Do you feel you properly cite the use of the AI Tools in your class submissions?

- Options: Never, Occasionally, Sometimes, Often, Always

5. Rate how useful AI Tools have been to you in your coursework.

- Scale: 1=Not useful to 5=Highly useful

6. Select all the ways that you used AI Tools in the course.

- Options: Research articles, Get ideas for an assignment, Create presentations for submitting in class assignments, Save time in formatting and organizing the content of an assignment, Review my completed submission to check for errors and improve writing

7. Rate how completely you "trained" AI Tools when you used them.

- Options: I never provided attachments or pasted examples into the LLM to train the tool before prompting, I occasionally uploaded or pasted an assignment example or rubric to train the AI before prompting, I understand the importance of training the AI so tried to include guidance, though sometimes was in a hurry and did not give boundaries or guidance before posting my prompt, I often trained the AI tool by providing explicit guidance on what I was expecting the response to look like, I always created lengthy prompts describing how I wanted the AI to act, set boundaries for the data I would allow it to use, and uploaded or pasted explicit guidance in the form of articles, assignment descriptions, document formats, etc. to train the AI

8. How long have you been using AI?

- Options: I just learned about AI in this course, I have used AI tools for other courses and this is my second or third time using it in a class, I have been using AI personally and professionally for over a year

Qualitative Questions**:** 9. Describe how you use AI tools? School, personal, work, etc. 10. Describe the benefits you feel and experience from using AI Tools for coursework. Be detailed and provide examples. 11. Describe any challenges you feel from the use of AI Tools in your coursework. Be detailed and provide examples. 12. What advice would you give to the teacher to assist students in the future when teaching or using AI in their courses? Be detailed and offer examples. 13. Is there anything else you would like to add about the use of AI Tools in education?

10.2.3 Summer 2024 Student Survey on AI Use in the Course

Title: *Summer 2024 Student Survey on AI Use in the Course*
Term Distributed: Summer 2024

Quantitative and Multiple-Choice Questions:

1. If you used AI tools during this course for coursework, research, idea generation, etc., please indicate the tools you used.

- Options: Gamma.app (free/subscription), Elicit (free/subscription), Claude.ai (free/subscription), ChatGPT (free/subscription)

2. How often did you use an AI tool during the semester on a scale of 1 to 5, 1=never to 5=several times a week.

3. How did you learn how to use the AI tools?

- Options: Video and course content provided in the class, Instruction mentoring and tutoring during class, individually, or in office hours, Self-exploration, practicing, Online videos, tutorials, free classes on my own time

4. Do you feel you properly cite the use of the AI Tools in your class submissions?

- Options: Never, Occasionally, Sometimes, Often, Always

5. Rate how useful you feel AI Tools have been to you in your coursework.

- Scale: 1=Not useful to 5=Highly useful

6. Select all the ways that you used AI Tools in the course.

- Options: Research articles, Get ideas for an assignment, Create presentations for submitting in class assignments, Save time in formatting and organizing the content of an assignment, Review my completed submission to check for errors and improve writing

7. Rate how completely you "trained" AI Tools when you used them.

- Options: I never provided attachments or pasted examples into the LLM to train the tool before prompting, I occasionally uploaded or pasted an assignment example or rubric to train the AI before prompting, I understand the importance of training the AI so tried to include guidance, though sometimes was in a hurry and did not give boundaries or guidance before posting my prompt, I often trained the AI tool by providing explicit guidance on what I was expecting the response to look like, I always created lengthy prompts describing how I wanted the AI to act, set boundaries for the data I would allow it to use, and uploaded or pasted explicit guidance in the form of articles, assignment descriptions, document formats, etc. to train the AI

8. How long have you been using AI?

- Options: I just learned about AI in this course, I have used AI tools for other courses and this is my second or third time using it in a class, I have been using AI personally and

professionally for over a year

Qualitative Questions**:** 9. Describe how you use AI tools? School, personal, work, etc. 10. Describe the benefits you feel and experience from using AI Tools for coursework. Be detailed and provide examples. 11. Describe any challenges you feel from the use of AI Tools in your coursework. Be detailed and provide examples. 12. What advice would you give to the teacher to assist students in the future when teaching or using AI in their courses? Be detailed and offer examples. 13. Is there anything else you would like to add about the use of AI Tools in education?

10.2.4 Summer 2024 Advanced Student Survey on AI Use in the Course

Title: *Summer 2024 Advanced Student Survey on AI Use in the Course*
Term Distributed: Summer 2024

Quantitative and Multiple-Choice Questions:

1. If you used AI tools during this course for coursework, research, idea generation, etc., please indicate the tools you used.

- Options: Gamma.app (free/subscription), Elicit (free/subscription), Claude.ai (free/subscription), ChatGPT (free/subscription)

2. How often did you use an AI tool during the semester on a scale of 1 to 5, 1=never to 5=several times a week.

3. Rate how useful you feel AI Tools have been to you in your coursework.

- Scale: 1=Not useful to 5=Highly useful

4. Do you feel your consistency in properly citing the use of the AI Tools in your class submissions improved this semester over last? Explain. What contributed to any change?

5. Select all the ways that you used AI Tools in the course.

- Options: Research articles, Get ideas for an assignment, Create presentations for submitting in class assignments, Save time in formatting and organizing the content of an assignment, Review my completed submission to check for errors and improve writing

6. Rate your level of improvement in "training" the LLM AI Tools when you used them.

- Options: I never provided attachments or pasted examples into the LLM to train the tool before prompting, I occasionally uploaded or pasted an assignment example or rubric to train the AI before prompting, I understand the importance of training the AI so tried to include guidance, though sometimes was in a hurry and did not give boundaries or guidance before posting my prompt, I often trained the AI tool by providing explicit guidance on what I was expecting the response to look like, I always created lengthy prompts describing how I wanted the AI to act, set boundaries for the data I would allow it to use, and uploaded or pasted explicit guidance in the form of articles, assignment descriptions, document formats, etc. to train the AI

7. How long have you been using AI?

- Options: I just learned about AI in this course, I have used AI tools for other courses and this is my second or third time using it in a class, I have been using AI personally and professionally for over a year

Qualitative Questions: 8. Describe how your use of AI tools changed, if at all, this semester over last semester. (e.g., confidence, level of skills, etc.) 9. Describe any changes in how you feel and experience using AI Tools for coursework after two semesters compared to the first semester. Be detailed and provide examples. 10. Describe any challenges you feel that may have developed since the first semester you used AI Tools in your coursework. Be detailed and provide examples. 11. What advice would you give to the teacher to assist students in the future when teaching or using AI in their courses? Be detailed and offer examples. 12. Is there anything else you would like to add about the use of AI Tools in education?

10.2.5 Summer 2024 Data Analysis Survey

Title: *Summer 2024 Data Analysis Survey*
Term Distributed: Summer 2024

Quantitative and Multiple-Choice Questions:

1. Did you use the data analysis methods described in the Zoom session and in Sagor and Williams Chapter 8 to explore the data you collected?

- Options: Yes, No, Other

2. Select the tools you used to analyze your qualitative data (interviews, observations, artifacts).

- Options: Coding and Theming by hand with sticky notes, highlighters or other organizational aids, Coding and Theming using MS Word document, Coding and Theming using MS Excel, Coding and Theming using Generative AI tool (Claude or ChatGPT), Other

3. Select the tools you used to analyze any quasi-qualitative data you collected.

- Options: MS Excel, Claude, ChatGPT, Other tools

4. How did you cite the use of tools used to perform your analyses?

- Options: I provided in-text citations for when I used outside sources to perform analysis of the data, I provided APA 7th edition references for the outside tools I used to perform the analysis, I did not cite my sources for data analysis

5. Are you ready to learn how to create an action plan with implications as the next steps in the action research process?

- Options: Yes, No, Other

Qualitative Questions: 6. Describe the process you used for synthesizing and analyzing data for your study using generative AI tools like Claude or ChatGPT. Be detailed so the instructor

can learn from the processes you used to improve the instruction. 7. Describe any benefits you found synthesizing data using generative AI tools. Be detailed and descriptive so the instructor can learn how to improve student experiences using AI to support the research process. 8. Describe any challenges you found synthesizing data using generative AI tools. Be detailed and descriptive so the instructor can learn how to improve student experiences using AI to support the research process. 9. Tell me what you know, don't know, and want to know about the data analysis and reporting before we move on with Chapter 9 Turning Findings into Action Plans.

10.3 Appendix 3

Table 1. *Did you use the data analysis methods described in the Zoom session and in Sagor and Williams Chapter 8 to explore the data you collected?*

Response Option	Frequency	Percentage (%)
Yes	10	100%
No	0	0%

Table 2. *Select the tools you used to analyze your qualitative data (interviews, observations, artifacts)*

Tool	Frequency	Percentage (%)
Coding and Theming using Generative AI	12	100%
Claude	9	75%
ChatGPT	8	67%
Other tools	3	25%
MS Word Document	2	17%
MS Excel	3	25%

Table 3. *Select the tools you used to analyze any quasi-qualitative data you collected*

Tool	Frequency	Percentage (%)
Claude	3	25%
ChatGPT	3	25%
Other tools	3	25%
MS Excel	1	8%

Table 4. *How did you cite the use of tools used to perform your analyses?*

Citation Method	Frequency	Percentage (%)
Provided APA 7th edition references	12	100%

Table 5. *Describe the process you used for synthesizing and analyzing data for your study using generative AI tools like Claude or ChatGPT*

Process Description	Frequency	Percentage (%)
Utilized AI tools for identifying patterns, themes, and insights.	6	50%
Combined AI insights with manual analysis for validation.	3	25%
Detailed step-by-step process provided for using AI tools.	3	25%

Table 6. *Describe any benefits you found synthesizing data using generative AI tools*

Benefit Description	Frequency	Percentage (%)
Streamlined data synthesis process	7	58%
Improved comprehensiveness and objectivity of analysis	6	50%
Timesaving and efficiency	6	50%

Table 7. *Describe any challenges you found synthesizing data using generative AI tools*

Challenge Description	Frequency	Percentage (%)
Ensuring AI captured the context and meaning accurately	6	50%
Need for critical review of AI-generated insights for validation	5	42%

Table 8. *Are you ready to learn how to create an action plan with implications as the next steps in the action research process?*

Response Option	Frequency	Percentage (%)
Yes	12	100%

Table 9. *Themes from Qualitative Data on Benefits of Using Generative AI Tools*

Theme	Subtheme	Quotation	Description
Efficiency and Timesaving	N/A	"Utilizing AI tools like Claude and ChatGPT greatly streamlined the process of synthesizing large volumes of qualitative data."	The use of AI tools significantly streamlined the data synthesis process, saving time and effort.
Improved Data Comprehensiveness	Enhanced Analysis Depth	"These AI assistants provided a more comprehensive and objective analysis, helping to surface connections and nuances that may have been overlooked through manual coding alone."	AI tools enhanced the depth and breadth of data analysis, making it more comprehensive and objective.
Objectivity and Reduced Bias	N/A	"AI analyzed the data objectively, reducing our own biases that might influence data interpretation."	AI tools helped reduce human biases in data interpretation by providing objective analysis.
Multi-dimensional Analysis	Identifying Patterns	"AI tools made complex data analysis more accessible by identifying patterns and correlations that might not have been immediately apparent."	AI tools facilitated the identification of patterns and correlations, providing a more multi-dimensional analysis.

Table 10. *Themes from Qualitative Data on Challenges of Using Generative AI Tools*

Theme	Subtheme	Quotation	Description
Context and Meaning Accuracy	Risk of Misinterpretation	"One key challenge was ensuring the AI accurately captured the context and meaning behind participants' responses."	Ensuring that AI tools accurately captured the context and meaning of participants' responses was challenging.
Critical Review and Validation	Human Touch Needed	"While these tools were incredibly helpful in identifying patterns and themes, it was crucial to critically review the AI-generated insights to validate their accuracy and relevance."	It was necessary to review AI-generated insights critically to ensure their accuracy and relevance.
Data Quality	Importance of Input Quality	"The accuracy of AI outputs heavily depended on the quality of input data. Poor-quality or irrelevant data led to unreliable results."	The quality of AI outputs depended heavily on the quality of input data.
Ethical Considerations	Transparency and Privacy	"The use of AI-generated data raises important ethical questions about the representation of human experiences and the potential for misinterpretation or misuse of the findings."	The use of AI-generated data raised ethical concerns about data representation and privacy.

11. Privacy Statement

The names and E-mail addresses entered in this journal's site will be used exclusively for the purposes of this journal and will not be made available for any other purpose or to any other party.