



Cross-Continental Insights: Comparative Analysis of Using AI for Information System Stakeholder Analysis in Undergraduate Courses in the EU and USA

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Abstract. The study investigates the use of AI in studying business aspects of software development and project management. Specifically, the research aims to determine how generative AI tools like ChatGPT can be used by students who do not yet have much experience using such tools or have mastered the role of stakeholders and processes such as creating a stakeholder register or engagement plan to involve them effectively. Unique approaches were considered to assess the student's use of AI, including collaborating with instructors at different universities. The research provides valuable insights about integrating AI for educational purposes, how AI can effectively augment the learning process, and documents how students using AI were more productive than the control group not using AI. However, our research reveals that students believe their work is more relevant and of better quality.

Keywords: Generative Artificial Intelligence (AI) · Information Seeking · Learning process · AI · Software Development · Project Management · Education · Stakeholder Analysis

1 Introduction

With the advent of generative artificial intelligence (AI) technologies, including the introduction of tools like ChatGPT in late November 2022, educators and professionals across various fields are increasingly interested in exploring the role and impact of AI in educational settings. With its ability to produce content in diverse forms such as text, images, audio, and software code, AI can potentially transform business and education. Despite varied opinions about these technologies' opportunities, benefits, and drawbacks, disregarding or restricting AI in educational contexts would be unwise.

There has naturally been substantial interest in this area. The topic of generative AI and education has gathered scholarly attention. A recent research paper offers a detailed analysis of generative AI in education by reviewing 207 research papers; the findings include bibliometric analysis and document the notable rise of tools like ChatGPT, underscoring AI's growing influence and potential to revolutionize educational practices [1].

After a year of alarm and caution, we believe that educators have now concluded that integrating AI into curricula is an excellent strategy, especially in some subject areas that align with the capabilities of AI tools. The following domains align well with the capabilities of generative AI [2]:

- Explaining Concepts
- Communication
- Creativity, Brainstorming, and Decision-Making
- Rehearsing and Role-Playing
- Summarizing and Reporting

Having taught web design and programming for over two decades, it is interesting to see the evolution of teaching tools from a plain notepad as a code editor and IDEs (Integrated Development Environments) to the use of AI tools for teaching programming. A book by Vissar [3] teaches readers how to develop unique websites using ChatGPT. Even without prior coding experience, students learn to leverage AI technologies to develop web design skills. The book covers the basics of web design, HTML, and CSS and guides readers through setting up their system for web projects. It advances to creating dynamic, multi-page websites with interactive features using JavaScript. Similar books are available to teach Python with AI. A book by Porter and Zingaro [4] teaches readers how to leverage the AI coding assistant Copilot to create functional Python programs, even for those without coding experience. This resource uses AI tools and teaches crafting prompts for Copilot to read and comprehend Python code, test programs, and fix code issues. Students who use AI tools will likely be more productive than students who are told to ignore AI.

2 Background and Motivation

Integrating generative AI into software development education is an important topic of interest for many researchers. For example, the paper by Petrovska et al. [5] explores a structured approach to incorporate AI in a program of study. It presents examples of formative and summative assessments investigating various aspects of ChatGPT, including its coding capabilities, its ability to construct arguments, and the ethical issues associated with using ChatGPT and similar tools in education and the workplace. The innovative use of ChatGPT in education is also being researched [6] in other environments. In her paper, Adair notes that generative AI technologies can transform teaching and learning methods [7]. Several studies have commented on how generative AI can be used in education and software development [5, 8]. We believe that capabilities such as generating text and summarizing information can save time taken to complete student assignments and projects and improve the results of students' written assignments.

AI can enhance students' assignments by introducing innovative, creative elements, broadening their knowledge base, and enriching the outcomes. Instead of sifting through numerous web pages, social media platforms, blogs, or other sources, students can leverage AI tools that synthesize vast amounts of information and provide targeted suggestions directly relevant to their queries.

Students are also anxious about the influence of AI on their learning. A recent paper states, "Students are concerned about actual learning and whether critical thinking skills can be successfully acquired when AI-based tools are used to generate essays. The survey reveals that student reaction ranges between acceptance to rejection" [9].

Another paper [10] investigates the integration of ChatGPT in educational settings, particularly for software programming courses. It highlights ChatGPT's potential to support education by generating human-like responses and facilitating learning through various applications like code suggestion, problem-solving, and interactive learning tools. However, this paper also raises concerns about students becoming overly reliant on AI, which may impede their understanding of fundamental programming concepts and promote passive learning habits. Yet, there was also apprehension about potential drawbacks such as undermining problem-solving skills and the risk of fostering an overdependence on technology solutions. The study underscores the need for a balanced integration of AI tools like ChatGPT in education, ensuring they complement rather than replace traditional learning methods, promoting sustainable educational practices and deeper learning engagements. As such, there is a need to survey whether faculty and student perceptions of AI have evolved in the past year.

In this paper, we research the "creativity, brainstorming, and decision-making" aspect of computing students' education at the undergraduate level. We seek to examine how AI can be integrated into courses that focus on the critical people aspects of software development, specifically addressing the needs and interests of the stakeholders involved. Project leaders must identify all stakeholders successfully, rank and classify them, and identify how they should be engaged. Stakeholders play an important role when the requirements for a new software application are established. Undergraduate computer science students, especially those without practical working experience, usually find such tasks more difficult because they lack real-world experience. They might miss some key stakeholders, resulting in a project being challenged or outright failure. Our research aims to investigate how generative AI can help in this direction.

We conclude by addressing the topic of hallucination with AI and research being done to manage such risks. In the context of AI, "hallucination" refers to instances when an AI model generates information or content that is not based on input data, training data, or real-world facts. This can occur in various forms, such as creating false facts, inventing details, or producing nonsensical or misleading outputs. Hallucinations in AI are particularly problematic in applications requiring accuracy and reliability, such as programming, medical diagnosis, legal advice, or other scenarios where factual reporting is needed. This topic is addressed widely, but research is being conducted widely to manage hallucinations. For example, recent research [11] describes statistical approaches such as entropy to measure uncertainty in the AI's responses, focusing on the overall meaning rather than specific words.

3 Research Methods

For our study, we followed a structured approach to collect data by designing an instrument to collect data from surveys in two undergraduate courses at Boston University (BU) – USA, and Sofia University St Kliment Ohridski (SU) – Faculty of Mathematics and Informatics Bulgaria. These courses are Project Management (BU) and Information Systems Analysis and Design (SU). They were chosen because they have several common properties.

Both courses discuss the same topic – the role of stakeholder software development and their needs, expectations, and requirements about the newly developed software system. Both courses use team projects as a part of the educational process. Stakeholder analysis is an essential task for student projects.

Considering that the inclusion of tasks requiring AI should be done consistently without breaking the coherence of the tasks for the whole project and contradicting the course's objectives, we carefully chose the tasks where AI could be used.

The tasks selected for using AI involve identifying stakeholders and methods for gathering requirements, analyzing their needs, and designing solutions that align with these requirements. By integrating AI into these tasks, students can leverage AI tools to understand stakeholder roles and interactions, generate user stories, and create requirement documents. This approach enhances the realism of the project scenarios and provides students with practical experience in using advanced technology to facilitate software development processes.

Additionally, AI aids in visualizing software designs and predicting stakeholder reactions to various features, which can significantly improve the iterative design process. By enabling students to perform detailed stakeholder analysis and requirement gathering with the help of AI, both courses aim to cultivate a deeper understanding of the practical challenges in software development, preparing them for real-world scenarios in their future careers.

3.1 Courses Description

Here, we briefly describe the courses used to compare the results of using AI for our research purposes.

Project Management

The first course researched is an undergraduate course in project management in the USA with a mix of local working professionals and international students. It is a required course in the undergraduate management program. This introductory course on Project Management provides a comprehensive foundation in the key elements of managing projects effectively within diverse environments and industries. Students will explore the socio-cultural and technical dimensions essential to successful project management. Topics covered include the strategic alignment of projects with organizational goals, detailed planning and scheduling techniques, and project management software to enhance practical skills. Through a blend of theoretical insights and hands-on application, participants will delve into socio-cultural considerations such as leadership styles,

cultural differences, and conflict resolution, alongside mastering technical tools like network scheduling, critical path analysis, and the earned value method. By the end of the course, students will be equipped with the knowledge and skills to plan, control, and execute projects efficiently, ensuring a competitive edge in the global marketplace. This course is experiential and particularly beneficial for those looking to strengthen their leadership capabilities and technical acumen in project management.

The target audience that used AI to do project work comprised four teams of 28 students. These students were developing websites for the health sector, specifically targeting specialty divisions. Some preliminary conversations occurred collectively.

Information Systems Analysis and Design

The second course in our research is “Information Systems Analysis and Design”. It is a compulsory third-year subject in the undergraduate Information System program at the Faculty of Mathematics and Informatics, Sofia University St Kliment Ohridski. The curriculum focuses on the object-oriented method for system analysis and design. Most of the course involves project-based learning involving requirements analysis and initial system design using UML diagrams. A key aspect of these projects is identifying stakeholders and selecting effective communication methods to gather their requirements accurately, which is vital for project success.

This academic year, six teams participated in projects, with half using AI technologies and the other half not. The teams employing AI focused on the following project topics:

- Information System for Casting in Films and Series in Bulgaria
- Information System for Film Festivals
- Information System for Music Talents Discovery

Within each of the three AI-utilizing teams, some students applied AI to identify stakeholders but did not use AI to determine communication methods. Conversely, others used AI to establish communication methods with stakeholders but did not apply AI to identify the stakeholders or their needs. 26 students worked on these three projects, and 24 used generative AI.

3.2 Project Tasks and Activities

Unique innovations attempted within stakeholder analysis exercises – measuring productivity differently.

At the Team level – one team uses AI, and the other does not. This comparison covered aspects such as:

- Efficiency in Task Completion: Measure the time taken for stakeholder identification and requirement gathering.
- Quality of Output: For example, evaluate the comprehensiveness and accuracy of the UML diagrams and system designs. Or the quality of stakeholder register and engagement approaches.
- Innovativeness of Solutions: Assess the creativity and utility of the solutions proposed by the AI-utilizing teams versus the non-AI teams.

At the individual level, students could identify additional stakeholders and document the best ways to engage with them. This involves:

- **Mapping New Stakeholder Profiles:** Use AI to analyze data and predict potential stakeholders not initially recognized.
- **Engagement Strategies:** Develop personalized communication strategies for different stakeholder groups.

3.3 The Survey

The purpose of the survey is to check how students use AI to perform their tasks and how they themselves evaluate the result of its use. It consists of 6 questions. Four of the questions use a 5-point scale for each question; the others require short answers. There is a separate section for additional comments.

4 Survey Results and Comments

The survey was conducted at Boston University (BU) and Sophia University (SU). It yields several conclusions regarding the use of AI in project tasks. In this section, we describe the survey and results first.

- 1) On a scale of 1–5, how would you rate the ease of creating the assigned task with AI?
 - **Difficult:** Requires significant effort and expertise to complete. Challenges are frequent, and solutions are not readily apparent.
 - **Challenging:** Moderately hard to accomplish; requires good skill and effort. Occasional assistance might be necessary.
 - **Manageable:** Requires some effort but is generally straightforward. The task can be accomplished with a fair amount of ease and occasional challenges.
 - **Easy:** Simple to perform with minimal challenges. Skills and resources are adequately sufficient to complete the task smoothly.
 - **Very Easy:** Requires very little effort or skill to complete. Solutions are obvious and can be executed quickly and efficiently.

| Question 1 | Q1 -1 | Q1 - 2 | Q1 - 3 | Q1 - 4 | Q1 - 5 |
|--------------------|-------|--------|--------|--------|--------|
| BU students | | | 10 | 10 | 8 |
| SU students | | 2 | 15 | 7 | |

- 2) On a scale of 1–5, how confident are you about the quality of the work created by AI?
 - **High Quality:** The output is excellent, accurate, and highly relevant. It consistently meets or exceeds expectations with precise and valuable information.
 - **Good Quality:** The output is reliable and generally accurate, with minor discrepancies or areas for improvement. It meets expectations with only occasional adjustments needed.

- **Moderate Quality:** The output is acceptable but may lack detail or accuracy in some areas. It serves the basic requirements but could benefit from further refinement.
- **Low Quality:** The output often contains errors or irrelevant information. It requires significant corrections or oversight to be useful.
- **Poor Quality:** The output fails to meet basic standards of accuracy or relevance. It is consistently flawed and requires extensive modification to be of any use.

| Question 2 | Q2 - 1 | Q2 - 2 | Q2 - 3 | Q2 - 4 | Q2 - 5 |
|-------------|--------|--------|--------|--------|--------|
| BU students | 1 | 7 | 14 | 4 | 2 |
| SU students | | 4 | 18 | 2 | |

3) On a scale of 1–5, If you used AI, did it help in completing the task faster?

- **Same Time:** AI integration did not alter the speed of completion. Tasks take as long as they would without AI assistance.
- **Twice as Fast:** AI has helped in doubling the speed of task completion. Tasks that normally take a certain amount of time can now be completed in half that time.
- **Three Times Faster:** The use of AI has tripled the speed of completion compared to performing tasks manually. Efficiency is significantly improved, with tasks being completed three times as quickly.
- **Four Times Faster:** AI assistance has quadrupled the speed of completion. Tasks are completed with remarkable speed, taking only a quarter of the usual time.
- **Five Times or Higher:** AI dramatically accelerates task completion, making processes five times faster or more. The speed increase greatly surpasses standard expectations.

| Question 3 | Q3 - 1 | Q3 - 2 | Q3 - 3 | Q3 - 4 | Q3 - 5 |
|-------------|--------|--------|--------|--------|--------|
| BU students | 2 | 10 | 9 | 6 | 1 |
| SU students | 4 | 11 | 5 | 1 | 3 |

4) For those who used AI, approximately how long did it take you to complete your activity? (eg. 1 h, etc.)

| Question 4 | Up to ½ hour | 1 hour | 1 ½ hours | 2 hours | 2½ hours |
|-------------|--------------|--------|-----------|---------|----------|
| BU students | 10 | 18 | | | |
| SU students | 10 | 10 | 1 | 2 | 1 |

5) For those who didn't use AI, how long did it take you to complete your task? (eg. 1 h, etc.)

| Question 5 | 1 hour | 1 ½ hours | 2 hours | 3 hours | 4 hours |
|-------------|--------|-----------|---------|---------|---------|
| BU students | | | 12 | 10 | 6 |
| SU students | 1 | 9 | 7 | 2 | 6 |

6) Would you be interested in using AI for future projects?

- **Definitely interested:** I see significant potential in using AI and actively seek opportunities to incorporate it into my projects.
- **Probably interested:** I am open to using AI and would consider it based on its relevance and benefits to the project.
- **Neutral:** I am indifferent and need more information to make a decision.
- **Probably not interested:** I have reservations about using AI and would be hesitant unless it shows clear advantages.
- **Definitely not interested:** I do not see a benefit in using AI for my projects and prefer not to use it.

| Question 6 | Q6 -1 | Q6 -2 | Q6-3 | Q6 -4 | Q6 -5 |
|--------------------|-------|-------|------|-------|-------|
| BU students | 10 | 16 | 2 | | |
| SU students | 4 | 19 | 1 | | |

Here are the comments from the survey conducted at the two locations:

1. Ease of Creating Tasks with AI:

- BU: The responses are evenly spread across ‘Difficult’ to ‘Manageable’, with no reactions indicating tasks being ‘Easy’ or ‘Very Easy’.
- SU: Most found it either ‘Difficult’ or ‘Challenging,’ indicating somewhat more difficulty than BU.

2. Confidence in AI’s Work Quality:

- BU: The majority perceive the quality as ‘Moderate,’ followed by ‘Good.’ Only a few found the quality either ‘High’ or ‘Poor’.
- SU: Most rated the quality as ‘Good’, with a substantial number finding it ‘High’, suggesting a more positive perception than BU.

3. AI’s Impact on Task Completion Speed:

- BU: The responses show a perception of moderate speed improvement, ranging primarily between ‘Twice as Fast’ and ‘Four Times Faster’.
- SU: The perceptions are less favorable than BU, with most indicating only ‘Twice as Fast’ or less.

4. Time Taken to Complete Activity with AI:

- BU: Most completed their tasks within 1 h when using AI.
- SU: The completion times are varied, with most completing within 1 h, and a few taking up to 2½ hours.

5. Time Taken to Complete Activity without AI:

- BU: Those not using AI took longer, with times ranging from 2 to 4 h.
- SU: Completion times ranged from 1½ to 4 h, indicating that tasks generally took longer without AI.

6. Interest in Using AI for Future Projects:

- BU: Most are interested ('Definitely' and 'Probably'), indicating a strong inclination towards integrating AI in future projects.
- SU: Interest is also high, with most being 'Probably interested', though slightly less enthusiastic than BU.

These results suggest that while there are some challenges and reservations about the quality and effectiveness of AI, there is also significant interest and perceived benefits in using AI for tasks at both locations, with SU being slightly more critical in ease and quality but equally interested in future use. The results are comparable, regardless, and the differences are attributable to students completing different projects at the two universities. The results suggest that AI significantly reduces the time required to complete tasks, enhancing efficiency.

5 Analysis

When comparing the roles of students and AI in developing information systems for the film and music industry and implementing a specialty care website for a fictional Caesar's clinic, it is clear that their contributions are both unique and complementary. Below, we present a table of findings (Table 1).

The following is a detailed analysis:

1. Role of Students Vs. AI

- Students are crucial in directly engaging with stakeholders, such as casting agencies, actors, healthcare professionals, and web developers. They provide a detailed, contextual understanding to meet specific needs. For example, in healthcare website development, students identify and address the needs of healthcare professionals, patients, developers, legal experts, and content creators.
- AI, like ChatGPT, excels at rapidly aggregating data to identify stakeholders and their general needs. However, AI may lack the depth to fully grasp sector-specific nuances. AI can analyze user data to tailor website features and predict stakeholder behaviors, aiding in targeted communications and refinement of real-time engagement strategy. For instance, AI provided creative engagement strategies for an operations manager concerned about a staff replacement by a chatbot.

2. Methods for Extracting Information:

- Students use qualitative techniques like interviews, focus groups, and surveys to gather detailed insights into stakeholders' needs.
- AI enhances efficiency in analyzing large-scale survey data, identifying patterns, and recommending data collection methods. AI can also suggest innovative approaches like focus groups, broadening the methodological toolkit for information systems projects.

3. Innovation and Creativity:

- Students directly engage in the development process, fostering user-focused design through real-time feedback and creative problem-solving.

Table 1. Key Takeaway About Role of AI

| Key Takeaway | Summary |
|--|---|
| Time Efficiency vs. Reliability | Students appreciate AI’s ability to save time. However, concerns exist about the reliability and accuracy of AI-provided information, requiring human oversight and verification. |
| Methodological Adjustments | Some students adapted their interaction method with AI, like compiling all questions into a single prompt, indicating experimentation with strategies to maximize AI utility. |
| Precision and Structuring Information | Concerns about AI’s precision and logical structuring of information. AI generates multiple approaches but sometimes lacks detailed explanations necessary for academic rigor. |
| Role in Learning and Idea Generation | AI is valued for providing new perspectives and aiding learning, serving as a helpful resource for clarifying and validating ideas, enhancing understanding and inquiry. |
| Limitations in Specificity and Accuracy | AI’s performance drops with specific or complex queries. Feedback suggests AI may provide misleading or inaccurate information on specialized topics, requiring cross-verification. |
| Quality of Output and Accuracy Concerns | Mixed opinions on AI’s impact on work quality. Some found AI broadened analytical perspectives and improved task quality, while others saw no change, emphasizing the need for accurate prompts and verification. |
| Strategic Use and Learning Curve | Users highlighted the importance of crafting clear and precise questions to get the best AI results, indicating a learning curve and the need for strategic thinking in AI integration. |
| Task-Specific Benefits and Limitations | For tasks like stakeholder identification, AI introduced unconventional methods and quick, diverse inputs, aiding less experienced users. Caution needed as AI may follow incorrect logic or provide irrelevant information if not properly directed. |

- AI generates creative ideas based on a vast database of existing solutions, requiring human refinement for project-specific alignment. Detailed questions yield better AI responses, aiding in method identification and requirement elicitation.

4. Efficiency and Speed:

- Student involvement extends project timelines due to their learning curve and iterative methods, enhancing learning and product robustness.
- AI boosts productivity by reducing stakeholder identification time from 4 h to 30 min and handling multiple tasks simultaneously. AI generates quick responses and drafts but requires human oversight for final decisions and implementation.

6 Summary

Students play a crucial role in directly identifying and engaging with stakeholders, bringing a detailed and contextual understanding to the process. This hands-on approach ensures a user-centric solution tailored to meet the nuanced requirements of various

stakeholders. In contrast, AI tools like ChatGPT excel at rapidly aggregating and analyzing large volumes of data to provide comprehensive lists of potential stakeholders and their generalized needs. However, this broad overview may lack the depth required to fully grasp certain sectors' unique cultural and operational nuances. Therefore, AI's contributions need further refinement by human agents to ensure relevance and accuracy.

For further research, we plan to use the following approach adapted from [5]. First, we will conduct a professional survey to assess organizational awareness of AI and their interest in using this technology for managing software development projects. Simultaneously, we will run surveys alongside formative assessments for both first and final-year learners to gauge their familiarity with AI, their thoughts on its use in software project management, and potential time savings. First-year learners will analyze pre-generated AI outputs and compare them with their own output, while final-year learners will generate and evaluate applications with extensive use of AI. Finally, an experimental summative assessment will also be conducted to evaluate first-year learners' understanding of AI, covering its capabilities and limitations.

7 Conclusions

This paper describes the practical effects of employing AI, including enhanced speed and productivity, while emphasizing the need for human involvement to ensure accuracy. Merging these abilities can boost opportunities for project success. This is an opportunity for further research. For instance, Salman Khan's best-selling book "Brave New Words" delves into the transformative impact of artificial intelligence and education and illustrates how to merge the abilities of humans and AI [12].

Compared with similar research from a year ago, we believe more students acknowledge the benefits of AI in saving time and providing an opportunity to enhance the scope of their work. Therefore, if AI is introduced in courses, we should expect more from students. It provides us an opportunity to enhance the depth of our curriculum. However, we should continue to remain cautious about AI's reliability and introduce processes to validate its outputs carefully. Indeed, while our research validates the advantages of efficiency and broad idea generation within the context of stakeholder analysis assignment, it also emphasizes the need for critical engagement with AI's output to mitigate errors. With the integration of AI in education, we will continue to witness students employ a dual approach—leveraging AI for its strengths while compensating for its weaknesses. With a strong foundational education in software development practices, they will successfully integrate good outputs, eliminate incorrect responses, and provide valuable contributions.

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Appendix: Additional Comments and Insights

Insightful comments were obtained from students when we asked them to document additional comments or feedback on the experiment or the method used. Here are some of them, edited slightly for readability:

- “AI may be a valuable time-saving tool, but it has not yet reached a level where it can provide reliable information. It has benefits, but its output needs to be scrutinized.”
- “Using AI on my task significantly reduced the time it took to complete, but there is definitely more to be desired regarding the accuracy of answers.”
- “Concerning the usage method, I compiled all the essential information and formulated all questions within a single prompt instead of addressing each question individually. This method produces a lengthy prompt but ensures that the entire concept is conveyed in one consolidated presentation.”
- “AI may be imprecise; further studies are needed. The questions must be prompted very carefully to get an accurate answer.”
- “Artificial intelligence has helped us find general information quickly, but it doesn’t do so well if we want something more specific. Also, the information it provides is often not well structured, and there is a need for changes. In my case, the AI listed several possible methods for selecting the requirements but failed to provide a rationale and consistency for their application.”
- “Artificial intelligence has helped us in our work, given ideas we had not thought about or missed. We decided not to implement some of his suggestions.”
- “AI is quite a valuable tool in project development, but I use it mostly actively in learning. I often turn to AI when I need further clarification or to confirm if what I have understood is true.”
- “Artificial intelligence is useful for gathering general information, but when it comes to something more specific, it should always be checked because it starts giving false information that may appear true.”

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