



Medienimpulse
ISSN 2307-3187
Jg. 63, Nr. 2, 2025
doi: 10.21243/mi-02-25-15
Lizenz: CC-BY-NC-ND-3.0-AT

The implementation of AI tutors for advancing students' research skills

Larissa Neuburger

Ilona Pezenka

Melanie Dejnega

Evelyn Fränzl

Artificial Intelligence (AI) is transforming higher education, enhancing learning for students and providing new tools for lecturers and thesis supervisors. Despite challenges, AI has the potential to be a powerful tool for teaching and thesis supervision especially through the facilitation of personalized learning experiences. A persistent issue in thesis supervision is the quality of students' work and their competencies in research methods, particularly in quantitative research. A quantitative study with external lecturers and supervisors identified significant gaps in students' methodological skills. Based on these findings, this pa-

per proposes a guideline for integrating AI into the process of thesis supervision. The guideline outlines how an AI tutor can support students in key tasks such as developing purpose statements and research questions while offering personalized guidance throughout the research process, ultimately improving research quality and student learning outcomes.

Künstliche Intelligenz (KI) verändert die Hochschulbildung grundlegend, indem sie sowohl das Lernen für Studierende als auch die Betreuung von Abschlussarbeiten durch neue didaktische Werkzeuge unterstützt. Trotz bestehender Herausforderungen bietet KI Potenzial für die Personalisierung von Lernprozessen. Ein zentrales Problem in der Betreuung von Abschlussarbeiten sind Defizite in den methodischen Kompetenzen der Studierenden, insbesondere im Bereich der quantitativen Forschung. Eine quantitative Studie mit externen Lehrenden und Betreuenden ergab Lücken bei den Studierenden gerade in diesen Kompetenzen. Auf Basis der Ergebnisse wird in diesem Beitrag eine Guideline zur Integration von KI in Betreuungsprozessen entwickelt. Das Resultat zeigt, wie ein KI-Tutor Studierende bei der Entwicklung von wissenschaftlichen Problemstellungen und Forschungsfragen unterstützen kann sowie individuelle Hilfestellungen im Forschungsprozess bietet, um die Qualität wissenschaftlicher Arbeiten zu verbessern.

1. Introduction

Artificial intelligence (AI) has rapidly transformed higher education, with the outlook to enable personalized and efficient learning (Brandhofer et al. 2024). However, despite technological advancements and the implementation of various support measures by universities, university lecturers and thesis supervisors continue

to face challenges concerning the quality of students' academic work and their competencies, particularly in research methodology.

AI-supported e-learning courses were developed, as part of the funded research project 'City of Vienna Competence Team Master Propaedeutics – Bridge Courses in Research Skills & Methods' (funded by the City of Vienna MA23), that are aimed at strengthening students' research skills and learning experience. To inform and substantiate the design of these courses, a survey was conducted among external lecturers at the university to gather their perceptions of students' methodological competencies and learning needs. The results revealed gaps in students' competencies in research methodology especially when it comes to the quantitative research process and hence provided valuable insights into common challenges in students' research practice and thus served as a foundation to structure thematic priorities of the course. The specific e-learning course on quantitative research methods constitutes the first module of a broader initiative in which further AI-enhanced learning units are planned across various domains where such support is pedagogically meaningful.

Based on the data of this study, the aim of this paper is the development of an AI-supported e-learning course guideline, leading students through the research process as part of the 'City of Vienna Competence Team Master Propaedeutics – Bridge Courses in Research Skills & Methods'. This project includes more than 60 self-paced and interactive e-learning modules focusing on the

three areas of research methods: (1) foundations of research methods, (2) qualitative research and (3) quantitative research. AI tutors were integrated into several e-learning chapters where it didactically made sense. The e-learning courses were designed as a theoretical foundation covering the most important topics within the field of research methods in order to be used as a 'bridging course' for incoming master students as well as online resources for bachelor and master courses. In addition, the e-learning material can be used by thesis supervisors to guide students throughout the final thesis process with targeted content. The AI tutor is used as a support for students to deepen their understanding with practical exercises as well as with interactive assistance and targeted feedback for crafting a purpose statement, developing a research design as part of their supervision process for their final thesis. In addition, the AI tutor was prompted in a way that it engaged in an interactive dialogue to enhance students' critical thinking abilities.

This project fits within the scope of human-centered technologies by addressing needs in education through AI-driven solutions that prioritize personalized support and accessibility for students and instructors alike. Hence, this project explores the development and implementation of AI and its impact on students' competencies and lecturer satisfaction, aiming to bridge competency gaps and improve teaching and learning in higher education. Furthermore, this paper suggests a guideline for an AI guided research

process that will be further tested in the ongoing advancement of this project.

2. Background

AI in education is a rather new phenomenon and is altering the way students learn, how lecturers teach and how both work together. When referring to AI in education, literature mostly focuses on AI supported tutors, chatbots and assessment systems (Chiu et al. 2023; González-Calatayud et al. 2021; Luckin 2017). Hereby AI in education can be classified into four different categories (Chiu et al. 2023): (1) Personalized learning tasks, (2) Human-Machine-Interaction (HCI) and conversations, (3) real time feedback and automated assessment and (4) adaptive learning environment through learning analytics and student data. The implementation of an AI tutor as part of an e-learning course is therefore focusing on (2) HCI whereby also the creation of an adaptive learning environment (4) and personalized learning tasks (2) are being planned for the project in the future.

The integration of AI tutors within the scope of teaching aligns with prior research. Imran and Almusharraf (2023) highlight the role of chatbots as aids and facilitators for both learners and instructors, emphasizing their potential to ease and support the academic process. Wu and Yu (2023) and Albdarani and Al-Shargabi (2023) showcase how AI chatbots improve learning outcomes through personalized support. Sandu et al. (2024) highlight the characteristics of AI to enable personalized learning experiences

and on demand feedback. Fuchs and Aguilos (2023) discuss how students value personalized AI learning experiences. Furthermore, AI is especially useful for higher education as it has the potential to support students in a more reflective learning and critical thinking process (Guo & Lee 2022; Sandu et al. 2024). Together, these studies underline the transformative potential of AI tools in education.

One of the biggest potentials of AI in education can be seen in the enhancement of higher education by enabling personalized experiences with real-time feedback (Chiu et al. 2023). This can be facilitated through a better understanding of students' learning processes that can be traced through learning analytics. In addition, Baillifard et al. (2023) and Chen et al. (2022) underline AI's ability to enhance learning by applying principles of education sciences and offering responsive assistance. Also from a learning outcome perspective, students were seen to be more motivated and engaged and felt more confident with the AI learning support (Chiu et al. 2023; Fu et al. 2020).

3. Methodology

The aim of this paper is to propose a guideline for how to integrate AI into digital teaching practices in order to enhance students' quantitative research skills and improve the thesis supervision process. The guideline is supported by data that was collected at the beginning of the project. Hence, in a first step, a quantitative online survey was conducted to examine lecturers'

evaluation of their students' research methods skills. The survey was developed and sent out to external lecturers and thesis supervisors of all study areas of the university in May 2024 ($n = 86$). The questionnaire included questions on the skills of students as perceived by the lecturers in the areas of (1) basic research skills, including academic writing, citing and scientific arguing, (2) qualitative research methods and (3) quantitative research methods (measured on a scale from 1 = fully satisfied to 5 = not satisfied). In addition, lecturers were asked in which areas they would like more material or support. Based on the findings, the next step was to define key areas for the content of the e-learning course. The whole quantitative research process, i.e. developing research questions and hypotheses, planning a research design, formulating a purpose statement, etc., emerged as a problematic area, with students struggling significantly in these aspects. As a result, the specific e-learning chapter 'Quantitative Research Process' is used as a prototype for testing out the application of AI tutors in appropriate contexts. Students are guided through the entire quantitative research process by the AI tutor.

4. Results

Results of the survey showed the distribution of applied research methods among bachelor and master theses. Only 36 % of students apply quantitative research methods, while more than half of students (55 %) use qualitative methods for their final theses

(with 9 % other forms of final papers such as e.g. project reports, etc.).

Results from the survey showed that lecturers are mostly satisfied with students' skills of citation of research ($M = 2,13$, $SD = 0,76$) and applying qualitative research methods ($M = 2,52$, $SD = 0,82$). Supervisors and lecturers are less satisfied with students' methodological competence in general ($M = 2,75$, $SD = 0,84$), the design of quantitative questionnaires ($M = 2,75$, $SD = 0,86$) as well as academic writing ($M = 2,79$, $SD = 0,82$). However, thesis supervisors and lecturers are least satisfied with students' skills of deducting research questions and hypotheses ($M = 2,82$, $SD = 0,92$), applying quantitative methods for their thesis ($M = 3,08$, $SD = 0,87$), using statistics for the analysis ($M = 2,96$, $SD = 1,02$) and the interpretation and discussion of their results ($M = 2,93$, $SD = 0,88$). The survey results thus indicate that the issues are primarily found in the domain of quantitative methods, particularly in relation to planning a quantitative design. Building on these data that revealed gaps in students' research competencies (see Table 1), this paper proposes a guideline for AI-driven support in the thesis supervision process (Figure 1), that indicates when and for what specific tasks, during the research process, an AI tutor can provide meaningful support to the students. The guideline is designed to guide students through each stage of their quantitative research process, starting with their initial research problem. At each step, students first receive theoretical input from the e-learning course.

At different points throughout the course, students are encouraged to engage in discussions about specific questions with the AI tutor. For example, to guide the students through the development of specific hypotheses, the AI tutor 'Karl' was created. Students were instructed in the e-learning course as follows to start the conversation with the AI tutor:

Now start a discussion with the chatbot Karl and develop a specific research question and hypotheses for the project 'Influencing factors on the purchasing behavior of sustainable and healthy products.' Each one of the AI tutors was named after famous personalities from the world of science and presented accordingly. For instance, the AI tutor 'Karl' was introduced as "Karl is named after Karl Popper (1902–1994), who is considered one of the most important theorists of science. He developed the principle of falsification, which states that scientific hypotheses can be disproved by experiments, but never definitively proven.

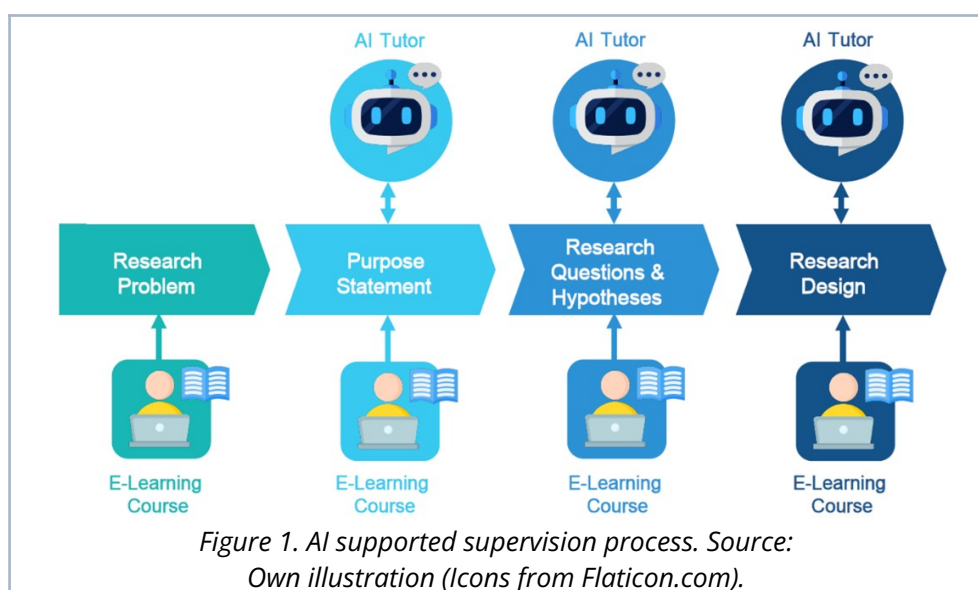
<i>Variable</i>	<i>Mean</i>	<i>Standard Deviation</i>
General methodological skills	2.75	.843
Qualitative methods	2.52	.822
Academic writing	2.79	.819
Academic discourse	3.22	.922
Establishing research questions and hypotheses	2.82	.922
Statistics/data analysis	2.96	1.019
Citations	2.13	.763
Constructing questionnaires	2.75	.856
Interpretation & discussion	2.93	.880
Quantitative methods	03.08	.868

Table 1. Lecturers' evaluation of their students' research methods skills

Based on the iterative development of the e-learning course and the implementation of AI tutors, three key stages were identified in which AI support is particularly beneficial. These stages serve as the conceptual backbone of the guideline for integrating AI tools into the supervision of student research projects. In this regard, the AI tutors provide targeted feedback and assistance along these steps: (1) by helping students craft a clear and structured purpose statement (chatbot Marie, named after Marie Curie), (2) support in developing research questions and hypotheses (chatbot Karl), and finally (3) assisting with the research design phase (chatbot Rosalind, named after Rosalind Franklin). The AI tutors were instructed to guide the student to a solution with specific questions and never present a ready-made solution to enable students' critical thinking. To support the transfer of methodological knowledge to students' own research projects, the chatbot dialogues were designed to offer two complementary options: (1) the opportunity to work through example-based exercises, and/or (2) to apply discussed topics and solutions to their own thesis or research question. This dual approach aims to foster both conceptual understanding and direct application, encouraging students to actively engage with their individual research projects throughout the learning process.

Hence, by addressing identified challenges in students' understanding and execution of a quantitative research process, the proposed guideline (Figure 1) offers a systematic, personalized approach to enhance thesis supervision, improve student outco-

mes, and bridge existing gaps in research skills. The development process of the e-learning course, including the integration of AI-based chatbots, served as the foundation for deriving the guideline for AI-supported supervision in the research process. Through the iterative design and the implementation of AI into the course, a structured approach emerged that identifies key phases in which AI tools can meaningfully support students in developing their research projects. Thus, the resulting guideline is not merely illustrated by the course but has been conceptually derived from its design and application.



5. Discussion and conclusion

The findings of this study highlight specific deficiencies in students' research skills especially when it comes to quantitative research methods and statistics. These gaps suggest the need for

targeted interventions to improve students' skills and better align their self-assessment with academic expectations. The development and implementation of an AI-supported e-learning course, as outlined in this project, directly addresses these challenges by providing personalized and targeted support.

AI tutors are integrated into the learning modules to provide immediate feedback, helping students to improve their learning and thinking process, identify weaknesses and enhance specific skills, such as formulating research questions or conducting quantitative analysis. This is in line with previous research highlighting the potential of AI to improve learning outcomes through personalized guidance (Chiu et al. 2023; Sandu et al. 2024) and immediate feedback (Baillifard et al. 2023; Chen et al. 2022) Through advanced prompting techniques of the AI tutor, students do not only get immediate feedback but are incentivized to critically reflect their proposed research questions and hypotheses and hence improve their critical thinking skills (Guo & Lee 2022).

In addition, the project highlights the added value of human-centered technology in higher education by prioritizing accessibility and adaptability to diverse student needs. By bridging the skills gap, these AI-driven solutions aim not only to improve students' research skills, but also to reduce the burden on lecturers by promoting a more efficient and effective supervisory process.

As part of this project, the proposed guideline of how to integrate AI in the learning process of quantitative research and the implementation of AI tutors will be tested in the context of research

classes and during the process of thesis supervision. Learning analytics will be measured to evaluate the interaction of students with AI and further quantitative studies will be conducted to analyze their learning experience in an online setting with AI. Also, lecturers and supervisors will evaluate the potential change of students' academic performance and their satisfaction with those tools to enhance the thesis supervision process. Furthermore, future research will focus on implementing the e-learning courses and AI tutors and test them with students in different classes and departments throughout the university and analyze students' learning analytics, performance as well as their user evaluation and learning experience. In addition, as part of the research project it is planned to also evaluate the long-term impact of these AI tools on students' academic performance and lecturer satisfaction.

References

- Albdrani, Raneem N./Al-Shargabi, Amal, A. (2023): Investigating the Effectiveness of ChatGPT for Providing Personalized Learning Experience: A Case Study. *International Journal of Advanced Computer Science and Applications* 14(11).
- Baillifard, Ambroise/Gabella, Maxime/Banta Lavenex, Pamela/Martarelli, Corinna, S. (2023): Implementing Learning Principles with a Personal AI Tutor: A Case Study. *arXiv preprint*.

Brandhofer, Gerhard/Gröblinger, Ortrun/Jadin, Tanja/Raunig, Michael/Schindler, Julia (2024): Von KI lernen, mit KI lehren: Die Zukunft der Hochschulbildung. Projektbericht. Norderstedt: Books on Demand.

Chen, Yu/Jensen, Scott/Albert, Leslie J./Gupta, Sambhav/Lee, Terri (2022): Artificial Intelligence (AI) Student Assistants in the Classroom: Designing Chatbots to Support Student Success. *Information Systems Frontiers* 25(1), 161–182.

Chiu, Thomas K./Xia, Qi/Zhou, Xinyan/Chai, Ching Sing/Cheng, Miaoting (2023): Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. *Computers and Education: Artificial Intelligence* 4, 100–118.

Fu, Shixuan/Gu, Huimin/Yang, Bo (2020): The affordances of AI-enabled automatic scoring applications on learners' continuous learning intention: An empirical study in China. *British Journal of Educational Technology* 51(5), 1674-1692.

Fuchs, Kevin/Aguilos, Veronica (2023): Integrating Artificial Intelligence in Higher Education: Empirical Insights from Students about Using ChatGPT. *International Journal of Information and Education Technology* 13(9), 1365–1371.

González-Calatayud, Victor/Prendes-Espinosa, Paz/Roig-Vila, Rosabel (2021): Artificial intelligence for student assessment: A systematic review. *Applied sciences* 11(12), 54-67.

Guo, Ying/Lee, Daniel (2023): Leveraging chatgpt for enhancing critical thinking skills. *Journal of Chemical Education* 100(12), 4876–4883.

Imran, Muhammad/Almusharraf, Norah (2023): Analyzing the Role of ChatGPT as a Writing Assistant at Higher Education Level: A Systematic Review of the Literature. *Contemporary Educational Technology*, 15(4), ep464.

Luckin, Rose (2017): Towards artificial intelligence-based assessment systems. *Nature Human Behaviour*, 1(3), 0028.

Sandu, Raj/Gide, Ergun/Elkhodr, Mahmoud (2024): The role and impact of ChatGPT in educational practices: insights from an Australian higher education case study. *Discover Education*, 3(1), 71.

Wu, Rong/Yu, Zhonggen (2023): Do AI chatbots improve students' learning outcomes? Evidence from a meta-analysis. *British Journal of Educational Technology*.