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GitHub Copilot: Introducing the artificial intelligence tool in an information systems course

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Abstract

Artificial intelligence (AI) holds the potential to revolutionize the way businesses operate. With the promise of generating creative solutions for complex problems, AI's transformative impact on the business landscape is undeniable. Against this backdrop, business schools become crucial in preparing future professionals with relevant tools and techniques associated with AI. This paper investigates the integration of GitHub Copilot in conjunction with Python libraries such as Pandas and Plotly, within two sections of an introductory information systems course. We examine how business students perceive GitHub Copilot's ease of use, utility, and relevance, particularly in tasks involving code generation for data analysis and visualization. Our findings indicate a generally positive perception of GitHub Copilot among business students in terms of its ease of use, utility, and relevance. However, notable gender differences emerged; male students reported finding GitHub Copilot easier to use and their interactions with the tool clearer and more understandable compared to their female counterparts. The paper also provides an overview of the course assignment and presents the visualizations produced, offering valuable insights into the practical application of GitHub Copilot in an information systems course setting.

Keywords: GitHub Copilot, generative AI, data analysis, large language models (LLM), data visualization

Introduction

Under the swiftly growing field of artificial intelligence (AI), the business landscape is rapidly transforming. This shift not only empowers business users with ubiquitous access to knowledge and skills previously unattainable but also heralds the evolution of every business into an AI-driven enterprise (Chandrasekaran, 2023). In this context, the role of business schools becomes increasingly pivotal.

With AI reshaping the business world, business schools are at the forefront of equipping the next generation of professionals with the necessary skills and knowledge. Business schools must provide content that is both relevant and forward looking, offering a curriculum that fosters current and emerging technologies. Accrediting organizations like the Association to Advance Collegiate Schools of Business (AACSB) highlight key guiding principles such as agility in education, prompting educators to modify curriculum content and skills in response to evolving trends and best practices (AACSB, 2020 Standards). However, researchers (e.g., Nithithanatchinnapat et al., 2024) note that additional research is needed to guide faculty members on how to effectively integrate AI into university courses and call for more studies that can provide this guidance. Our study answers this call for more pedagogical research on incorporating AI into college courses.

In this light, our paper explores our application of an AI developer tool, GitHub Copilot (GitHub Inc., 2024), along with Python libraries including Pandas and Plotly to help business students analyze data. It is becoming increasingly important that students from every academic discipline be exposed to and develop a practical familiarity with the tools and techniques relevant to AI and data analytics (Sollosy & McInerney, 2022). To better understand the inherent advantages in AI tools, our research seeks to answer this question:

How do students in an introductory information systems course perceive GitHub Copilot's ease of use, utility, and relevance in generating code to help analyze data and create visualizations?

This question is investigated through a methodologically robust approach, employing a survey administered to students in two face-to-face sections of an information systems course. The survey aimed to glean insights into students' perceptions of GitHub Copilot, especially in the context of generating code to help analyze data and create visualizations using popular Python libraries. Our findings reveal that business students perceive GitHub Copilot positively in terms of its ease of use, utility, and relevance. These perceptions highlight the potential of GitHub Copilot as a beneficial tool in educational settings.

The contribution of this study offers valuable insights into the integration of the generative AI tool, GitHub Copilot, in an information systems course. An overview of the course assignment provides a hands-on approach to using the AI tool to generate code, ultimately empowering students to better analyze, explore, and visualize datasets. By better understanding students' perceptions regarding the ease of use, utility, and relevance of GitHub Copilot, the paper aims to support the effective integration of such tools into information systems courses. This integration can improve technology literacy and skills across genders, enabling all students to leverage AI advancements.

The rest of the paper is structured as follows. The subsequent section discusses relevant literature relating to AI's impacts on industries and work, AI's roles in business programs in higher education, and concerns about gender bias in the development and use of AI. This section concludes by presenting the hypothesis that we test. The following section describes the methodology of the study detailing how the tool was introduced over two class sessions, including an overview of the assignment student participants were tasked with completing. Following this, the paper delves into the findings of our research. It then concludes by reflecting on the study's limitations and proposing avenues for future research.

Literature review

In this section, we provide an overview of literature that is germane to our project. Unless otherwise stated, our use of the term AI focuses on large language model (LLM) based tools, such as ChatGPT and Microsoft's GitHub Copilot. LLMs employ advanced computational methods, including neural network architectures, to learn from extensive narrative data through natural language processing (Hobensack et al., 2024). These capabilities make them versatile tools for a wide range of applications, including text generation and complex data analysis (Raiaan et al., 2024).

AI's impacts on industries and work

Generative AI holds immense potential to advance and revolutionize various industries. In the Financial Technology (FinTech) sector, for example, ChatGPT integration has been found to enhance customer service by effectively addressing payment-related inquiries and offers, "potential benefits in payment services, robo-advisor platforms, and smart contract execution" (Gill et al., 2023). Additionally, in creative

fields, such as art, writing, and content creation, artists and writers are leveraging LLM-based tools to generate ideas, craft compelling narratives, and compose poetry (Haque & Li, 2024). These tools are reshaping the creative process by providing new sources of inspiration and assistance in developing high-quality content.

The future success of businesses will hinge on their ability to adopt AI technologies, seamlessly integrate them into their existing systems, and continuously explore new opportunities for growth and differentiation (Kanbach et al., 2024). Incorporating AI in educational practices to help students entering the workforce master these tools is becoming increasingly important across many disciplines, ensuring that graduates are well-prepared to leverage AI's capabilities in their respective fields. We return to this topic after considering the issue of gender bias.

Gender bias in the development and use of AI

Gender differences in the adoption of new technologies often underscore a persistent gap in how males and females engage with and perceive technology. Technological literacy and skills have been found to represent barriers to women's internet usage, highlighting gender gaps in the use of the internet, mobile devices, and digital services (Huyer & Nuñez, 2022). Additionally, effort expectancy, defined as the perceived ease of using an information system (Venkatesh et al., 2003), emerges as a critical factor in technology adoption. For example, research into mobile internet acceptance has similarly underscored effort expectancy as a stronger determinant of intention for women than for men (Wang & Wang, 2010).

In the realm of AI, gender gaps manifest in usage and participation in AI development and design (Schulenberg et al., 2023). Gender bias in AI can emerge during the algorithm's development, the training of datasets, or through AI-generated decision-making processes (Manasi et al., 2022). As a result, AI systems might not adequately consider the needs and perspectives of female users. (West et al., 2019).

AI's roles in higher education

The rapid development in AI technology has facilitated the implementation of AI solutions across numerous industries, including higher education (Rahiman & Kodikal, 2024). Integrating AI technologies into business school curricula is becoming increasingly important because of its potential to enhance students' critical thinking and problem-solving skills through real-world applications (Nithithanatchinnapat et al., 2024), equip students with necessary AI literacy and ethical considerations for future job markets (Chen & Qin, 2023), assist them in analyzing complex business scenarios (Essien et al., 2024), and prepare them to navigate AI-augmented work environments (Nithithanatchinnapat et al., 2024). Although research into the use of AI in pedagogy remains underdeveloped (Mattalo et al., 2024), the importance of students mastering data management—including data collection, cleaning, analysis, and visualization—is increasingly emphasized (Tenório & Romeike, 2023). This competency can be further enhanced through the use of generative AI technologies in courses.

AI also presents challenges for the academic community, and concerns relating to AI in business school education are multifaceted. AI poses prominent issues including the potential to exacerbate academic integrity violations by facilitating plagiarism and cheating (Rodrigues et al., 2024). Use of watermarked images, however, has been identified as a helpful approach for verifying the integrity of and authenticating digital media (Harran et al., 2018). The ethical implications of AI use in education, such as biases in AI algorithms, also pose serious concerns (Rudolph et al., 2024).

Researchers from diverse fields have examined the integration of AI in college courses and programs. These studies come from a variety of business fields, such as accounting (Ballantine et al., 2024), entrepreneurship (Bell & Bell, 2023), and marketing (Guha et al., 2024), as well as non-business fields, such as chemistry (Alasadi & Baiz, 2024) and physics (Ding et al., 2023). We can make two observations about this existing literature. First, existing research often does not provide guidance on how to give students hands-on experience with AI applications, though this has been found to be a valuable active learning approach to enhance college students' understanding (e.g., Pahi et al., 2024). Second, a subset of this research focuses on using AI to support teaching programming skills (e.g., Ahmed et al., 2024). However, we did not find any studies that focus on student learning for visual analytics programming tasks. Our study aims to fill these two research gaps.

Increasingly, researchers have sought to understand students' attitudes towards AI in higher education settings. Many of these studies utilize the Technology Acceptance Model (TAM) or adapt constructs that make it up. To briefly review, TAM (Davis, 1989) posits that two factors, perceived ease of use and perceived usefulness, influence an individual's attitude or behavioral intention to accept and use a technology (Yilmaz et al., 2023). Perceived ease of ease may be defined as the extent to which someone perceives a technology as being difficult to use (Yilmaz et al., 2023). In contrast, perceived usefulness can be defined as the extent to which someone believes that a technology can enhance their ability to perform an activity (Yilmaz et al., 2023). Existing research supports the value of using TAM to understanding student attitudes, such as those relevant to our work. For example, Ali et al. (2024) highlighted the value of TAM for understanding students' attitudes towards using AI applications in educational settings, finding significant support for both perceived ease of use and perceived usefulness on students' attitudes towards and intentions to use AI. Persuaded by findings such as this, we adapt TAM constructs to underpin our efforts to understand student perceptions of GitHub Copilot.

Additional research provides insights about the roles of gender and college majors in influencing students' perceptions of AI, such as GitHub Copilot. Regarding gender, multiple studies found disparities in terms of perceived ease of use and perceived usefulness. In a study of student attitudes towards ChatGPT, Yilmaz et al. (2023) found that males perceived this tool as easier to use than females to a significant degree. In addition, Araujo et al. (2020) found a significant gender influence on perceptions of AI's usefulness. Here, males perceived AI as useful to a significant degree relative to females' perceptions of usefulness (Araujo et al., 2020). Taken together, these findings suggest that male and female students will evaluate GitHub Copilot differently in terms of perceived ease of use, usefulness, and relevance. In terms of college majors, researchers found that a broad range of majors (for example, non-business majors such as education students, as well as multiple business majors, such as management and economics) tend to have the same degree of positive attitudes towards AI, all else being equal (Almaraz-López et al., 2023; Țală et al., 2024). Such findings suggest that differences in college majors will have little or no influence on students' perceptions of GitHub Copilot.

Based on these findings, we propose the following hypothesis:

H1: Students will perceive GitHub Copilot as easy to use, useful, and relevant for generating code to help analyze data and create visualizations. Additionally, there will be significant differences in some of these perceptions based on gender, but not based on major.

This hypothesis complements the research question that guides this work, permits statistical testing of influences on students' perceptions of GitHub Copilot, and helps to enhance the validity of this study. We delve into the procedures that underpin our study in the next section.

Methodology

A survey was administered to two face-to-face sections of an information systems course to glean students' perceptions of GitHub Copilot. Survey items covered statements about the relevance and use of GitHub Copilot, in addition to the GitHub Copilot activity involving analyzing data (see Table 2 on page 7). The survey was designed and analyzed by adapting the TAM framework. To analyze the data collected from the survey, ANOVA, one-sample t-tests, and independent samples t-tests were employed. ANOVA was used to compare means across different student major groups and the independent samples t-tests were used to compare the means between genders.

In the business information systems course, students are exposed to several data analysis tools including Excel and Tableau. Excel was introduced during the first week. Students were provided with a simple data set containing units, costs, and sales. They are tasked with formulating calculations for gross sales, profit, total values, and averages, and creating a pie chart. The introduction of GitHub Copilot built on this foundation. Midway through the semester, students were introduced to Tableau and created additional interactive data visualizations.

Class 1: introducing GitHub Copilot

The GitHub Copilot assignment was introduced in the second week and extended over two class sessions. The first class session involved describing how to access the tool by creating a GitHub account, applying to GitHub Global Campus, and integrating it into the Visual Studio Code editor (see Figure 1 below).

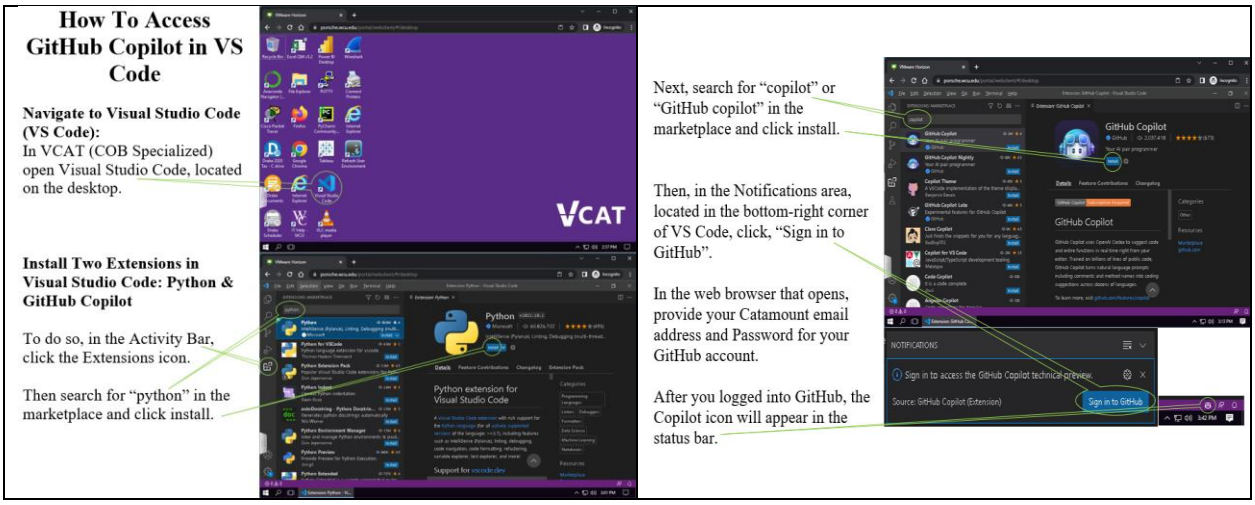

Figure 1: How to Access GitHub Copilot in VS Code

The instructor demonstrated how to use GitHub Copilot by leveraging the Plotly and Pandas Python libraries to analyze a small Iris flower dataset. The instructor began by creating a new Python file. At the beginning of the first line in the file, a pound sign (#) was written to indicate a comment. The instructor continued by typing natural language comments to prompt GitHub Copilot to import the necessary libraries for data analysis. GitHub Copilot then suggested the appropriate code to import the Pandas and Plotly libraries. The code suggestion could be accepted, dismissed, or, if offered, multiple suggestions could be viewed in the completion panel. Next, the instructor showed students how to prompt GitHub Copilot to suggest code completions for loading and exploring the dataset. Finally, by drawing context from comments written using language, GitHub Copilot provided the code to create a scatter plot of the dataset.

Figure 2: A Python File with Code Generated from GitHub Copilot and the Chart Result

Class 2: GitHub Copilot assignment

The second class involving GitHub Copilot allowed for the instructor and students to work with the widely used Superstore dataset that comes bundled with Tableau software. The assignment contained instructions for students to create four charts using the Superstore dataset and GitHub Copilot to assist them. Students could view finalized chart images with embedded watermarks, to help ensure their independent completion of the work (see Figure 3 below).

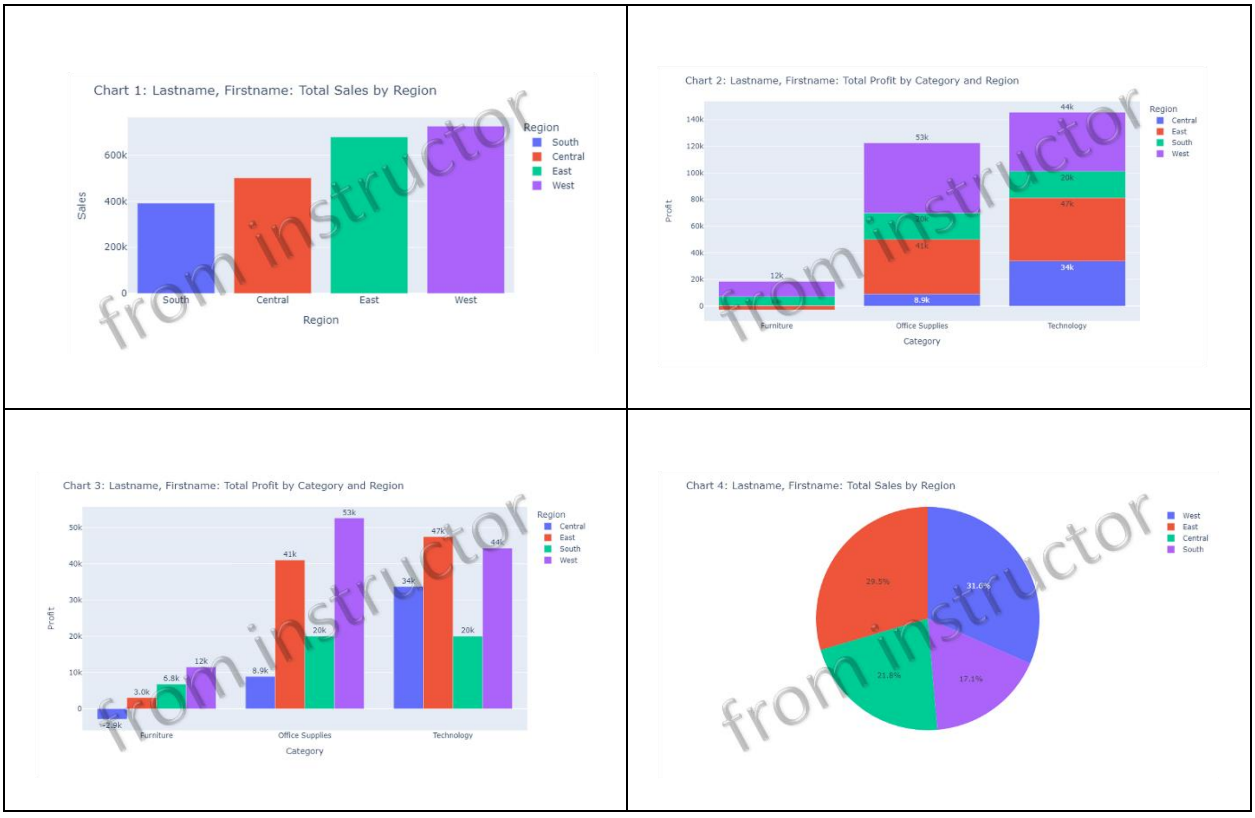

Figure 3: Images with Embedded Watermarks of Finished Visualizations

Results

In total, 56 surveys were completed by the students in the undergraduate business information systems course. The sample (see Table 1 below) contained slightly more male (52%) than female (48%) respondents, and many more non-CIS majors (98%) than CIS majors (2%). The non-CIS majors included students majoring in hospitality and tourism (13%), sport management (18%), entrepreneurship (7%), marketing (18%), management (9%), business law (14%), finance (7%), accounting (4%), and other disciplines (10%).

Table 1: Demographics

	Majors	# of Survey Responses
Male	CIS Majors	1
	Non-CIS Majors	28
Female	CIS Majors	0
	Non-CIS Majors	27

Students were instructed to identify their level of agreement or disagreement with statements by using a 7-point Likert scale, where they could select options ranging from 'Strongly Disagree' (scored as '1') to 'Strongly Agree' (scored as '7').

Students and GitHub Copilot

One-sample t-tests were conducted to determine student perceptions of GitHub Copilot. The means for items regarding using GitHub Copilot all differed from the neutral value in a positive direction. The items concerning the relevance of GitHub Copilot were all statistically significant. Students in the course thought GitHub Copilot would be useful in the workplace (M = 5.63, SD = 1.75), $t(55) = 6.94$, $p < .001$ and that they would benefit from knowing something about GitHub Copilot (M = 5.45, SD = 1.99), $t(55) = 5.44$, $p < .001$. In addition, students believed that GitHub Copilot could benefit inexperienced programmers (M = 5.55, SD = 1.80), $t(55) = 6.47$, $p < .001$ and thought that tools like GitHub Copilot are relevant to their discipline (M = 5.38, SD = 1.81), $t(55) = 5.70$, $p < .001$. Furthermore, students found most code suggestions from GitHub Copilot to be helpful (M = 5.73, SD = 1.66), $t(55) = 7.82$, $p < .001$ and the visualizations created with the code suggestions provided from GitHub Copilot could help to illuminate underlying patterns in data from a wide variety of sources (M = 5.66, SD = 1.55), $t(55) = 8.01$, $p < .001$.

Gender and GitHub Copilot

There were differences between male and female perceptions about GitHub Copilot. For example, according to an independent samples T-test, males found learning to use GitHub Copilot in the class significantly easier (M = 5.14, SD = 1.73) than females (M = 3.78, SD = 2.14), $t(54) = 2.61$, $p = .012$. In addition, the interaction with GitHub Copilot for males was clearer and more understandable (M = 5.34, SD = 1.63), compared to females (M = 4.19, SD = 2.39), $t(54) = 2.11$, $p = .041$.

Furthermore, although not statistically significant, it's noteworthy that the means for each survey item relating to the relevance of GitHub Copilot were all higher for males than female students. For example, males (M = 5.76, SD = 1.53) found most of the code suggestions from GitHub Copilot to be more helpful than females (M = 5.70, SD = 1.82) and males believed that GitHub Copilot is more useful in the workplace (M = 5.90, SD = 1.50) than females (M = 5.33, SD = 1.98). Males also believed that it would benefit them from knowing something about GitHub Copilot (M = 5.83, SD = 1.63), more than female students (M =

5.04, *SD* = 2.28), and males believed GitHub Copilot could benefit inexperience programmers more (*M* = 5.93, *SD* = 1.65), compared to females (*M* = 5.15, *SD* = 1.98). Finally, males (*M* = 5.79, *SD* = 1.52) thought the visualizations created with code suggestions could help to illuminate underlying patterns in data from a wide variety of sources more, compared to females (*M* = 5.52, *SD* = 1.60), and males (*M* = 5.72, *SD* = 1.44) believed that AI tools like GitHub Copilot are relevant to their disciple, more than females did (*M* = 5.00, *SD* = 2.09).

Majors and GitHub Copilot

To investigate whether the perceptions of GitHub Copilot differed between student majors, a one-way ANOVA was conducted. Student majors were grouped into Accounting, Entrepreneurship, Finance, Marketing, and the Management group (which included Business Law, Hospitality and Tourism, Management, and Sport Management). Because there was only one respondent majoring in CIS, this respondent was included in the separate group labeled "Other". The one-way ANOVA results indicated no statistically significant differences, overall, in the ease of use [$F(5, 50) = 1.33$, $p = .269$] or relevance [$F(5, 50) = 1.03$, $p = .411$] of GitHub Copilot between the student major groups.

Table 2: Frequency Responses for GitHub Copilot Survey Items

	1 = Strongly Disagree	2 = Disagree	3 = Somewhat Disagree	4 = Neither Agree Nor Disagree	5 = Somewhat Agree	6 = Agree	7 = Strongly Agree	
The Use of GitHub Copilot Survey Items								
Learning to use GitHub Copilot in the class was easy for me	8 (14%)	6 (11%)	2 (4%)	5 (9%)	14 (25%)	12 (21%)	9 (16%)	
I find it easy to use GitHub Copilot	9 (16%)	4 (7%)	6 (11%)	5 (9%)	10 (18%)	12 (21%)	10 (18%)	
My interaction with GitHub Copilot was clear and understandable	8 (14%)	3 (5%)	4 (7%)	4 (7%)	10 (18%)	13 (23%)	14 (25%)	
It would be easy for me to become skillful using GitHub Copilot	5 (9%)	4 (7%)	6 (11%)	7 (13%)	3 (5%)	18 (32%)	13 (23%)	
The Relevance of GitHub Copilot								
I found most of the code suggestions from GitHub Copilot to be helpful	3 (5%)	2 (4%)	0 (0%)	8 (7%)	8 (14%)	15 (27%)	24 (43%)	
GitHub Copilot is useful in the workplace	4 (7%)	1 (2%)	2 (4%)	4 (7%)	5 (9%)	18 (32%)	22 (39%)	
Students in my discipline would benefit from knowing something about GitHub Copilot	6 (11%)	2 (4%)	1 (2%)	3 (5%)	8 (14%)	12 (21%)	24 (43%)	
I believe GitHub Copilot can benefit inexperienced programmers	4 (7%)	2 (4%)	3 (5%)	1 (2%)	6 (11%)	20 (36%)	20 (36%)	

	1 = Strongly Disagree	2 = Disagree	3 = Somewhat Disagree	4 = Neither Agree Nor Disagree	5 = Somewhat Agree	6 = Agree	7 = Strongly Agree	
In my discipline, AI tools like GitHub Copilot are relevant	5 (5%)	5 (15%)	7 (15%)	9 (15%)	7 (15%)	34 (35%)	32 (30%)	
The visualizations created with the code suggestions provided from GitHub Copilot can help to illuminate underlying patterns in data from a wide variety of sources	3 (5%)	1 (2%)	1 (2%)	4 (7%)	6 (11%)	24 (43%)	17 (30%)	

Discussion

Generative AI technologies hold great potential for value creation in the business world, and thus many companies are seeking employees with an understanding of AI applications. An overview of the course assignment involving the integration of GitHub Copilot and the generated code and visualizations produced, offers valuable insights into the content development, instruction, and enables new forms of learning. The integration of generative AI tools like GitHub Copilot into information systems courses will hopefully enhance technology literacy and skills across all genders, thus fostering an equitable learning environment where all students can learn to effectively employ AI advancements.

This study's core objective was to better understand students' perceptions regarding the ease of use, utility, and relevance of GitHub Copilot in facilitating code generation for data analysis and visualization tasks. We conclude that the hypothesis H1 was supported, and the findings predominantly indicate a positive reception among students, underscoring the relevance of GitHub Copilot. It was particularly heartening to note the acknowledgement that visualizations crafted using GitHub Copilot's code suggestions could reveal underlying data patterns from diverse sources. This helps to underscore its positive influence of equipping students with essential skills and competencies, thereby fostering enhanced technological literacy across multiple fields. Moreover, the lack of significant differences in perceptions of relevance and ease of use among the different major groups suggests that GitHub Copilot is perceived uniformly across various business disciplines.

However, the study has certain limitations. A notable constraint was the solitary focus on GitHub Copilot, without comparing its relevance and user experience against other generative AI tools, such as Google's Gemini. A comparative analysis could provide more in-depth insights into the strengths and weaknesses of different generative AI tools in educational settings, offering guidance for curriculum development. Another limitation pertains to the timing of the assignment's introduction in the course schedule. The GitHub Copilot assignment was introduced in the second week, contrasting with a later assignment using Tableau which used the same dataset in the eighth week. It's possible that this scheduling could have influenced students' engagement and perceptions of the tool. Future studies might experiment with different sequencing of assignments to better understand the optimal integration of generative AI tools into the curriculum.

These limitations notwithstanding, the study's findings contribute valuable insights into the potential of generative AI tools like GitHub Copilot to enrich business information systems courses. They also

underscore the importance of ongoing research to address gender disparities in technology adoption and interaction, ensuring equitable access to and benefits from such AI technologies. Future research could expand on this work by exploring a broader range of generative AI tools, diversifying the timing and context of their introduction, and examining the impact of such tools on different student demographics to foster an inclusive and comprehensive learning environment.

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