

# AI Tutor: Student's Perceptions and Expectations of AI-Driven Tutoring Systems: A Survey-Based Investigation

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## Abstract

Generative AI (GenAI) and LLMs have started to influence how teachers teach and students learn, including the ones in programming languages and tutoring. However, there have been debates on whether AI could be beneficial to students' learning or not. One way to see this issue is from the perspectives of the students. Therefore, this study explored how students perceive the use of AI in their education. The data was gathered through interviews with 62 students and other stakeholders, such as instructors and IT specialists. The results showed that the students positively perceived using AI as a tutor. Moreover, this study suggests several things to consider when integrating AI tutors for programming. The findings reveal positive student perceptions regarding AI's potential within the teaching-learning process. Students envision AI tutors offering personalized assistance, adapting to individual learning styles, and providing immediate feedback, potentially augmenting their grasp of programming concepts. We applied Statistical analysis, machine learning, and natural language processing techniques such as PCA, t-SNE, LDA, and sentiment analysis.

**Keywords:** AI Tutor, Education, Programming, Generative AI, LLMs, Topic Modeling

## Introduction and Overview

The education field is experiencing significant growth and change, mainly due to rapid advances in artificial intelligence technology. These advancements in AI have the potential to significantly impact and transform the way education is delivered and experienced. AI-powered tutors are emerging as a fascinating and promising option in education. These tutors, powered by artificial intelligence, have the potential to revolutionize the way teaching and learning are conducted. They can personalize the learning experience for each student, tailoring the content and pace of instruction to their specific needs and preferences.

Challenges may include issues such as the need for effective implementation and integration of AI technology into educational systems, concerns about privacy and data security, and potential biases in AI algorithms.

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Satyam (2023) et al. review the challenges and opportunities presented by AI tutoring, necessitating a multifaceted lens that meticulously captures the spectrum of perspectives emanating from professors, students, working professionals, and executives. Our inquiry draws inspiration from seminal work in Chan and Zhou (2023), Duan, Edwards, and Dwivedi (2019), Chen, Chen, and Lin (2020), which emphasizes the importance of stakeholder perspectives in shaping the trajectory of educational technology. Building on their insights, we employ a robust interview strategy, engaging with 62 participants in the aforementioned stakeholder groups. Guided by Oltmann (2016) in conducting insightful qualitative interviews, we delve into the lived experiences and nuanced perceptions surrounding AI tutoring.

Through this exploration, we aim to: 1) Break down the challenges and opportunities associated with AI tutoring in programming education. 2) Illuminate the various comfort levels and expectations of professors, students, working professionals, and executives toward AI tutor assistance. 3) Uncover the potential benefits and drawbacks of AI tutoring as different stakeholders perceive it. 4) Identify specific areas where AI technology can effectively address learners' and educators' challenges in the programming domain. 5) Provide a framework for developing and implementing AI tutors that resonate with the multifaceted needs and desires of the human learners they serve.

## Proposed Methodology

The goal is a qualitative study exploring student perceptions and expectations of AI tutors for programming. We started with participant recruitment and interviewed stakeholders such as students, some professors, and individuals with condign enthusiasts. The qualitative data then undergoes qualitative and quantitative analysis, potentially involving techniques like dimensionality reduction, topic modeling, and sentiment analysis. Finally, the results are interpreted and used to draw findings and implications. The method architecture proposes a comprehensive approach to understanding student perspectives on AI tutors in programming education.

The quantitative questionnaire comprised around 22 questions related to using AI and AI as a helping tutor for programming. It focused on analyzing students' attitudes, awareness, and behavioral intentions regarding using an AI

Tutor as an ITS to deliver help and guidelines to the students. The students were asked to return their completed questionnaire within 30 days, from September 2023 to November 2023. On average, the questionnaire was completed by students in 5 to 10 minutes. The questions were adapted from similar surveys published in the literature and were validated by the supervisors. **Questions asked by the Interviewee** The questions explore the challenges professors and students face in teaching and learning programming concepts and investigate the potential of AI-powered tutoring systems to address these challenges. Some sample questions asked such as: 'Are you comfortable with having an AI tutor?', 'Are there any limits to the help an AI tutor can provide?', 'How often do you face problems during coding?' 'What is your learning style?', 'Would you be open to having an AI-assisted tutoring system to help you?'. These questions aim to gather information about individuals' experiences, strategies, and preferences in their learning and professional journeys, particularly in coding, skill development, and overcoming challenges.

### Dataset and Interview Structure

Our overall dataset contained 62 semi-structured interviews (15-20 minutes length each) in the form of text and voice recordings spanning a diverse set of stakeholders of students, educators, industry professionals, and leaders in the field of computer science, giving us a rich dataset of 281 question-and-answer exchanges in total. The interviews were then machine-transcribed and manually reviewed for transcription precision, semantic exactness, and syntactical accuracy to ensure each question and answer were conserved in its most authentic state in textual format. The dataset was then pre-processed, parsed, and stored in a structured Large JSON schema to allow for further Natural Language Processing and analysis for sentiment, topic modeling, and critical information extraction.

### Evaluation Results

Our analysis further confirmed our insights on how students perceive using AI tutors for their programming. Moreover, The pedagogical implications of the students' perceptions were also elaborated. Our study leveraged practical statistical machine learning and natural language analysis, such as principal components analysis(PCA), t-SNE (t-distributed Stochastic Neighbor Embedding), Latent Dirichlet Allocation (LDA), and sentiment analysis to explore the students and interviews perspective toward using AI as a tutor for programming.

The PCA analysis reveals fascinating insights into students and other participants' preferences for AI-based tutoring systems. The data points in the scatter plot represent individual students, and their positions along the principal components (axes) reflect their attitudes toward different aspects of AI tutoring. For example, students near the top of the graph may prioritize the accuracy and effectiveness of AI tutors. At the same time, those on the right side may be more concerned about the potential negative impacts of AI on human interaction and learning.

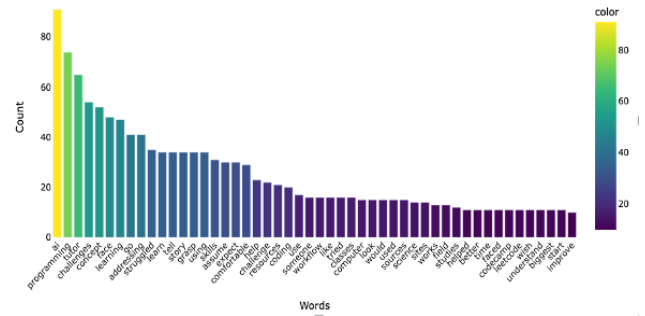


Figure 1: Top most common words among in answers dataset

### Conclusion

Studying and analyzing the interviews conducted among the stakeholders in computer sciences to explore the use of AI Tutor for programming, we examined the factors that impact students' behavior and attitudes toward using AI Tutor. The interview was conducted among 62 participants, and as a result, a feature-rich corpora of questions and interviewee answers were curated in the form of text data. We conducted NLP techniques such as PCA, LDA, t-SNE, and sentiment analysis to explore the data. We found that the CS students who participated in this study showed positive perceptions towards using AI Tutors ITS for programming and coding. The study reported that the AI tutor could help them comprehend the theoretical ideas, support them during the coding approach, and help them understand the syntax and language terminology in their coding. Future research could focus on understanding the factors influencing students' perceptions of AI tutors, such as their prior knowledge and experience with AI technologies.

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