

**ARTIFICIAL
INTELLIGENCE in
EDUCATION**

**Editors:
Prof. Veysel BOZKURT
Dr. Dheeba MOOSA**

First Edition

Artificial Intelligence in Education

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TESAM Publications No: 69



ISBN: 978-625-6148-46-8

E-ISBN: 978-625-6148-47-5

DOI: 10.17574/tesam.9786256148468

1st Edition, April 2025

Lider Sancak Akademi Kitaplığı

It is recommended that a reference to the DOI is included when citing this work.

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Editor-in-Chief: Muhammet Aydođan
Publication Coordinator: Ferzan Tařpınar
Page Design: A. Muhammed Tařpınar
Cover Design: Neslihan Trkkan
Cover Editing: Fethiye Akarcalı

Library Information Card

Bozkurt, Veysel - Moosa, Dheeba
Artificial Intelligence in Education / Veysel Bozkurt, Dheeba Moosa
1st Edition, 226 p., 13,5x21 cm. Bibliography available, no index.
ISBN: 978-625-6148-46-8
E-ISBN: 978-625-6148-47-5
DOI: 10.17574/tesam.9786256148468
1. Artificial Intelligence 2. Education 3. Academic

General Distribution

Lider Sancak Eđitim Akademisi
Tel : +90 506 188 93 92
Kçkbakkalky Mah. Kayıřdađı Cad.
Bilgi Plaza No: 111/8 İstanbul/Atařehir
www.tesamyayinlari.com | tesamyayinlari@gmail.com
TESAM (Center for Economic, Political and Strategic Research)
www.tesam.org.tr
Printing and Binding: Repar Tasarım Matbaa, Yenibosna Merkez Mh. Cemal Ulusoy
Cd. No:43 Bahçelievler/İstanbul (Certificate no: 40675)

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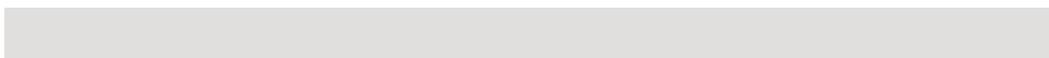
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PREFACE

Humanity is on the verge of a “great transformation” with the introduction of artificial intelligence (AI). AI, once confined to the realm of science fiction, has permeated every aspect of life including education. Today, artificial intelligence technologies are reshaping the educational landscape, revolutionizing and unlocking innovative approaches to teaching and learning, and administration.

This book presents a diverse array of research from Türkiye, the Maldives and Germany, showcasing perspectives from Europe, Türkiye’s crossroads with east and west, and Asia. With insights from these regions, the book embraces a broad spectrum of cultural, technological and educational contexts. This approach underlines the universal relevance and transformative potential of AI in education. The international scope embodied in this book enriches the narrative indicating clearly the importance of dialogue and collaboration across borders for a more inclusive and forward-think-

ing future in education.

The data on students' AI literacy levels, perceptions of performance, concerns about disinformation, and perceptions of AI as both an opportunity and a threat can be instructive for anyone interested in the topic.

In particular, its use in education offers revolutionary innovations in a wide range of areas, from assessing student achievement to enriching course materials, from reconstructing teaching strategies to reshaping assessment and evaluation processes. At the same time, it also opens the door to a whole new set of issues such as privacy, misinformation and ethics.

This book aims to provide a multifaceted and timely insight for educators, students, policymakers and anyone interested in the educational dimension of AI.

Given that we are only at the beginning of the AI revolution, many questions about its future impacts and opportunities await us. We hope that this work will provide insight into the current state and future of artificial intelligence and serve as a seminal guide.

We would like to extend our endless thanks to the researchers, participants and all supporters who contributed to the preparation of this book. We wish you an enjoyable and inspiring read...

Prof. Veysel BOZKURT

Dr. Dheeba MOOSA





ARTIFICIAL INTELLIGENCE IN EDUCATION: AN INTRODUCTION

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Dheeba Moosa²

Citation: Bozkurt, V., & Moosa, D. (2025). Artificial intelligence in education: An introduction. In V. Bozkurt & D. Moosa (Eds.), *Artificial intelligence in education* (pp. 11–25). TESAM Publications. <https://doi.org/10.17574/tesam.9786256148468>

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Technological developments in our age profoundly affect many sectors, from daily life to professional fields. In particular, advances in computer technologies, big data, robotics, and artificial intelligence (AI) are reshaping the way humanity works and lives (Russell & Norvig, 2020; Acemoğlu, Johnson, 2024; Mitchell, 1997). AI, which until recently was only discussed in science fiction, represents the capacity of machines to learn, reason, and solve problems similar to human intelligence. Recently, it has captured the public attention, evoking both great optimism and serious concerns, particularly with the proliferation of Generative AI models (Bozkurt & Gursoy, 2025).

Today, AI models, which provide a wide range of services from automatic translation tools to online recommendation engines, from speech-based assistants to image recognition and academic research, are also having an increasingly prominent impact in many areas, from writing poetry and creating images to writing student assignments and tracking student achievement (Popenici & Kerr, 2017; İlikhan et al., 2024; Özer, 2024).

Especially with the rapid spread of “generative” AI models such as ChatGPT, Claude, Gemini, and DeepSeek, discussions in the field of education have also intensified. Students have started to make use of these tools in many processes ranging from homework preparation to foreign language learning, and teachers’ practices such as classroom management, assessment and evaluation, and preparation of course materials have been questioned. All these developments reveal that AI offers great opportunities but also poses significant risks. “How AI will transform education?” is becoming an increasingly critical agenda for teachers,

school administrators, policy makers, students, and society at large. Kong, Lee and Tsang, 2024 along with Pont et al. (2024) suggest that generative AI tools can play an important role in fostering university students' creativity. Similarly, Creely (2024) highlights the opportunities provided by GenAI in language education. Students have already begun to use these technologies in many different ways, yielding both positive and negative outcomes.

What is Artificial Intelligence (AI)?

In general, AI is defined as the field of computer science that aims to enable a computer or a computer-controlled robot to perform activities like humans or other intelligent beings. AI focuses on developing systems that mimic human intelligence and can operate in a wide range of functions, from visual perception to speech recognition, from decision-making to language translation (Liu et al., 2021). The goal is for machines to not only mimic humans but, in some cases, to perceive, reason, learn, communicate, and act better than humans (Feng et al., 2021).

In the classical context, AI aims for machines to go beyond merely imitating human thought processes and exhibit independent and intelligent behaviour, increasing productivity and reducing costs in various sectors. Some experts believe that AI is ultimately capable of replacing human intelligence, while others see it as an "intelligence-enhancing" tool. AI includes programming computers and other technological devices to enable them to think "intelligently." Some researchers define it as "the design and analysis of computer programs that exhibit intelligent behaviour," while others refer to it as "the exploration of concepts

necessary for computers to become intelligent” (Hassani et al., 2020).

In their book *Artificial Intelligence: A Modern Approach*, Russell and Norvig (2020), presents four basic definitions of AI. This includes *Thinking Humanly* which includes cognitive modeling to understand and emulate the workings of the human mind; *Thinking Rationally*, focusing on logic-based inference processes to the computers, *Acting Humanly* grounded in the Turing Test, to assess the capacity of a computer to mimic human behaviour; and *Acting Rationally*, which is based on the rational agent approach, and emphasizes achieving optimal outcomes even in uncertain circumstances.

AI is often confused with “machine learning” (ML), but it goes beyond ML to address broader issues such as knowledge representation, planning, and reasoning. ML is a subfield of AI that develops systems that can learn patterns from large datasets; it involves computer programs whose performance improves with experience (Deville et al., 2021). ML is divided into “supervised learning,” “unsupervised learning,” and “reinforcement learning” according to the structure of the learning process. Deep learning, on the other hand, automatically discovers complex patterns using artificial neural networks (ANNs) that have the capacity to process data and learn like humans (Deville et al., 2021). In addition, subheadings such as artificial neural networks, convolutional neural networks (CNN), recurrent neural networks (RNN), natural language processing (NLP), and text mining constitute important components of AI from a broad perspective (Fierens et al., 2021; Oladipo, 2023; Häuselmann, 2022).

Artificial Intelligence in Education

The first examples that come to mind when it comes to AI in education are applications such as personalized learning platforms, intelligent systems that provide automatic feedback, online assessment and evaluation tools, and enrichment of course materials. GenAI can provide personalized learning experiences that are appropriate for students' individual learning styles and paces (Kong et al., 2024; Holmes et al., 2019). This allows students to learn more effectively and provides instructors with comprehensive data.

For example, adaptive systems that support students to learn at different speeds and styles can provide important clues about student performance through big data analytics. However, issues such as data privacy, algorithmic bias, and ethics become increasingly critical in this process (Selwyn, 2019; Harry, 2023). Large language models also provide students with a 24/7 "teacher to ask questions of" as well as simplifying complex texts, translating, and creating learning materials (Chang et al., 2023; Kasneci et al., 2023; Rasul, 2023). Students with disabilities or those who tend to be slow learners can thus develop a learning setup that suits their pace and needs.

Teachers can also use AI in assessment and evaluation to partially automate student grading, provide individualized feedback, and use AI to detect plagiarism. AI potentially makes great contributions in areas such as lesson planning, content production, and personalized instruction (Kasneci et al., 2023). On the other hand, there is also a risk of academic integrity when students seek help from AI models in their assignments. If AI becomes a tool that does

the assignment instead of an “assistant,” it negatively affects the student’s learning process and can pose a threat, especially in environments with a culture of cheating and misconduct. The dimension of academic integrity is therefore a major concern in discussions of AI in education.

In this context, researchers acknowledge the transformative potential of GenAI in education but remain cautiously optimistic. Educators are especially concerned about the possibility of AI substituting teachers. It is emphasized that AI applications for education may raise issues of ethics and inequality, widening the gap between students who do not have access to advanced AI technologies and those who do (Rasul, 2023). At the same time, risks such as data privacy, algorithmic bias, and erroneous results are also important items on the agenda (Özer, 2024; Özer, Perc & Suna, 2024). Therefore, objectivity, transparency, and accountability of AI algorithms are vital.

What is in this book?

The various studies in this book present field studies conducted in different countries by addressing the effects of AI on educational processes with empirical and theoretical dimensions.

The first paper, “The Effect of Artificial Intelligence Literacy on Students’ Academic Performance Perceptions”, is based on a survey of 452 university students in Türkiye. It is emphasized that as AI literacy and the frequency of using AI use increase, students’ perceptions of their academic performance with the help of AI also improve. This study reveals that male students are more likely to use AI compared to female students. Majority of the students in this study report

that AI tools provide various benefits such as preparing homework, increasing learning efficiency, better understanding of subjects, and increasing motivation.

In the paper titled “The Effects of Artificial Intelligence (AI) Literacy and Use on Students’ Perceptions of Academic Performance in the Maldives”, the same research model used in the study in Türkiye was applied to 260 higher education students in the Maldives. The study revealed that these students were also able to enhance both efficiency and motivation in their learning processes through the use of AI technologies. Regression analysis further confirmed that AI literacy and frequency of use positively influenced student performance perception. Recently published in a journal, the paper has been included in this book with the editor’s approval.

The third paper, titled “Artificial Intelligence and Performance Assessment” is based on a pre-test study conducted in Germany. This research, which examines two teachers’ approaches to AI-supported performance assessment tools, draws attention to the tools’ potential for acceleration and the “insidious” risks they pose. In particular, teachers emphasize ethical and legal uncertainties but also point to the power of AI to restructure teaching processes. The use of AI in student assignments is disrupting traditional assessment and evaluation practices. Teachers with low “AI literacy” often struggle to identify instances of cheating and plagiarism, whereas experienced teachers recommend process-oriented assessment approaches.

The fifth paper, “The Artificial Intelligence Paradox among Turkish Students”, points out that students in Türkiye see AI as both an opportunity and a threat.

On the one hand, students believe that AI will increase productivity and make life easier, but on the other hand, there is a segment that thinks that it will increase unemployment, deepen social inequalities, or bring about the end of humanity. While female students perceive AI as a threat to a greater extent, male students emphasize the opportunity dimension more.

The paper titled “The Artificial Intelligence Paradox Among University Students in the Maldives” reveals that Maldivian students similarly perceive AI as both an opportunity and a threat. Although the majority of the students state that AI will make life easier, increase productivity, and support its use in higher education, there are also a significant number of students who are concerned about issues such as unemployment, social inequality, and even the end of humanity. In both Türkiye and the Maldives, as the frequency of AI use increases, the perception of threat decreases and the perception of opportunity increases.

“Artificial Intelligence in Education: Chances of AI-generated Images for Enhanced Landscape Architecture Design” presents the findings of a student project conducted at the Neubrandenburg University of Applied Sciences in Germany. The project explores how AI-generated images can be used in landscape architecture design. The students were able to quickly generate images with different AI tools but had occasional difficulties in getting the technical concepts right. Nevertheless, this approach has the potential to support creative processes by providing alternative designs.

The paper titled “Artificial Intelligence and Misinformation in Türkiye” examines perceptions

towards AI-induced disinformation. The findings show that more than half of the students think that AI does not always provide accurate information and may have manipulative functions. It is emphasized that disinformation awareness increases as AI literacy and frequency of use increase.

All these studies provide practical examples of the use of AI in education in different geographies such as Türkiye, Maldives, and Germany and shed light on the cultural and social context of AI. AI, which manifests itself in different layers of educational processes, not only transforms learning-teaching processes but also creates wide repercussions in ethical, social, and economic dimensions. As a selection of research on the potential opportunities and risks of artificial intelligence in education, this book aims to provide important clues about the future educational applications of AI technologies.

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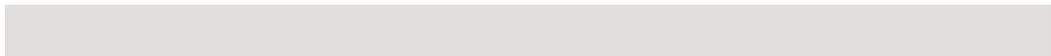
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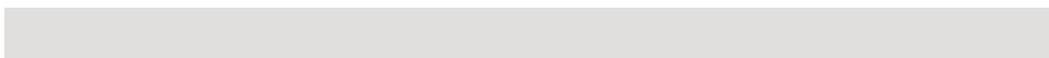
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THE EFFECT OF ARTIFICIAL INTELLIGENCE LITERACY ON STUDENTS' ACADEMIC PERFORMANCE PERCEPTION

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Citation: Bozkurt, V., Gülerce, H., & Moosa, D. (2025). The effect of artificial intelligence literacy on students' academic performance perception. In V. Bozkurt & D. Moosa (Eds.), *Artificial intelligence in education* (pp. 27–49). TESAM Publications. <https://doi.org/10.17574/tesam.97862561484681>

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1. Introduction

Technology has brought great transformations throughout history. Today, the technology with the greatest potential to change the way humanity lives, works, and thinks is artificial intelligence. Although it was first discussed more than 70 years ago, productive AI has gained immense popularity with the introduction of ChatGPT. With ChatGPT, AI is now a technology that can be used by anyone with no software knowledge. In fact, no other technology has reached a wide user base as quickly as ChatGPT. A wide range of professions, such as students, teachers, salespeople, managers, and researchers without software knowledge, can use productive AI to increase the efficiency of their work. Sectors such as health, media, and education have already been deeply affected by AI applications (Özer, 2004; İlikhan et al., 2024).

However, humanity is currently experiencing an AI paradox. On the one hand, a large proportion of people believe that AI will make their jobs easier and therefore technology should be supported, while the other is concerned that AI will increase unemployment and social inequalities. There is also a significant number of people who believe that AI, a double-edged sword, will bring about the end of humanity (Özer, Perc & Suna, 2024; Bozkurt & Gursoy, 2025; Tlili, et.al,2023; Bozkurt, 2023).

Artificial intelligence applications bring great potential to educational transformation. Even though education systems have not been able to set agreed-upon standards for the use of AI, students have begun to extensively use generative AI in their assignments. Over time, the impact of AI technologies is not limited to the

field of education; it can also be felt in all areas of social life. With 85% of Americans stating that they use at least one AI-enabled technology in their daily lives, the literature suggests that the impact of innovative AI applications is important for society and future generations (Park et al., 2023; Yetişensoy & Rapoport, 2023).

Similarly, there is a paradox about AI in the field of education. Universities, academics, and students in many countries around the world are striving to increase the efficiency of their work by utilising the possibilities of AI. AI offers individuals the opportunity to learn according to their own learning pace and needs, and students have a mentor who they can ask questions to 24 hours a day (Su & Yang, 2023; Özer, 2004). On the other hand, there is a concern that when it is not used within ethical rules or when the tasks that students should do are delegated to AI, learning skills will regress (Brew et al., 2023).

2. AI Literacy

As in other areas of society, AI literacy has gained vital importance in the field of education. Artificial intelligence literacy refers to using AI technologies critically, effectively, safely, and ethically and is closely related to the academic performance of students in the field of education. AI literacy refers to a set of competencies that enable individuals to use AI technologies critically, effectively, safely, and ethically and to communicate and collaborate with AI (Ng et al., 2021; Long & Magerko, 2020). AI literacy is not just a technical concept. As the definition suggests, it also includes critical thinking and ethical awareness (Lin, 2020). Nowadays, it is extremely important to examine university students' AI litera-

cy levels, their frequency of AI use, and their effects on their perceptions of academic performance. At the same time, AI literacy has become a competency that students will need in the future (Stolpe & Hallström, 2024).

Academic research has found that students often have difficulty identifying the limitations of AI and its constraints in problem solving (Liaqat, Mahmood, & Ali, 2020). Although AI has become a widely used technology, it is difficult to assert that it is still used effectively by students. On the other hand, some students are much more sceptical about AI. In particular, female students tend to trust AI less than male students (Dai et al., 2020; Silitubun, 2023).

The purpose of this study was to examine the effects of AI literacy on students' use of AI and their perceptions of academic performance. By doing so, the study aims to understand how students use AI to improve their academic performance and contribute to the existing body of the academic literature.

The need for AI literacy is increasing daily as the impact of AI technologies expands (Biagini, 2024). Therefore, the impact of AI literacy on university students' academic performance is an area of increasing research interest. As AI becomes more integrated into various fields, including education, understanding its impact on students' academic performance is of great importance (Ng et al., 2021a). AI literacy has already become one of the most needed skills today. Academic literature has highlighted the importance of AI literacy and its positive impact on students' perceptions of academic performance (Lérias et al., 2024; Silitubun, 2023; Moosa, et al., 2025).

Studies (Yılmaz & Yılmaz, 2023; Lérias et al., 2024)

have found that utilising AI technologies in education can contribute to students' skills development. They emphasised the importance of AI literacy in education by stating that a higher level of AI literacy among educators can improve the teaching-learning process and positively affect students' perceptions of academic performance (Lérias, 2024). Research has demonstrated that AI can improve academic performance (Alsariera et al., 2022; Wang et al., 2024). Voulgari et al. (2024) considered AI as a tool for positive change in education and suggested raising awareness for teachers, students, and the public, providing practical applications, and aligning curricula to AI literacy.

The academic literature shows that AI literacy has a positive impact on student academic performance. This effect is manifested in various areas, from technical skills to ethical awareness regarding the use of AI. Based on the academic literature, the following hypotheses were developed in this study:

H1. As AI literacy increases, students' perceptions of academic performance related to AI use also increase.

H2. There is a positive relationship between the frequency of AI use and AI literacy.

H3. As the frequency of AI use increases, students' perceptions of academic performance related to AI use also increase.

H4. The frequency of AI use (H4a), AI literacy (H4b), and perception of AI performance (H4c) are higher in males than females.

3. Methodology

A quantitative research method was employed in this study. The study population consisted of students enrolled at a university in Türkiye. The random sampling method was utilised. The questionnaires were administered by university students who acted as surveyors.

University students are among the first groups to interact with particularly productive AI technologies. A total of 452 university students voluntarily answered the questionnaire. The survey included questions on AI literacy, frequency of use, and perception of performance, along with demographic data such as age, gender, education, and major. The average age of the students was 22. Of the respondents, 28 % were male and 72% were female. Notably, female students who tend to exhibit higher empathy skills, were more likely to participate in such surveys compared to male students.

During university education in Türkiye, paid employment is generally uncommon. A small proportion of the students who responded to this survey (7.5%) are employed. Of the respondents, 10.2% were from education, 17% from social sciences, 17.9% from health sciences, 4.4 % from science, and the remaining were from other departments. The sample represents a diverse range of students.

The Artificial Intelligence Literacy Scale developed by Wang, Rau, and Yuan (2023) was used in this study. The original scale comprises 12 questions and 4 dimensions. However, since the reliability coefficient (Cronbach's Alpha) of some dimensions was below 0.70, the scale was reduced to a single factor consisting of 7 questions in the Exploratory Factor Analysis. The scale

used to assess students' AI literacy levels. The reliability coefficient of the revised 7-question AI scale was 0.85.

The researchers developed the Student AI Performance Perception Scale, which consists of 6 items and one dimension. The Cronbach's alpha value of the scale was 0.89. The frequency of use of artificial intelligence was also measured using Exploratory Factor Analysis with a factor consisting of three questions. Cronbach's alpha for this factor was 0.69.

The necessary ethics committee approval was obtained before the study began. The data were collected anonymously, and utmost care was taken with respect to the confidentiality of the participants and ethical rules. During the writing process of the research, support was received from artificial intelligence applications such as DeepL, Trinka, and Claude within the ethical rules on issues such as editing the article, translation, and adapting the language to the APA 7 format.

Descriptive statistics, Exploratory Factor Analysis, Cronbach's alpha, one-way analysis of variance, correlation analysis, and multiple regression analysis were used in the data analysis process.

4. Results

The AI literacy scale was subjected to exploratory factor analysis with questions measuring the frequency of use and students' perceptions of AI use performance. The KMO measure of sampling adequacy was 0.914, indicating that the sample was suitable for factor analysis. Bartlett's test of sphericity ($\chi^2 (120) = 3508.601$, $p < .001$) shows that the correlation between the items is sufficiently large. The common values of the variables

are 0.415–0.761. Principal Component Analysis yielded three factors (eigenvalues greater than 1). The total variance explained is 61.755%. The identified factors were AI student performance, AI literacy, and the frequency of AI use. The reliability coefficients of the factors were within acceptable limits.

Table 1. The Results of Exploratory Factor Analysis

Rotated Component Matrix*				
	Component			%
	Student performance	AI Literacy	AI Usage	Agree & Strongly Agree
AI improves my problem-solving skills.	0.844			37.2
AI increases my motivation to study	0.831			35.8
AI helps me understand subjects better.	0.822			54.5
AI provides me with materials suitable for my personal learning style.]	0.733			46.4
With AI, I complete my assignments and projects faster.	0.686			65.0
Artificial intelligence tools make my learning process more effective and efficient.	0.679			53.8
I can choose a proper solution from various solutions provided by a smart agent.		0.815		69.0
I can evaluate the capabilities and limitations of an AI application or product after using it for a while		0.767		64.6
I always comply with ethical principles when using AI applications or products.		0.724		62.8
I can choose the most appropriate AI application or product from a variety for a particular task.		0.693		57.7
I can use AI applications or products to improve my work efficiency.		0.648		64.9
I can distinguish between smart devices and non-smart devices.		0.527		77.2
I can identify the AI technology employed in the applications and products I use.		0.512		42.7
How often have you used generative AI tools such as Chat GPT etc. so far?			0.82	37.6
How often have you used (AI) tools such as DeepL, Google Translate, Grammarly etc. so far?			0.731	62.8
I am proficient in the utilisation of AI applications and products to enhance my daily work activities.			0.546	39.6

On the right side of the Exploratory Factor Analysis table, the sum of “agree” and “strongly agree” responses to each item is shown. Most students (69.0%) stated that they were confident in selecting appropriate solutions offered by AI tools. Conversely, 7.5% of respondents disagreed and 23.5% were undecided. Additionally, almost two-thirds of the students (64.6%) believe they have the skills to critically evaluate AI technologies. Similarly, most students stated that they were committed to ethical principles (62.8%).

The ability to select appropriate AI tools varied among the students, with 57.7% “agreeing” or “strongly agreeing”, 32.7% undecided, and 9.5% “disagreeing” or “strongly disagreeing”. Additionally, 64.9% of the students showed a strong belief in their ability to use AI tools to increase work efficiency. The students’ confidence in their ability to distinguish between smart and non-smart devices was also found to be quite high (77.2%).

The findings indicate that the students’ perceptions of their confidence in their AI literacy were slightly above average. The average AI literacy score was 3.64 on a five-point Likert scale. Although perception does not always reflect reality, understanding students’ AI literacy is important.

The students’ perceived AI use performance score was $M = 3.36$ ($SD = 0.79$), with a median of 3.33. The scores were distributed over a wide range. More than half of the participants (53.8%) stated that AI tools improved their learning processes. Again, approximately two-thirds of the students (65%) believe that AI helps them complete assignments and projects faster, and 54.5% believe that it helps them better understand in-

telligence topics. As seen in the frequency distributions in the left column of Table 1, most students believe that the use of AI improves their academic performance. However, a minority of students disagree with and remain undecided.

When examining the frequency of AI use, nearly two-thirds of students use AI applications such as DeepL, Google Translate, and Grammarly, while the rate of those who use productive AI applications such as ChatGPT decreases to 37.6%. Considering that this rate is increasing daily, the number of users is expected to increase significantly in the future. The frequency of AI use was highest among engineering architecture students ($M = 3.65$, $SD = 1.06$) and lowest among social sciences students ($M = 2.84$, $SD = 1.09$). The mean scores were $M = 2.95$ ($SD = 0.93$) for Medical Health Sciences students, $M = 3.28$ ($SD = 1.00$) for education students, and $M = 2.80$ ($SD = 1.04$) for students from other departments. The differences between the groups were significant ($F(4,438) = 7.30$, $p < .001$).

In terms of AI literacy, Engineering-Architecture students had the highest mean ($M = 3.87$, $SD = 0.68$). The mean literacy for social sciences students was $M = 3.63$ ($SD = 0.67$), for Medical Health Sciences students $M = 3.58$ ($SD = 0.58$), for Educational Sciences students $M = 3.72$ ($SD = 0.59$), and for students from other departments $M = 3.30$ ($SD = 0.91$). The differences in AI literacy between the groups were also significant ($F(4,438) = 3.93$, $p = .004$). These findings indicate that the frequency of using AI tools and the literacy levels of engineering students are higher than those of other student groups. This may be due to the greater emphasis placed on AI technologies in engineering education.

Table 2. The Results of Correlation Analysis

Variables	1.Student performance	2.AI Usage Frequency	3. AI Literacy	4. Age	5. Gender	6. GPA
1. Student performance	1					
2. AI Usage Frequency	.485**	1				
3. AI Literacy	.504**	.541**	1			
4. Age	.010	.018	-.006	1		
5. Gender 0=Female, 1=Male	.093*	.146**	.054	.178**	1	
6. GPA	.032	-.006	-.012	.010	-.061	1

Correlation analysis was conducted to understand the relationships between the variables. A positive and statistically significant correlation was found between AI literacy and student perception of academic performance in AI use ($r = .504$, $p < .01$). This result confirms hypothesis H1. Similarly, a positive correlation was found between the frequency of AI use and the perception of AI performance ($r = .485$, $p < .01$). This result also confirms hypothesis H2. As both AI literacy and frequency of AI use increase, students' perceptions of AI use academic performance also increase. Further, as expected, a positive relationship was found between frequency of AI use and AI literacy ($r = .541$, $p < .01$). This result also confirms hypothesis H3. It was observed that the more students used AI, the more their AI literacy patterns increased.

The distance between the students' ages was quite narrow. Therefore, no significant correlation was found between age and other variables. However, a significant correlation was found between gender and frequency of AI use ($r = .146$, $p < .05$). These data indicate that males have a higher frequency of AI use than females

(H4a is confirmed). A positive correlation was also found between the perception of student performance and the gender ($r = .093$, $p < .05$), with men having a slightly higher perception of AI academic performance than women (H4c is confirmed). However, contrary to expectations, no significant statistical relationship was found between AI literacy and gender (H4b hypothesis was rejected).

No relationship was found between GPA and student academic performance. Due to differences in evaluation methods among faculties, no hypothesis was proposed for the GPA variable.

Multiple regression analysis was conducted to identify the variables predicting the students' AI academic performance perception. The independent variables in the regression model (AI literacy, frequency of AI use, age and gender) significantly predicted the dependent variables (Adjusted $R^2 = .312$; $F(4, 444) = 51.867$, $p < .001$).

Table 3 presents the coefficients for the regression model. AI literacy ($B = .409$, $p < .001$) and frequency of AI use ($B = .222$, $p < .001$) show significant positive effects on student performance, confirming H1 and H2 hypotheses. The effects of gender and age were not significant. The gender variable, which had a significant, albeit weak, relationship in the correlation analysis, it did not have a significant effect in the regression model. This process also falsifies H4a, H4b, and H4c. The effect of gender was low and not statistically significant.

Table 3. Regression Analysis Results

Coefficients a							
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
		B	Std. Error	Beta			
1	(Constant)	1,183	0,267		4,437	,000	
	AI Literacy γ_i	0,409	0,056	0,34	7,292	,000	
	AI Usage frequency β_i	0,222	0,035	0,296	6,295	,000	
	Sex	0,065	0,071	0,037	0,917	,360	
	Age	-2,73E-05	0,009	0	-0,003	,998	
a Dependent Variable: Student performance δ_i							

5. Conclusion and Discussion

This study examined the effects of AI literacy and the frequency of AI use on university students' academic performance perceptions. The findings show that as AI literacy and the frequency of AI use increase, students' academic performance perceptions of AI use also increase. In addition, the AI usage frequency and AI performance perception of male students were higher than those of female students.

The results of our study are consistent with the existing literature. Studies by Yılmaz and Yılmaz (2023) and Lérias et al. (2024) found that AI literacy increases students' academic performance and contributes positively to their learning processes. Similarly, Wang et al. (2024) demonstrated that AI can improve academic performance.

Our findings regarding gender differences partially support the view that female students trust AI less than male students and are more hesitant to use it (Dai et al., 2020; Silitubun, 2023). The higher frequency of AI use

by male students indicates gender differences in this area. However, no significant difference was found in AI literacy according to gender.

Our findings demonstrate that AI literacy has a significant impact on students' perceptions of academic performance. This emphasises that AI literacy is not only a technical competence but also a broad concept that includes critical thinking and ethical awareness (Lin, 2020). Students' ability to use AI technologies effectively and ethically make their learning processes more efficient and increases their academic achievement. Objective situations and perception may not always be the same; however, students' subjective perceptions are that the frequency of AI use and AI literacy increase student academic performance.

The findings revealed the great importance of incorporating AI literacy into the educational curriculum. Students' ability to use AI technologies effectively not only improves their academic performance but also provides an important competence for their future careers (Stolpe & Hallström, 2024). In particular, the fact that engineering and architecture students' AI literacy and frequency of use are higher than those of students from other departments can be considered an indicator of the importance given to AI technologies in these fields.

Based on our findings, there are several possible reasons why AI literacy increases students' perceptions of academic performance. One possible reason is the personalised learning opportunities offered by AI technologies. AI simplifies complex subjects and allows students to learn at their own pace (Su & Yang, 2023). This way, students have the advantage of having access to their "teachers" 24 hours a day.

Conversely, the use of AI tools helps students in completing their homework more quickly and improves their learning process. In fact, most of the students who participated in the study believed that AI increased their productivity. However, the use of AI for assignments poses significant challenges for lecturers. AI literacy can improve students' critical thinking skills and enable them to evaluate AI applications effectively and ethically (Ng et al., 2021).

Among the unexpected findings of this study, no significant relationship was found between AI literacy and gender. This demonstrates that AI literacy should be developed irrespective of gender. However, the higher frequency of AI use by male students indicates that female students need additional support in terms of access to and confidence in AI technologies.

In summary, this study revealed that AI literacy and the frequency of AI use have a significant impact on students' academic performance. These findings indicate that educational institutions should develop strategies and curricula to increase AI literacy. The inclusion of AI literacy in educational curricula will significantly contribute to students' ability to acquire the competencies they will need in the future and to use AI technologies ethically and effectively. On the other hand, violating ethical principles can lead to significant issues related to AI over time. (Tanberkan, Özer, & Gelbal, 2024). Therefore, fostering a responsible AI culture and promoting AI literacy in education are particularly important.

Furthermore, it is crucial to raise awareness among policymakers about the critical importance of AI literacy and to provide AI literacy training, starting with rele-

vant courses and programs. This is essential in adapting to the rapid changes we are experiencing. While AI can further exacerbate plagiarism in educational institutions where such practices are prevalent, it is impossible to avoid AI altogether. Learning to use AI ethically has become one of the most essential skills for faculty members and students to enhance their educational performance. Moreover, boosting female students' confidence in using AI can help reduce gender inequalities in technology use.

This study was conducted with limited resources. In the future, longitudinal studies with a considerably larger sample size may contribute to a deeper understanding of the problem. In conclusion, this study shows that AI literacy and use positively affect students' perceptions of academic performance. Effective and ethical use of AI technologies in education is of great importance for raising competent individuals.

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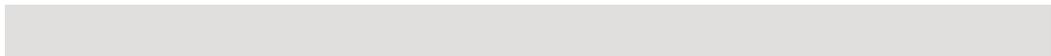
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THE EFFECTS OF ARTIFICIAL INTELLIGENCE (AI) LITERACY AND USE ON STUDENTS' PERCEPTIONS OF ACADEMIC PERFORMANCE IN THE MALDIVES

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Citation: Moosa, D., Bozkurt, V., Reesha, A., & Shina, A. (2025). The effects of artificial intelligence (AI) literacy and use on students' perceptions of academic performance in the Maldives. In V. Bozkurt & D. Moosa (Eds.), *Artificial intelligence in education* (pp. 51–79). TESAM Publications. <https://doi.org/10.17574/tesam.97862561484682>

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Introduction

The Maldives has made significant strides in its education in recent years. 97% of the Maldivian population is literate in Dhivehi and 82.6% literate in English. The Maldives higher education sector is also evolving and growing. Presently, there are 2 public universities, 10 private institutions (Higher Education Statistics Booklet, 2023). Higher education in the Maldives has undergone significant changes over the years. Initially, higher education was accessible only to a small elite group who studied abroad. This phase is known as the “elite stage” of higher education. Over time, the Maldives moved towards the “mass stage,” where more people gained access to higher education within the country. This shift aimed to meet the growing social, economic, and employment needs of the nation (Shareef & Shoughee, 2020).

The Maldives, known for its unique geographical landscape and rapidly evolving education system, presents a distinct context for exploring the integration of AI in education. Despite global advancements in AI, the Maldives faces specific challenges such as limited technological infrastructure and a need for specialized training among educators (UNESCO, 2020). However, the government’s commitment to digital literacy initiatives offers promising opportunities for enhancing AI literacy among students (Ministry of Education, 2021).

In this digital age, Artificial Intelligence (AI) has become an integral part of various sectors including education and higher education. AI is an important component of media and information literacy and in contemporary education and society (Hasan et al, 2024).

AI integration signifies a transformative shift in education methodologies.

In this context, the ability to understand AI, referred to as AI literacy, has emerged over the past few years as a crucial skill for students in higher education (Long & Magerko, 2020). Consequently, the influence of AI literacy on academic performance among university students is an increasingly intriguing subject in educational research. Hence understanding the impact of AI on student performance is of great significance.

The current state of AI literacy among students reveals significant disparities influenced by various demographic and educational factors. Research indicates that while some students possess a fundamental understanding of AI, there is a pressing need for comprehensive educational frameworks to enhance AI literacy across diverse contexts (Ng et al, 2023).

Kit Ng and Chai (2021) have proposed four key components—understanding, using, evaluating, and ethical considerations—in enhancing AI literacy, based on existing literature. They emphasize the multifaceted nature of AI literacy and its potential effects on academic performance. Additionally, Chai et al. (2020) have defined students' AI literacy, subjective norms, and anxiety as background factors based on the theory of planned behavior. These authors examined how the AI learning intentions of Chinese middle school students are associated with eight other relevant psychological factors.

This research underscores the potential impact of literacies, including AI literacy, on student behaviours and competencies, which are integral to academic performance.

Furthermore, Otero and Seifan (2023) have explored the effects of AI literacy in K-12 education. According to these authors, the haphazard and inadequately considered implementation of AI can lead to undesirable outcomes, an aspect that has received limited attention. Therefore, there is a need for a competency framework that will guide educational institutions in designing didactic proposals. This framework should be modular, personalized, and adaptable to the conditions of schools. With the involvement of teachers in curriculum design, leveraging AI literacy can enhance the learning of fundamental subjects within the discipline by integrating AI into the teaching process.

Kim et al. (2021) have emphasized the importance of integrating AI literacy into elementary school curriculums. They argue that developing AI literacy from an early age could influence students' academic performance as they progress into higher education. In addition, Leander and Burriss (2020) have discussed the impact of AI and computational tools on literacy practices and identity, pointing to the broader societal implications of AI literacy extending to academic environments.

The academic literature demonstrates the multifaceted nature of AI literacy and its potential impact on the academic performance of university students. Perceptions of AI's role in personal development and the preparation of research projects are crucial in understanding its effect on educational experiences. Seifan et al. (2022) conducted a comprehensive survey among undergraduate students to assess the usefulness of a research project in achieving various outcomes, including personal, learning, and research perceptions. Their

study provides insights into students' perceptions of research projects, which could be extended to include projects related to AI. They found that AI could be an effective tool in the teaching and learning process of undergraduate research programs.

Ethical issues and privacy concerns regarding the use of AI applications and products among students have garnered significant attention in academic literature. Akgün and Greenhow (2021) addressed ethical challenges related to privacy concerns and biases in K-12 settings, underscoring the need to overcome these challenges while leveraging the benefits of AI in education. According to these authors, AI is transforming education and educational tools. AI has various educational applications, such as personalized learning platforms to enhance student learning, automated assessment systems to assist teachers, and facial recognition systems to generate predictions about student behavior. Despite the potential benefits of AI in supporting students' learning experiences and teachers' practices, the ethical and societal drawbacks of these systems are rarely fully considered in K-12 educational contexts. The ethical challenges of AI in education need to be identified and introduced to teachers and students. This study provides information on specific ethical issues related to students' use of AI applications in educational settings.

The integration of AI tools into higher education and their societal impacts have been comprehensively examined, shedding light on student perspectives and their broader effects on education and society. Popenici and Kerr (2017) explored the implications of AI integration in universities, providing insights into the future nature of higher education and the impact of AI

on teaching and learning in this context. This study contributes to understanding students' perspectives on the integration of AI tools into higher education and its potential societal effects. The role of AI in enhancing learning effectiveness, assignment completion speed, and problem-solving skills in educational contexts has been a subject of extensive research. Various studies have provided valuable insights into the impact of AI tools on learning outcomes and problem-solving skills among students. Kashive et al. (2020) conducted a study on user perceptions of AI-enabled e-learning, highlighting the significant impact of AI on perceived efficiency. This study offers information on students' positive perceptions regarding the use of AI in e-learning environments and its potential to enhance learning effectiveness. Similarly, Chubb et al. (2021) researched the use of AI in the research process, shedding light on the potential of AI as a facilitator of new methods, processes, and management to enhance problem-solving skills and research efficiency among students.

This paper aims to investigate how AI literacy and its use influences students' academic perceptions and performance. By examining the current state of AI literacy, identifying the challenges and opportunities within the Maldivian educational landscape, and exploring students' attitudes towards AI, this study seeks to provide valuable insights into the role of AI in shaping academic experiences and outcomes. Understanding these dynamics is essential for developing effective educational strategies that leverage AI to enhance learning and performance.

The main hypotheses of this study follow the discussion of literature.

There are several studies highlighting the benefits of AI for student learning. These studies indicate that AI enhances personalized learning, engagement, and academic performance, leading to a favorable perception among students. For instance, research conducted by Ward et al. (2024) revealed that AI resources greatly benefit student learning by enhancing study techniques, time management skills, and feedback systems. The findings indicated a notable decrease in the number of study hours along with a rise in GPA, showcasing favorable academic results. The same study showed that AI tools support personalised learning. This personalised approach has been shown to make learning effective, reduce stress leading to improved academic performance (Ward et al., 2024). According to Zhang (2024) AI tools have shown to improve academic performance, with users reporting better outcomes compared to non-users. Similarly, adaptive learning systems powered by AI have demonstrated significant improvements in student performance, with post-assessment scores rising notably (Sari et al., 2024). Based on the literature, one of the hypothesis for this study is:

H1- There is a positive effect of “AI Usage in Academic Tasks” on “Perceived Benefits of AI on Student Performance”.

The relationship between AI literacy and the perceived benefits of AI on student performance is increasingly recognized in educational research. Studies indicate that higher levels of AI literacy correlate positively with enhanced academic outcomes, as students become more adept at utilizing AI tools effectively. Some studies have shown that students with higher AI literacy are more likely to engage with AI technologies (Singh et al,

2024) and that AI literacy enhances student motivation towards learning (Mallillin, 2024). Hence, the hypothesis following this literature is:

H2- There is a positive effect of “AI Literacy” on “Perceived Benefits of AI on Student Performance”.

The relationship between a student’s field of study and their engagement with AI in academic tasks, AI literacy, and perceived benefits of AI on performance is significant. Research indicates that students in fields with higher technological integration tend to exhibit greater AI usage and literacy, which correlates with improved academic outcomes. This is particularly evident among Generation Z students, who demonstrate enhanced learning experiences through AI tools, leading to better performance (Singh et al., 2024). Therefore, the hypothesis for the purpose of this study is:

H3- There is a statistically significant relationship between the field of study of the student and “AI Usage in Academic Tasks” (H3a), “AI Literacy” (H3b), and “Perceived Benefits of AI on Student Performance” (H3c).

1. Method

A close-ended adapted online survey questionnaire was utilised for data collection. The questionnaire comprised of six sections including demographics. The survey questionnaire was prepared both in Dhivehi (local language) and English Language. The Dhivehi translation followed a back to back translation procedure where the English questionnaire was translated to Dhivehi first and then back translated, to ensure alignment between two translations. The questionnaire

link was sent to the selected focal points in the higher education institutions.

The instrument was pilot tested for accuracy and level of comprehension with 50 similar samples who were not part of the original research. Necessary amendments were brought to it before administering for data collection.

1.1. Sample and data collection

This survey was conducted online among students studying at six private higher education institutions and two public universities in the Maldives. The total population is 21,964 (Maldives Bureau of Statistics, 2021). Based on Krejcie and Morgan's (1970), the sample size is 377 for this population. However, 260 responses were received which is 69% response rate. The confidence level was 95% with an error margin of 5%.

As shown in table 1, the respondents consisted of 72.7% ($n = 189$) female and 27.3% ($n=71$) male, suggesting a significant gender disparity in higher education participation. This indicates that more women are pursuing higher education compared to men, which reflects the societal trends and specific initiatives aimed at increasing female enrolment in higher education.

Table1. Demographic characteristics participants

Variable	Category	n	%
Age	17-20	59	22.7
	21-30	103	39.6
	31-40	60	23.1
	41-50	29	11.2
	51 above	9	3.5
Gender	Female	189	72.7
	Male	71	27.3
Marital Status	Single	116	44.8
	Married	129	49.8
	Divorced	14	5.4
Employment Status	Waged Employee	128	49
	Not Employed	112	42.9
	Not Applicable	21	8
Occupation	Student Only	104	40
	Public Sector Employee	79	30.4
	Private Sector Employee	41	15.8
	Self-Employed	26	10
	Other	10	3.8
Education Level	Certificate	60	23.3
	Diploma	54	21
	Bachelor's Degree	105	40.9
	Master's Degree	28	10.9
Field of Study	Doctoral Degree	4	1.6
	Education	77	29.5
	Health	58	22.2
	Business Management	44	16.9
	Information Technology	17	6.5
	Other	65	24.9

Most respondents fall within the 21 to 30 age range (39.6%), the mean age of the students was 29 years, and the median age was 26 years which is typical for university students. The marital status of the respondents reveal that almost half of them (49.8%, n = 129) are married. On the other hand, 44.8 % (n = 116) were single and 5.4 % (n=14) of the participants were divorced. Additionally, 49% respondents (n=128) are waged employees and 42.9% are not employed. From the respondents 40 % (n=128) identify themselves only as students while 30.4% (n=79) respondents are working in the public sector and 15.8% are working in the private sector. Most of the respondents are currently enrolled in undergraduate programs (40.9%, n=105), while 23.3% (n =

60) are enrolled in certificate programs and 21.0% (n = 54) in training programs. Most of the respondents come from Education discipline (29.5%). This was followed by students studying in health sciences (22.2%, n = 58) and business administration (16.9%, n = 44). The proportion of IT students is 6.5% (n = 17). The rest consisted of other groups.

1.2. Measurement

In this study, the 12-question “Artificial Intelligence Literacy Scale” developed by Wang et al (2023) was used to measure AI Literacy. The scale has four dimensions: Awareness, Usage, Evaluation and Ethics. However, since the Cronbach Alpha values of the factor dimensions of the scale were less than .70 during the data analysis phase, the scale was reduced to a single dimension scale of 7 questions in Exploratory Factor Analysis. The Cronbach’s Alpha value of this new one-dimensional general AI Literacy scale version is .889.

In contrast, the frequency of AI use consists of questions measuring the frequency of students’ use of AI for their exams, language studies, research and projects. In the Exploratory Factor Analysis, the Cronbach’s Alpha value of this dimension, which is termed as “frequency of AI use in academic studies” is .822.

In addition to this, since there was no relevant ready-made scale that measures students’ perceptions of AI use on their performance, a measurement tool was developed. In the process of developing the “Perceived benefits of AI on student performance” scale, a comprehensive literature review was first conducted. Based on this literature, a large pool of questions were formulated and online interviews with some students were also

conducted. The items were prepared in a 5-point Likert format (1=strongly disagree, 5=strongly agree).

In the second stage, the opinions of expert academicians working in this field were obtained and content validity was checked. The comprehensibility of the items was tested in the pilot application and then reliability analysis was performed. Item-total correlations were also analysed. Exploratory Factor Analysis (EFA) was conducted, and the Kaiser-Meyer-Olkin (KMO) value was .92. Bartlett's Test of Sphericity was significant ($p < .001$).

Exploratory Factor Analysis was performed using Varimax rotation. One factor was obtained. The lowest factor loading ranged from 0.740 to the highest 0.836. All items were well above the critical value of 0.30. The item-total correlations of the scale vary between 0.479 and 0.698. These values show that the discrimination power of the items is sufficient. Anti-image correlation values are between 0.847-0.887. These values indicate that sampling adequacy is also provided at the item level. The total variance explained by the one-dimensional scale consisting of 6 questions is 63.62%. The reliability coefficient of the scale (Cronbach Alpha coefficient) is .892. This value indicates that the scale is highly reliable (> 0.80). In summary, the scale shows strong psychometric properties. The one-factor structure is consistent with theoretical expectations. These findings indicate that the reliability and validity evidence of the scale is at an adequate level.

2. Results

2.1. Factor analysis results

Questions related to AI literacy, AI use and AI perception of student's academic performance were subjected to Exploratory Factor Analysis. The questions in the scale prepared by Wang et al (2023) that did not form a meaningful structure (reliability coefficient below 0.70) were excluded. Principal Component Analysis (PCA) was used in the analysis and varimax rotation was performed. Kaiser-Meyer-Olkin (KMO) measurement was used to assess sampling adequacy and Bartlett's test of sphericity was applied. In this study, the KMO value was .92. It was concluded that the data set was suitable for factor analysis. The 3 factors obtained explain 63.62% of the variance. As presented in the methodology section, the Cronbach's Alpha of all three factors is above .80. This shows the internal consistency of the dimensions of the scale.

The AI literacy dimension of the scale shows students' competencies in evaluating, selecting and using AI tools ethically. This finding reveals that AI literacy includes not only technical knowledge but also ethical use skills. In this study, the mean of AI literacy consisting of 7 questions is 3.63. This means that the result is close to agree.

75% of the students who answered the questionnaire claim that they can distinguish between smart devices and non-smart devices, 71% claim that they can use AI applications or products to increase work efficiency, and 72% claim that they follow ethical principles when using AI applications or products. Students see AI as a productive tool and are aware of the importance of eth-

ical use. The rate of those who say that they can choose the most suitable AI application or product among various options decreases to 53%. The rate of those who say that they can skilfully use AI applications or products in their daily work is relatively low.

Table 2. Exploratory Factor Analysis results and percentages (Agree + Strongly Agree)

Item	AI Literacy	Perceived Benefits of AI on Student Performance	AI Usage in Academic Tasks	Agree + Strongly Agree Total %
4.8 I can choose a proper solution from various solutions provided by a smart agent	.831			62
4.7 I can evaluate the capabilities and limitations of an AI application or product after using it for a while	.803			61
4.9 I can choose the most appropriate AI application or product from a variety for a particular task	.750			53
4.1 I can distinguish between smart devices and non-smart devices	.734			75
4.6 I can use AI applications or products to improve my work efficiency	.721			71
4.10 I comply with ethical principles when using AI applications or products	.641			72
4.4 I can skilfully use AI applications or products to help me with my daily work	.607			53
6.4 AI increases my motivation to study		.840		55
6.5 AI improves my problem-solving skills		.801		50
6.3 AI helps me understand the subjects better		.748		68
6.6 AI provides me with materials that suit my personal learning style		.708		54
6.1 AI tools make my learning process more effective and efficient		.674		73
6.2 I complete my assignments and projects faster with AI		.547		53
3.5 I use AI for preparing research projects			.810	48
3.1 I use AI for preparing assignments			.790	47
3.2 I use AI for preparing for exams			.673	41
3.3 I use AI for language support			.606	60
3.4 I use AI for personal development			.582	59

Note. Extraction method: Principal Component Analysis.

Rotation method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations

In Table 2, the second dimension of the scale measures the perceptions of AI on their academic performance. Accordingly, students think that AI increases their motivation, improves their problem-solving skills and helps them understand subjects better. The average of this factor is 3.44. This dimension focuses on the effects of AI on learning and academic performance. 73% of students think that artificial intelligence tools make their learning process more effective and efficient. The rate of those who said "Artificial Intelligence helps me understand the subjects better" is 68%. The lowest rate of participation is in the item "Artificial Intelligence improves my problem-solving skills" which is 50%. This shows that students are partially sceptical about the contribution of Artificial Intelligence to problem solving skills.

In contrast, the third dimension shows the practical use of AI in academic tasks. Data shows that at least some of the students utilize AI in areas such as research projects, assignments and preparing for exams. The mean for this dimension is 3.08. Sixty percent of the students stated that they use AI for language support, 59% for personal development, 47% for preparing assignments and 48% for research projects. The lowest rate of usage was 41% for those who said that they use it to prepare for exams.

Table 3. Correlation analysis results

	Age	Gender	AI_Literacy	AI_Performance	AI_Usage
Age	1				
Gender	.140*	1			
AI_Literacy	.187**	.047	1		
AI_Performance	.032	.026	.538**	1	
AI_Usage	.022	.082	.455**	.639**	1

Note: *. Correlation is significant at the 0.05 level (2-tailed).
 **. Correlation is significant at the 0.01 level (2-tailed).

Table 3 shows the relationship between the variables. A strong, positive and statistically significant relationship was observed between student perception of AI performance and frequency of AI use ($r = .639$, $p < .001$). This result shows that as the use of AI increases, the perceived performance also increases and confirms hypothesis H1.

A significant positive and statistical relationship was also found between AI literacy and AI student performance perception ($r = .538$, $p < .001$). This confirms hypothesis H2. Similarly, a significant positive correlation was found between AI literacy and frequency of AI use ($r = .455$, $p < .001$).

On the other hand, a weak, negative and significant relationship was found between age variable and AI literacy ($r = -.187$, $p < .01$). This finding indicates that AI literacy decreases slightly as age increases. However, no significant relationship was found between age and AI performance ($r = .032$, $p = .618$) and AI use ($r = .022$, $p = .726$).

No statistically significant relationship was found between gender and AI literacy ($r = .047$, $p = .449$), AI performance ($r = -.026$, $p = .684$) and AI use ($r = -.082$, $p =$

.186). Age has a small negative effect on AI literacy, but gender has no significant effect on these variables.

Table 4. Results of Multiple Regression analysis

Model	Unstandardized Coefficients		Standardized Coefficients	
	B	Std. Error	Beta	t
1 (Constant)	.689	.247		2.791
AI Literacy	.350	.058	.318	6.008
AI Usage	.416	.044	.491	9.462
1.1 Age	.007	.004	.081	1.686
1.2 Gender	-.018	.088	-.010	-.205

Note. Dependent Variable: AI Performance. $R^2 = .472$, $p < .001$.

For the regression analysis, the assumptions required for it were checked. Regression analysis results in table 4 shows that AI literacy ($\beta = .318$, $p < .001$) and frequency of AI use ($\beta = .491$, $p < .001$) statistically significantly predict students' perceptions of AI performance. On the other hand, as in the correlation analyses, age ($\beta = .081$, $p = .093$) and gender ($\beta = -.010$, $p = .838$) variables did not have a significant effect on students' AI performance perceptions. The results of regression analysis also confirm hypotheses H1 and H2. In other words, it shows that as the frequency of AI use and AI literacy increase, students' perceptions of AI performance increase. In other words, the data confirms that the increase in AI literacy and frequency of use positively affects student performance perception.

Table 5. ANOVA results of Artificial Intelligence variables according to field of study

Variable	Source	Sum of Squares	df	Mean Square	F	Sig.
AI Literacy	Between Groups	13.963	4	3.491	6.109	.000
	Within Groups	145.701	255	.571		
	Total	159.664	259			
AI Performance	Between Groups	5.891	4	1.473	2.048	.088
	Within Groups	181.184	252	.719		
	Total	187.075	256			
AI Usage	Between Groups	3.131	4	.783	.775	.543
	Within Groups	257.640	255	1.010		
	Total	260.771	259			

It is hypothesized that the student's field of study will affect students' AI literacy, frequency of AI use, and student performance perception. For this purpose, as shown in table 5, a one-way analysis of variance (ANOVA) was conducted and a significant difference in AI literacy was found only with the student's field of study, $F(4, 255) = 6.11$, $p < .001$. Hypothesis H3b was confirmed. When group means for AI literacy were analyzed, as expected, the mean AI literacy of students studying IT ($M = 4.11$, $SD = 0.58$) was significantly higher than the mean of other students. The lowest mean belongs to students studying in the field of educational sciences ($M = 3.38$, $SD = 0.83$).

On the other hand, AI performance ($F(4, 252) = 2.05$, $p = .088$) and AI use ($F(4, 255) = 0.78$, $p = .543$) did not differ significantly according to the field of study. To summarize, three main hypotheses were formulated in this study. Two of these hypotheses were confirmed. The third hypothesis, which tests the differentiation accord-

ing to the field of study, is divided into three sub-headings. Of these subheadings, only H3b was confirmed, the others were not. When we look at AI in terms of students' perceptions, students' frequency of AI use and AI literacy positively affect their performance perceptions. Supporting the conscious use of AI in education can positively affect students' academic performance.

2.2. Discussion

AI integration in the academic arena has forced academics and students to become AI literate and to explore innovative ways for effective use of AI. Hence, this study intended to find out the effects of AI literacy and use on students' perceptions of academic performance in the Maldives.

Students' perceptions on AI literacy and its use reveal that most students have the basic understanding of smart AI devices and non smart AI devices. Similarly, many students also reported they were confident to use AI applications or products efficiently to enhance their work. This indicates that students believe that AI is a potential tool for the advancement of their academic and professional endeavours. It is equally important to highlight that a larger percentage of students also adhered to the ethical principles, when utilising AI applications in their work. Students' awareness of appropriate AI usage reflects a positive trend toward fostering responsible users of AI technology.

On the other hand, lack of confidence was noted by students with their ability to identify the most suitable AI application tools among many. Additionally, a lower percentage of students believed that they have the necessary skills to use AI applications in their daily work

effectively. This indicates that most students do not possess the necessary skills and knowledge to assess and select the appropriate AI tools, in addition to their lack of ability to use AI applications. This highlights a gap between awareness and practical application.

With regards to students' perception of AIs impact on their academic performance, students believe that AI enhances their motivation and assists in the understanding of subject matter. In general, most students highlight that AI tools make their learning more effective and efficient. This aligns with the existing literature in which Fadel et al (2019) have highlighted that AI tools can break down complex information into simple parts, making it easier for students to grasp the content. Although many students have highlighted the benefits of AI such as motivation and easy comprehension, a good number of students have highlighted that AI did not assist them in problem solving skills. This finding aligns with the existing literature where Selwyn (2019) emphasizes that excessive reliance on AI for assignments can lead students to become passive learners, which may impede their ability to develop deeper problem-solving skills. Additionally, the ease of obtaining AI-generated answers might encourage a superficial understanding of subjects instead of fostering a comprehensive grasp of the material. This shallow engagement can negatively affect students' critical thinking abilities and their capacity to tackle challenges with a nuanced approach (Verge AI, 2024).

Students' practical application of AI in academic tasks, revealed that students are moderately using these technologies for various academic purposes including language enhancement and personal development.

However, fewer students state that they use AI for exam preparations and for research purposes. The reason for this could be due to their lack of awareness to use AI appropriately to fulfil their purposes.

Conclusion and Recommendations

In conclusion, these findings emphasize the potential of AI to improve academic performance while also identifying areas that require additional support and education. By promoting greater awareness and practical skills in utilizing AI tools, educational institutions can empower students to maximize the advantages of technology in their learning experiences. To enhance AI literacy and its effective use among students in the Maldives, educational institutions should implement comprehensive AI literacy programs that include hands-on workshops and emphasize ethical AI usage. Addressing the gap between awareness and practical application is crucial, so targeted training sessions should be offered to develop skills in assessing, selecting, and using AI tools effectively. Integrating AI-related topics into the curriculum across various subjects will help students see the relevance of AI in different fields. Additionally, establishing support systems like AI help desks or mentorship programs can build students' confidence and competence. Continuous evaluation of AI literacy programs, based on feedback, will ensure they remain relevant and effective, ultimately empowering students to maximize the advantages of AI technology in their academic pursuits.

One significant limitation of this study is the low response rate. Despite extensive efforts to reach out to potential participants, the response rate was lower than

anticipated. This limitation may affect the generalizability of the findings, as the sample may not fully represent the broader population. Future research should consider employing additional strategies to increase participation, such as offering incentives or utilizing multiple communication channels.

Ongoing research is essential to understand how these perceptions change over time and to determine the most effective ways to incorporate AI into educational practices.

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ARTIFICIAL INTELLIGENCE AND PERFORMANCE ASSESSMENT

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Citation: Graalmann, K. (2025). Artificial intelligence and performance assessment. In V. Bozkurt & D. Moosa (Eds.), *Artificial intelligence in education* (pp. 81–105). TESAM Publications. <https://doi.org/10.17574/tesam.97862561484683>

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1. Introduction

This article discusses heuristic initial findings on the topic of “Artificial Intelligence (AI) and performance assessment” in the school sector, as seen through the perspectives of two² male secondary school teachers. These findings are part of an evaluation of the pretests from an interview study within the author’s postdoctoral research project. The aim of this subproject is to investigate whether and how performance assessment may be modified by AI or needs modification due to its influence (SWK, 2023). The focus is on reconstructing practices, particularly concerning the forms of performance assessment. The teachers, who come from the same federal state in Germany, were interviewed using a guided structure with narrative prompts (Witzel, 1982). The interviews were analyzed using the documentary method (Bohnsack, 2014). The paper is organized as follows: first, to emphasize the relevance of the heuristic insights, a brief overview of the theoretical positioning of the topic and the design and methodological approach is given. Following this, a detailed presentation and analysis of the heuristic dimensions of how AI can influence performance assessment practices is outlined. Finally, the implications of these reconstructed perspectives for teacher education, among others, are discussed.

AI and performance assessment are relevant in three ways: firstly, concerning the use of AI for performance

2 The author acknowledges that two interviews cannot fully reconstruct orientations or provide universally valid perspectives. However, given the rapid evolution of all topics related to AI, it is reasonable to use these initial insights on “AI and performance assessment” from the pretests to heuristically stimulate considerations regarding the dimensions that could or should be taken into account, particularly in the context of teacher education.

assessment by teachers and secondly, regarding AI-supported student performances that must be evaluated by teachers – and this evaluation could be, thirdly, done either with or without AI (e.g., Fig. 1).

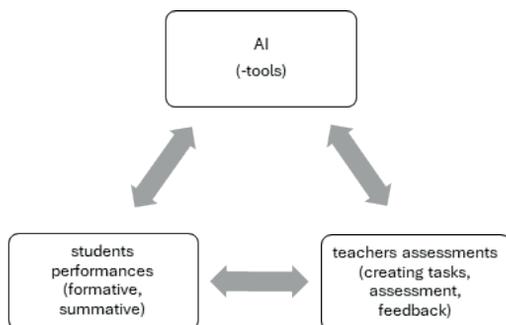


Figure 1: Relationship of AI, Assessment, Teachers, and Students**

Numerous resources about AI are available to schools and teachers. Skepticism towards AI in education has decreased (cf. Helm & Große, 2024); however, many teachers are questioning how AI systems can be utilized in ethical, legal and technological perspectives. These considerations concern both the meso and micro levels, along with organizations at the macro level (cf. Fend, 2008), such as the Conference of Ministers of Culture.

To define the relevant terminology in this article, it is important to mention that it focuses on generative AI. This type of AI can be categorized as weak AI within the software sector; it simulates human capabilities by imitating thinking, decision-making, and problem-solving behaviors. While it is capable of learning, it is fundamentally a supportive tool rather than a substitute for teachers (cf. Ertel, 2020; European Commission, 2022;

Knaus, 2023; SWK, 2023). In the German educational context, a wide array of guidance documents has swiftly emerged detailing how to deal with AI, primarily focusing on “learning about AI or learning with AI” (Ungerer & Slade, 2022, p. 107).

The concepts of performance and performance assessment also need clear differentiation. Performance is defined as “Vollzug und das Ergebnis einer Tätigkeit, die mit Anstrengung verbunden, auf die Erlangung eines Ziels gerichtet und auf Gütemaßstäbe und Anforderungen bezogen ist” (Sacher, 2014, p. 13). This definition inherently differentiates between formative and summative performance assessment (referenced in the notion of execution and results). Notably, performance is characterized by effort and goal orientation, with criteria that are particularly reflected in these forms. The article emphasizes the educational understanding of performance (cf. e.g. Jürgens, 2000). Performance assessment is a critical aspect of teachers’ professional roles. Besides educating, teaching, and innovating it is a competency that has to be developed by the end of their studies and teacher training (cf. KMK, 2019). Even without the influence of AI, performance assessment presents a challenging task within teachers’ everyday practices—not only because it serves various functions for students, parents, and employers (selecting, socializing, legitimizing, monitoring, forecasting, providing feedback, disciplining, diagnosing, educating) (cf. Sacher, 2009, pp. 22-31), but also due to the complexities that accompany the task to assess students’ performances: Performance assessment should be ideally objective, reliable, valid, useful, economical, and accepted (ibid., pp. 36-42), while it ideally corresponds to the individual, social, and criterion-based reference

norms (cf. Rheinberg, 2014, pp. 63-68). Performance assessment is also functional for teachers, enabling them to maintain curricular control and acquire insights into the effectiveness of their teaching.

2. Test Design and Research Objectives

The pretests were conducted to validate the guideline for the interviews. This guideline was constructed according to the SPSS principle as outlined by Helfferich (2011, pp. 178-189). Initially, respondents were requested to provide a descriptive self-categorization. They were then asked to talk about their most recent performance assessment experience. This narrative prompt was followed by specific questions about various examination formats or their practices concerning performance assessment in different subjects. Ultimately, they were asked to define AI according to their understanding. They were required to elaborate on how AI influences their professional responsibilities regarding performance assessment. The guiding interview structure included various follow-up questions, such as specific AI tools mentioned by the teachers. At the conclusion of the interview, participants were given the opportunity to add any narrative comments regarding "AI and performance assessment." Each interview lasted approximately 85 minutes. The respondents were regarded as experts (cf. Bogner & Menz, 2005, p. 46) in their respective teaching contexts, despite not receiving any special training concerning the research interest surrounding AI in performance assessment.

Two pretests were conducted to empirically verify and ensure the reliability of the guideline (cf. Misoch, 2015, p. 144). Based on the pretest results, no adjust-

ments were necessary for the guideline.

To thoroughly examine whether the generated guidelines reveal teachers' underlying orientations regarding the impact of AI on performance assessment practices, the pretests were analyzed using the documentary method (cf. Bohnsack, 2014). The aim of reconstructing teachers' action-guiding orientations is to form types. The documentary method was used to develop these types and it outlines three interpretative steps: These include a formulating interpretation, a reflecting interpretation and type formation, which are briefly summarized here:

1. The written transcript provides a valid basis for reconstructing the respondents' action practices (cf. Bohnsack, 2013, p. 187). Therefore the transcript is thematically organised during the formulation of interpretation, aiming to focus on the content of *what* is said; all notes remain verbatim and thus in the respondents' perspectives. In this way topics are identified, which establish the foundation for a comparative approach to the whole empirical material (step 3).

2. Subsequently, dense passages that are relevant for the research focus are interpreted reflectively for each interview. The focus shifts to understanding *how* the content (see step 1) is articulated, interpreting the context in which the themes from the formulating interpretation are framed from the researcher's perspective. This approach involves linguistic analysis and considers focus metaphors relevant to the subject matter. Focus metaphors are characterized by "interaktive und metaphorische Dichte" (Bohnsack, 2011, p. 67).

3. Utilizing the tertium comparationis (or tertia comparationis), the specific comparative elements derive

from both case-immanent and cross-case comparative analyses. In this way the foundation for the final type formation is established. Generalization occurs classically in two phases: initially through semantic type formation and subsequently through sociogenetic and/or relational type formation (cf. Nohl, 2013), considering either sociodemographic dimensions or other criterion-guided experiential dimensions. This step focuses less on capturing action practices and more on cross-case aspects revealing homologous or heterologous orientations.

3. AI and Performance Assessment – Heuristic Initial Insights into Teachers’ Perspectives

Three heuristic dimensions that emerged from the intra- and interspecific case comparison of the two pre-tests concerning the influence of AI on the performance assessment practices of teachers are now presented. Each of the three perspectives is illustrated with a concise interview excerpt.

The first heuristic dimension can be summarized under the label “Insidious AI.” The second perspective opens up a negotiation regarding the performance capabilities of AI and AI tools. The subject of performance assessment shifts from students’ performances to AI and its tools, which is why the heuristic dimension is called “AI under Performance Assessment.” The third heuristic dimension that becomes evident is “AI Needs Practice.”

An overarching ambivalence due to the question how to deal with AI in the context of performance assessment can be reconstructed, oscillating between an ethical axis and an instrumental-technological axis. This

ambivalence is fundamentally pedagogical; it is perceptible through antinomies (cf. Helsper, 2004), traditional professional tasks (e.g., Amrhein, 2016), broadly defined professional approaches (cf. Oevermann, 2002; Terhart, 2011), and perspectives on school and school development in general (cf. Tenorth, 1996). This points out the characteristics of the profession of teachers. AI disrupts this pedagogical foundation and intensifies the prevalent professional ambivalence as it is described here.

3.1. "Insidious AI"

An excerpt from the interview³ with Teacher 1 illustrates why AI is perceived as insidious from the teachers' perspective:

*I: U:::nd ähm dann haben Sie noch gesagt, auf diesen Geräten sind Apps drauf. sind es dann KI-Apps?
#00:44:05-8#*

L1: Also ich habe dort die GPT-A::pp schon mal per Bildschirmaufnahme gesehen. also ich habe das zumindest gesehen und ich weiß äh auch von Schülern beziehungsweise ich weiß auch von Eltern, dass das da schon Thema ist. also die kennen diese App, die benutzen diese App und ich denke, da lässt sich so mancher bei den Hausaufgaben helfen; in de::m Sinne, sich die schon fix und fertig machen zu lassen. das hat natürlich immer wechselnde Qualität. sehr häufig wird ja kompletter Unsinn:: äh äh verfasst, was schlicht und ergreifend nicht stimmt? haben Sie vielleicht auch schon mal ausprobiert, dass die Antworten

3 The audio recordings of the interviews were transcribed following the guidelines outlined in „Talk in Qualitative Research“ (Bohnsack, Nentwig-Gesemann & Nohl, 2013, pp. 399-400). In the transcripts, ‚I‘ serves to anonymize the interviewer, while ‚L1‘ and ‚L2‘ denote the respective teachers who were interviewed.

von ChatGPT schlichtweg sachlich falsch sind, weil die Informationen einfach nicht da ist. andere Produkte, die dieses Gerät dann eben da liefern kann, sind dann wieder ganz gut; also wenn man es richtig macht. (3) da muss ich sagen: Quellenanalyse beispielsweise. n typischer äh Arbeitsauftrag aus=m Fach Geschichte äh, nimm ne quellenkritische Analyse mit den Kriterien XYZ (.) vor und arbeite die Position des Verfassers heraus mit -ner vorgegebenen Textquelle. das können die gut. #00:45:05-9#

Examining the passage as a whole and taking into account the linguistic elements, AI is ascribed insidious characteristics, which points out a moral stance in the context of AI in education. The interviewer's closed question is posed neutrally and could be answered with a simple "yes" or "no." Interestingly, Teacher 1 does not directly approach the question; instead he states a factual observation in an uncertain tone ("Well, I have seen the GPT app through a screen recording"). This suggests that clear knowledge is not available. It appears that AI apps may not be standard in that school – in this case this is possibly creating a taboo making AI a 'sin' which should not be present in educational settings. This sense of non-integrity shows through concealment and externalization away from the school environment ("at least seen the apps," "parents use them," "homework assistance that is 'ready-made'"). Linguistically, this distances the teacher from the suspicious AI use (I vs. them or they (e.g. students and parents)), while the proposition from the interviewer regarding "devices, AI apps, apps" is vaguely elaborated upon using references like "other products," "it," "those," and "the" – AI emerges as an unknown entity, almost kind of nebulous.

Thus, AI adopts a disreputable connotation, particularly its use is even reproached or blamed. The externalization of AI's use (the teacher mentions in other parts of the interview that he also uses AI in his personal life, for instance, for vacation planning, managing finances, or writing greeting cards) towards parents who finance, own, and therefore facilitate the access to such apps⁴, and towards students who independently download these apps onto school tablets suggests an ambiguous status of usage. It seems neither sanctioned nor explicitly forbidden; rather, there is documented confusion and respect for 'the new'—leading to ethical, legal, and technological questions and resulting in an uncertain and vague handling of AI apps in the classroom. The ambiguity in the naming of the apps accentuates their immorality in the school context. This underlines a pursuit of clarity and security through regulations, particularly in a federalist political perspective. This is indicated in other parts of the interview with Teacher 1 when he explicitly mentions needing guidelines from the Conference of Ministers of Education to implement his ideas of using AI in his lessons. Teacher 1 is regarding the efficiency AI can bring to performance assessment, alongside fairness and objectivity. Until then, AI retains an insidious connotation, challenging performance assessment practices as a result and maybe increasing a digital divide.

4 Furthermore the topic of digital divide – or perhaps AI divide – is indicated (cf. van Deursen & van Dijk 2014, Gabriel 2024). Teacher 1 feels challenged to make his students competent in the use of AI tools or apps, specifically by addressing issues such as automation bias and AI hallucinations. This task seems to be newly relevant, as differences in students' access to AI tools may depend on their parents' socioeconomic resources, motivation, and ability to manage these technologies competently.

3.2. “AI under Performance Assessment Itself”

AI is also subjected to a form of performance assessment. The relevant criteria concentrate on quality, thoroughness, accuracy, reliability, validity, and permissibility (in ethical, legal, and conventional terms). Within this context, AI innovation is characterized by an orientation towards managing external advancements within the educational sector.

L2: die KI kann ja selbst auch schon, wenn ich einen passenden Prompt eingebe und das sage, da ich sage:::ja, mach mal bitte ein paar Rechtschreib- und Grammatikfehler rein und schreib ich bin gerade in der achten Klasse, schreib das aus der Sicht eines Achten:::aus (.) eines Schülers, der achte Klasse ist. aber man merkt das dann schon an einigen Stellen, da ganz konkret, (2) und auf der anderen Seite; was mit meinem Unterricht macht, ist, dass ich versuche mit meinen Klassen, die ich habe, kritisch mit diesem Thema umzugehen. sie sollen KI nutzen. äh auf jeden Fall. (.) aber eben nicht nur anwenden, sondern ähm auch reflektieren das Ganze; das heißt auch ganz konkretes Beispiel achte Klasse Großstadtlyrik. sollten sie mit der KI arbeiten? wir hatten vorher Themenmotive zusammengearbeitet, die eben bei Gedichten und Großstadtgedichten drankommen, die häufig thematisiert wird (.) und da sollten sie ein Gedicht selbst verfassen und dann sollte die KI ein Gedicht verfassen und dann sollten wir es eben miteinander vergleichen. was (.) was kann die KI eigentlich in der Hinsicht? hey, ist sie schon so gut, dass sie auch unsere Themen hat? welche Themen greift eine künstliche Intelligenz auf? und dass man äh::: dass die beiden Gedichte dann () wirklich kritisch vergleicht? ja, das kann die KI schon ganz gut, aber auch eben kritisch ne? sagt ja, nee, das passt jetzt

gar nicht. zum Beispiel formale Aspekte oder auch sowas wie Reimschema, Metrum, was ist das; ging gar nicht.
#00:31:01-2#

According to Teacher 2 AI is able to produce texts that appear surprisingly authentic. Therefore it is necessary to use clear and persuasive prompts. Teacher 2 is surprised by the quality of the purported student products—similar comments are made by Teacher 1. Both teachers adopt an investigative approach feeling challenged to identify potential cheating by students using AI. This criminal perspective poses difficulties and raises the question about what can still be assessed and what truly constitutes performance. An orientation characterized by tumult, restlessness, and tension emerges as longstanding practices or routines no longer suffice. The interview excerpt from Teacher 1 in section 3.1 demonstrates that AI apps can modify tasks in the teaching profession. While AI could effectively assume specific responsibilities from teachers, its ability to simulate human errors through appropriate prompts (as described by Teacher 2 when referring to the perspective of an eighth grader) can foster a sense of helplessness among teachers. AI continues to evolve and improve, creating uncertainty in restructuring of education. Nevertheless, the occurrence of transformation is unquestionable. AI possesses potential for both teachers and students. Simultaneously, limitations exist; AI cannot fulfill all requirements (e.g. lyrical elements like meter or rhyme schemes), hence it falls short of human expectations. AI cannot compete with human cognition when it comes to content (“is it competent enough to understand our themes?”). This delineates a contrast between humans and AI and reveals an inclination among the interviewed teachers to optimize

themselves based on their own experiences and their own orientations while evaluating AI. Furthermore, AI is anthropomorphized and endowed with the capacity to make human-like mistakes. Within the assessment of AI regarding performance evaluation in schools, a fundamental ambivalence becomes apparent: while certain AI tools and features prove beneficial (formal support, task simplification, student motivation), there remains a persistent drive to address AI's deficiencies, particularly from a subject-matter perspective.

3.3. "AI Needs Practice"

L2: Potenzial hat für mich eben ein Aufgreifen von aktuellen::-auch gesellschaftlichen und technischen Tendenzen aufzeigen, Aktualität. es hat für mich Potenzial, dass die Schülerinnen und Schüler lernen, mit technischen Hilfsmitteln wie KI umzugehen (.) äh:: auch kritisch umzugehen. es hat für mich Potenzial darin, tatsächlich. (2) wer also reproduktive Aufgaben, sei es Aufgaben im Anforderungsbereich eins, tatsächlich zu- irgendwann zu übernehmen. für mich als Lehrer natürlich dankbar; wie das dann konkret in Leistungsüberprüfung aussieht () weiß ich noch nicht. #01:00:21-1#

Enabling students to be AI-competent emerges as a new professional responsibility for Teacher 2. He regards this positively ("potential") and significant due to the relevance for students, both present and future. Concurrently, a quest for handling security emerges—how will students acquire this proficient use of AI without the support of teachers? The necessity of integrating AI competence into educational settings is underscored by Teacher 2, who consistently positions the potential for making AI accessible to students within the school

framework (as opposed to Teacher 1, who discusses AI in relation to homework and parental assistance, thus externalizing the issue into the extracurricular area). Teacher 2 emphasizes that practice is essential for achieving AI competence. For him, the recognition of AI competence as an indispensable new skill is beyond dispute (“timeliness,” “current, societal trends”). A critical approach to AI is outlined as essential, encompassing an awareness of AI inaccuracies, like biases. This involves not only both teachers and students becoming AI competent but also teachers learning and practicing ways to facilitate their workloads through AI (“eventually taking over requirement area 1⁵”). Here, AI is assigned limited competence in contrast to the expertise of teachers. This aspect is similarly evident in the excerpt from Teacher 1 in section 3.1, where he asserts that mastering AI tools or prompting correctly requires teachers support and explanations. Thus, it is evident that the pedagogical aspect distinguishes teachers from AI, inherently involving subject knowledge (the expertise necessary for precise prompting) and reflective knowledge (for higher cognitive levels in the context of performance assessment). Ultimately, alongside possessing intrinsic skills and motivation to engage with contemporary developments, one requires practice and commitment to handle AI and AI tools competently.

In relation to AI and performance assessment, the importance of differentiating between early and late adopters (cf. Hameyer, 1986, p. 28) becomes apparent. Teacher 1 is not only utilizing AI innovation, recognized since the rollout of ChatGPT in 2022 privately (for vacation planning, greeting cards, financial management),

5 Requirement area 1 refers to the reproduction of knowledge.

but also aims to establish it as an intrinsic aspect within his working place (by initiating training sessions, regularly updating his knowledge, incorporating AI into his teaching). In contrast, Teacher 2 adopts a more cautious stance, waiting initially for state guidelines and subsequent internal school regulations to emerge. As outlined in Hameyer's innovation model, both teachers recognize the opportunities that AI presents for their profession (awareness), begin to engage with AI from technological, ethical, and legal perspectives (interest), evaluate its potentials and challenges (evaluation), and seek to integrate specific tools into their teaching (trial). Teacher 1 has already extensively experimented with AI viewing it as "future-oriented" and "indispensable" by integrating it into his daily professional routine and various responsibilities. In contrast Teacher 2 has postponed this decision. Hence, Teacher 1 can be classified as an early adopter, while Teacher 2 embodies the profile of a late adopter. Both approaches illustrate that AI needs practice, whether adopted quickly or more cautiously.

4. Heuristic Insights for Further Reflection on AI's Relevance in Schools

In conclusion, the reconstructive-interpretative approach to the pretests of the research project "Performance Assessment and AI" reveals heuristically that traditional performance assessment practices are disrupted by AI. Indicators of de-subjectification (cf. thematic section of the *Journal of Pedagogy* 5 (2020)) are noticeable, as is the compelling need to engage with AI within teachers' professional contexts. In the sphere of performance assessment, it is critical to consider how AI enables teachers to operate within their specific per-

formance ethos—suggesting a dichotomous negotiation between the legitimacy and illegitimacy of AI use on various levels. From subject matter, ethical considerations, internal school policies, legal considerations, and self-optimization perspectives, it becomes clear that the discourse on AI within performance assessment encompasses various approaches to presenting oneself as an indispensable representative of the profession.

Currently, AI can be utilized for both performance execution and evaluation, realigning the practice of performance assessment. The interviewed teachers describe how this is already taking shape in their schools, illuminating both the challenges and vast potential for their profession. The reconstructive analysis of the two pretests yielded three heuristic perspectives. These perspectives encompass discussions on what constitutes performance in the age of AI, along with intersections with the content learned in teacher education programs and internships. Heuristic conclusions can be drawn for further research and practical application in schools and teacher education. For instance, it may initiate discussions on if and how common judgment errors in educational performance assessments (cf. Sacher, 2009) need to be adjusted or modified—such as the phenomenon of automation bias, the inclination to trust AI suggestions without scrutinizing.

Beyond that, a reevaluation of what performance entails or what remains performance in the context of AI is necessary. The concept of performance, intrinsically linked to assessment task requires refinement. Heuristically, teachers strive to evaluate student outputs across multiple dimensions (e.g. criterial, social, individual standards), all while being acutely aware of

their sovereign responsibilities assigned by their civil servant status. However, if the use of AI leads to more homogenized output, the focus must shift more toward process assessment. Although this perspective is not new (cf. Schmiedinger, 2013, linking formative assessment with self-regulated learning; or more recently, Sliwka & Klopsch, 2020, addressing the enhancement of formative feedback during the COVID-19 pandemic), it emphasizes the urgent need to focus more on process rather than product. This is especially important in relation to the AI influence on educational settings including schools and teaching, teacher actions, student development, and teacher professionalization.

AI disrupts incorporated practices within the school sector. Embracing these disruptions and adapting practices accordingly may be the key to fostering innovation and maintaining relevance. Initial findings from this study on AI's effects on teachers' performance assessment practices suggest a profound impact of AI tools on habitual teacher practices. Ideally, this impact should be addressed earlier within teacher education to establish a shared foundation, subsequently built upon through further training, intrinsic motivation to engage with contemporary topics, and ongoing professional development. In summary, AI disrupts established performance assessment practices. Nonetheless, its influence is inescapable, including within schools, classrooms, and consequently in performance assessment contexts. Teachers have to recalibrate their performance ethos, learning to embrace the potentials offered by AI and integrate them into their philosophies. They have to navigate and resolve the documented tensions between the perceived legitimacy and illegitimacy of AI usage in performance assessment contexts. This depiction pres-

ents AI as kind of insidious (3.1.), while simultaneously portraying AI as an object itself within performance assessment frameworks (3.2.) and emphasizing the necessity of practice in interactions with AI (3.3.).

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THE ARTIFICIAL INTELLIGENCE PARADOX AMONG TURKISH STUDENTS

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Citation: Bozkurt, V., Gülerce, H., & Moosa, D. (2025). The artificial intelligence paradox among Turkish students. In V. Bozkurt & D. Moosa (Eds.), *Artificial intelligence in education* (pp. 107–129). TESAM Publications. <https://doi.org/10.17574/tesam.97862561484684>

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1. Introduction

No technology inspires as much hope and fear as artificial intelligence (AI). The rapid development of AI technology is changing many areas of life. Sundar Pichai, Google's CEO, described AI as "probably the most important thing humanity has ever worked on" and emphasised that this technology could have a more profound impact than fire or electricity. Many experts consider AI as a "game changer" (Acemoglu & Johnson, 2023; Taddeo & Floridi, 2018; Rawas, 2024).

Some authorities, including those who have made significant contributions to the development of AI technologies (e.g. Geoffrey Hinton, Elon Musk) are concerned that the system could become uncontrollable and potentially lead to the end of humanity. According to these authorities, AI that becomes more intelligent than humans over time could easily escape from human control and cause the end of human civilisation. We should remember that AI is the first technology capable of making decisions and generating new ideas independently; it could alter the evolutionary trajectory of all life forms, not just humanity (Bostrom, 2014; Harari, 2024).

On the one hand, AI can contribute to social welfare by introducing dramatic innovations in areas such as education and health (Taddeo & Floridi, 2018). However, it can also lead to severe problems in areas such as ethics and security (İlikhan et al., 2024; Özer, 2024). Concerns include mass unemployment, economic instability, and the consolidation of biases (Acemoglu & Johnson, 2023; Brynjolfsson & McAfee, 2014; Frey & Osborne, 2017; Ford, 2021). The structural transformations that AI may

bring are more likely to affect groups like university students who are also getting ready to enter the labour market. Considering that AI may rapidly replace the human labour force in many occupational fields that require mental work, it seems that these concerns are especially prevalent among students.

This research aims to examine the “AI paradox” (i.e., the perception that technology holds both great opportunities and profound threats) in university students’ perceptions of AI. Although the existing literature has revealed a general dilemma of enthusiasm and concern about AI, the attitudes of the student population towards the subject have not yet been sufficiently investigated. Given the rapid changes in the education system and the labour market, understanding how students perceive AI is of great importance. Therefore, this study aims to contribute to the literature by examining the opportunities, threats, and intersections of these perceptions among university students. Our research will reveal the concerns and expectations of this group of students, who will soon engage directly with the labour market, regarding AI technologies. The results are expected to shed light on the wider debate about the societal impact of AI.

2. Literature Review

AI, which has the potential to affect all social strata, has begun to attract considerable attention in both popular media and academic literature (Cave & Dihal, 2019). AI is a set of systems that collect and process data for specific purposes and learn from such data. It consists of intelligent systems that can perform high-level cognitive processes and self-improve without human

intervention (Bostrom, 2014; Williamson, 2024). AI is often used interchangeably with “machine learning” or “deep learning”. Machine learning algorithms and statistical models that learn from data and thus recognise and identify patterns in it (Du-Harpur, et.al, 2020).

The possibilities and risks of AI raise concerns in many countries, and these concerns are reflected in AI policies. For example, the member states of the EU are taking pioneering steps in developing AI within the framework of regulatory and ethical principles and are making very strict regulations in this regard (Albarrán Lozano et al., 2021). However, the US government, which has taken the lead in the development of AI technologies, aims to reduce the potential risks of AI technologies on society and protect consumer privacy (McCallum & Kleinman, 2023). China, in competition with the US, has placed technological development and innovation at the centre of its national development strategy, aiming to become a global leader in the field of AI (Voss, 2024).

Researchers from different disciplines have highlighted the social and economic impacts, potential advantages, and possible risks of this technology (Acemoglu & Johnson, 2023; Taddeo & Floridi, 2018). The debate on the effects of AI on the labour market is particularly focused on economic inequalities and the possibility of mass unemployment. While some authors (Brynjolfsson & McAfee, 2014; Frey & Osborne, 2017) point out that there may be an increase in unemployment rates with the automation of routine jobs, others (Acemoglu & Johnson, 2023) emphasise that automation may have negative consequences for certain groups of workers.

Some authors argue that AI can also create new jobs and sectors and contribute to economic growth by increasing productivity (Bessen, 2018; Ford, 2021). However, there is also the concern that the benefits of AI will not be equally distributed, and that AI may create new types of inequalities within society (Bughin et al., 2018).

The potential of AI to enhance productivity and innovation is one of the most studied topics in the literature. In the healthcare sector, AI-based applications, such as early diagnosis of diseases, personalised treatment planning, and drug development, have produced successful results (Ching et al., 2018; Sakly et al., 2022; Fritsch et al., 2022). In the manufacturing sector, machine learning can minimise automation, production errors and improve overall quality (Chui et al., 2023). On a broader scale, AI has also been reported to have positive impacts in many areas, such as energy efficiency, sustainability, transportation, decision-making processes, and education (Liao et al., 2012; HBR, 2023). For example, previous studies have found that facial recognition systems increase processing speed significantly in border control processes (Modhvardia, 2023; Bullock et al., 2022).

Alongside these positive aspects, ethical and security concerns related to AI also take an important place in the literature (Bessen, 2019; Taddeo & Floridi, 2018). Issues such as privacy violations, bias reinforcement, and loss of control indicate that the proliferation of AI technologies can have devastating consequences. Therefore, the need for transparent and accountable AI infrastructures is often emphasised (Sankaran et al., 2021).

University students are among the groups that will

be most affected by the potential impacts of AI. The possibility that professions that require mental work may be substituted by AI systems causes increased concern, especially among students who will graduate soon . However, the positive effects of AI in education cannot be ignored. The development of more flexible, personalised and accessible educational opportunities can help students to adapt to rapidly transforming employment conditions (Taddeo & Floridi, 2018). Therefore, students' perceptions of AI are an important factor that will shape both their future professional orientations and societal acceptance of technology in general.

As a result, several studies have been conducted on the positive and negative aspects of AI, its impact on the labour market and socioeconomic inequalities, its ethical dimensions and its social perception. However, the attitudes of university students towards AI and the factors (familiarity, gender, future expectations, etc.) that play a role in these attitudes have not yet been sufficiently investigated. This research aims to fill this gap and comprehensively reveal the factors influencing university students' perceptions of AI.

In this research, which measures students' perceptions of AI, the following questions were explored :

1. Do students perceive AI as an opportunity or a threat? Or paradoxically, both?
2. How does familiarity with AI affect the perception of AI as an opportunity or threat?
3. What role does gender play in seeing AI as an opportunity or threat?

3. Methodology

This questionnaire was collected by academics using the snowball method. A total of 448 students responded to the survey. The link to the online survey was distributed to the students, who were encouraged to both complete the survey and circulate it within their networks. Following the ethics committee approval, the survey was commenced, and participation was entirely voluntary.

The age distribution of the participants was concentrated between 19-23 years. The reason for this age distribution is that more than 85% of the respondents are undergraduate students. The sample included more women than men. In surveys conducted on a voluntary basis, women with a high sense of empathy participated more than men. In total, 324 female and 128 male students completed the questionnaire.

	Component	
	AI as threat	AI as opportunity
I worry that AI will increase unemployment	,903	
I think AI will lead to mass unemployment	,896	
I think AI will increase inequalities in society	,842	
I worry that AI will bring about the end of humanity	,770	
I think AI will increase the efficiency of our work		,900
I think AI will make our lives easier		,890
The use of AI tools should be encouraged		,868
More use of robots (AI) in the workplace should be encouraged		,650
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.		
a. Rotation converged in 3 iterations.		

The “Artificial Intelligence Paradox Scale” was used in this research (Bozkurt & Gürsoy, 2023). The scale includes dimensions for AI as an opportunity and AI as a threat. The reliability coefficients were quite high in this study, as in a previous study. For the 8 questions the reliability coefficient value for AI as an opportunity factor was Cronbach’s alpha = 0.846 and for the AI as a threat dimension, it was Cronbach alpha = 0, .878. In addition, the total variance explained by the two factors is 73,469; KMO= .812.

Use of AI

AI-based language tools, such as Trink AI, ChatGPT o1, Gemini 2.0, and DeepL Pro, were used to edit the grammar and style of this article, its translation into English, the reporting of some findings, and the arrangement of references. These tools were used to improve the fluency and intelligibility of the paper, but no changes were made to the content. The authors bear full responsibility for the study.

4. Results

AI as an opportunity factor consists of 4 questions with a mean value of 3.56. Considering that 3 is undecided and 4 is agree on a 5-point Likert scale, it can be said that students tend to perceive AI as an opportunity. On the other hand, the mean level of AI as a threat factor, which also consists of 4 questions, is 3.53. This indicates that students paradoxically consider AI as both an opportunity and a threat. The correlation coefficient between these two factors is negative, but weak ($r = -.174$, $p = .000$). There is diversity in the responses for both dimensions. The standard deviation values are 0.95892 for AI threat and 0.85710 for AI as opportunity. However,

the kurtosis and skewness values were close to the normal distribution.

When we analysed the factors at the item level, most students who answered the questionnaire (57.3%) said, "The use of artificial intelligence tools should be encouraged". Approximately one-third of the respondents were undecided (32.3%). A negligible group (10.4%) stated that they were opposed to AI. Additionally, approximately 70% of the respondents stated that "I think artificial intelligence will make our lives easier". The percentage of respondents who disagreed was only 7.7%. However, the percentage of respondents who stated that "I think artificial intelligence will increase the efficiency of our work" is 64.4%. While one of 4 people is undecided on this issue, one out of 10 people oppose the view that AI will increase the efficiency of jobs. However, the percentage of respondents who said "More use of robots (AI) in workplaces should be encouraged" decreased to 35.6%. In relation to this issue, respondents seem to be divided into three groups. Although 31.2% of the participants disagreed with this view, one-third were undecided.

Table 2: Frequency Distributions of The Artificial Intelligence Paradox Scale

Question	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
The use of AI tools should be encouraged	4.2%	6.2%	32.3%	39.6%	17.7%
I think AI will make our lives easier	3.3%	4.4%	22.3%	43.4%	26.5%
I think AI will increase the efficiency of our work	3.8%	6.2%	25.7%	41.6%	22.8%
Encourage more use of robots (AI) in the workplace	12.4%	18.8%	33.2%	24.3%	11.3%
I worry that AI will bring about the end of humanity	8.4%	20.4%	29.2%	26.3%	15.7%
I worry that AI will increase unemployment	4.6%	8.6%	22.8%	34.7%	29.2%
I think AI will increase inequalities in society	5.5%	12.4%	30.5%	30.5%	21.0%
I think AI will lead to mass unemployment	4.2%	9.7%	25.4%	36.7%	23.9%

Notably, a very high percentage of students, 42 percent, agree with the idea that AI will bring about the end of humanity. In contrast only 28.8% of respondents disagreed, while the remaining students were undecided.

The percentage of those who say AI will increase unemployment is about 64%. Almost two out of the three students are worried that AI will lead to unemployment. Similarly, more than half of the students (51.5%) stated, "I think AI will increase inequalities in society" (See Table 2). These results suggest that there is an AI paradox among students as well as other groups in society.

To determine students' familiarity with AI, they

were asked whether they had used generative AI such as ChatGPT and Gemini. Among the students, 62.4 percent stated that they do not use AI, and 37.6% stated that they sometimes or always use generative AI. This result shows that more than one-third of students use generative AI. This rate is expected to increase significantly in the future.

To understand whether the use of generative AI makes a difference in students' perceptions of AI as an opportunity or threat, the Independent Sample t-test was used. The mean score of students who used data generative AI tools to perceive AI as a threat was 3.3250, while the mean score of students who did not use it was 3.6507. Independent Sample t-test revealed a statistically significant difference between the two groups ($t(450) = 3.543, p < 0.001$). In other words, those who use generative AI believe that AI is less of a threat.

Table 3. Results of the t-test

		Group Statistics			
	Generative AI (ChatGPT,, Geminai vb.) usage	N	Mean	Std. Deviation	Std. Error Mean
AI as threat	No	282	3,6507	,90342	,05380
	Yes	170	3,3250	1,01499	,07785
AI as opportunity	No	282	3,3218	,83753	,04987
	Yes	170	3,9456	,74156	,05687

Examining the effect of generative AI use on the perception of AI as an opportunity, the mean of students who used generative AI (3.9456) was significantly higher than the mean of students who did not use gen-AI (3.3218). Independent sample t-test revealed that there is a statistically significant difference between the groups ($t(450) = -8.002, p < 0.001$). This indicates that when students start using AI, they start to see it as more of an opportunity.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
AI as threat mean	Equal variances assumed	3,526	,061	3,543	450	,000	,32571	,09194	,14502	,50640
	Equal variances not assumed			3,442	324,463	,001	,32571	,09463	,13955	,51187
AI as opportunity	Equal variances assumed	3,323	,069	-8,002	450	,000	-,62378	,07796	-,77698	-,47058
	Equal variances not assumed			-8,246	390,109	,000	-,62378	,07565	-,77250	-,47506

The independent sample t-test was performed to determine the effect of gender on perceptions of AI as a threat and opportunity. The data revealed that the mean of female students (N=324, M=3.6481, SD=0.92754) perceiving AI as a threat was significantly higher than the mean of male students (N=128, M=3.2246, SD=0.97349) ($t(450) = 4.313, p < 0.001$).

	Sex	N	Mean	Std. Deviation	Std. Error Mean
AI as threat	Female	324	3,6481	,92754	,05153
	Male	128	3,2246	,97349	,08604
AI as opportunity	Female	324	3,4938	,84999	,04722
	Male	128	3,7148	,85788	,07583

The results of the t-test analysis showed that the mean of male students (N=128, M=3.7148, SD=0.85788) was significantly higher than the mean of female stu-

dents (N=324, M=3.4938, SD=0.84999) ($t(450) = -2.484, p = 0.013$).

Table 6-Independent Sample Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
AI as a threat	Equal variances assumed	,094	,759	4,313	450	,000	,42354	,09821	,23053	,61655
	Equal variances not assumed			4,223	223,148	,000	,42354	,10030	,22589	,62119
AI as an opportunity	Equal variances assumed	,310	,578	-2,484	450	,013	-,22102	,08897	-,39587	-,04617
	Equal variances not assumed			-2,474	230,952	,014	-,22102	,08933	-,39702	-,04501

These results demonstrate that gender had a statistically significant difference in the perception of AI as a threat and opportunity. Female students are more likely to perceive AI as a threat. In contrast, males are more likely to see AI as an opportunity.

5. Conclusion and Discussion

By examining university students' perceptions of AI technologies, this study revealed the paradoxical perception of AI as both an opportunity and threat. The results show that students perceive AI as an opportunity, largely due to its potential to increase productivity and make life easier, but also as a threat, with concerns such

as unemployment, social inequalities, and even the risk of bringing about the end of humanity. This dichotomy is very much in line with the general trends of both positive and negative impacts of AI previously mentioned in the literature (Acemoglu & Johnson, 2023; Taddeo & Floridi, 2018).

In this research, 64.4% of the students thought that AI would increase productivity and 69.9% thought that it would make life easier. These findings agree with the general acceptance in the literature on the positive effects of AI on economic growth and quality of life (Bessen, 2018; Ford, 2021). However, 63.9% of students are worried that AI will increase unemployment. This concern aligns with the warnings of authors such as Frey and Osborne (2017) about the negative effects of automation on the labour market. Moreover, 51.5% of students believed that AI would increase social inequalities, a finding that reflects the risk of worsening inequalities expressed by Bughin et al. (2018).

Gender plays an important role in the perception of AI. Female students perceive AI as a threat whereas more male students perceive AI as an opportunity. This finding agrees with previous studies showing gender-based differences in attitudes towards technology (Baksa, Konecki & Konecki, 2024). The fact that women are more concerned about technological change is likely a reflection of gender roles and inequalities in access to technology.

In this study, familiarity with AI (especially the frequency of using generative AI tools) was found to have a significant impact on perception. Students who use generative AI perceive AI as less of a threat and more of an opportunity. This result is consistent with stud-

ies that have demonstrated that familiarity with technology positively affects individuals' attitudes towards technological innovations (Bozkurt & Doğan, 2024). In addition, this result supports the expectation that the perception of threat will decrease, and that the perception of opportunity will increase as AI becomes more widespread.

This study aimed to fill this gap in the literature by presenting an up-to-date dataset on the paradoxical attitudes of young people towards AI. The results emphasise the need to consider the expectations and concerns of the younger generation, especially when developing education and awareness programs or designing AI policies.

The fact that a considerable proportion of students (42%) agree with the statement "AI could bring about the end of humanity" indicates a high level of concern about this vital issue. The higher threat perception of female students towards AI confirms the findings in the literature on the relationship between gender roles and perception of technological innovation but also indicates that some cultural factors may also come into play. The fact that male students emphasised the "opportunity" dimension of AI significantly more than female students clearly emerges from this study.

The results revealed that female students had higher threat scores in their perception of AI, whereas male students had higher opportunity scores. This indicates that women in technology fields may feel excluded or discriminated. Inclusive policies and positive incentives can be designed to break possible negative biases and enable women to benefit from AI technologies.

Unemployment and social inequality are among

the most prominent issues of concern for students. Policymakers can mitigate these concerns by designing employment and skill development programs that facilitate young people's adaptation to technological transformation.

Young people's perceptions of AI provide concrete guidance for future social and economic policies. Universities and technology developers should work together to develop strategies to overcome the "paradoxical" effects of increased technology use.

In summary, the data demonstrate that young people have both high expectations and deep concerns about AI. As the use of AI increases, the perception of threat decreases and that of opportunity increases. This finding has serious implications for the proper promotion, education, and integration of AI into society, while gender differences highlight the importance of inclusive technology policies.

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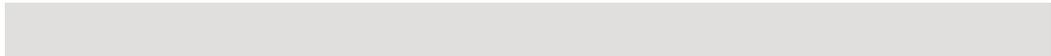
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THE ARTIFICIAL INTELLIGENCE PARADOX AMONG UNIVERSITY STUDENTS IN THE MALDIVES

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Citation: Moosa, D., Bozkurt, V., Reesha, A., & Shina, A. (2025). The artificial intelligence paradox among university students in the Maldives. In V. Bozkurt & D. Moosa (Eds.), *Artificial intelligence in education* (pp. 131–167). TESAM Publications. <https://doi.org/10.17574/tesam.97862561484685>

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1. Introduction

The roots of Artificial Intelligence (AI) can be traced back to the 1950s. However, it was mainly through generative AI (such as ChatGPT) that it entered the agenda of those outside the technology sector. Today, authors and technologists trying to explain societal transformation emphasize that we are on the verge of an unprecedented transformation (Rienties et al., 2024). However, there is also confusion among experts about the direction of this rapid change. Thus the discussion on the AI paradox of whether it is a threat or an opportunity in the context of various issues appears extensively in the literature.

In 2014, the renowned physicist Stephen Hawking drew a foreboding, almost apocalyptic picture of AI, suggesting that the speed at which AI will progress could mean the end of the human race (Rudolf et al 2024). The possibility that an AI that surpasses human intelligence over time could be out of human control (Bostrom, 2014) is one of the most popular topics of discussion even today. Nobel laureate Geoffrey Hinton, one of the pioneers of AI, expressed serious concerns about the rapid development of AI to the BBC (2024). According to Hinton, AI is increasingly likely to destroy humanity in the next 30 years, and humans could be as vulnerable to powerful AI systems as a three-year-old child. The uncontrolled development of AI carries great risks, Hinton said, particularly that malicious actors could use the technology to cause harm. Hinton, who reportedly resigned from his position at Google last year due to these concerns, argues that governments should regulate AI.

Despite this, there are many who argue that AI presents opportunities as much as it presents threats. Some authors see AI as a technology that will save humanity. For example, Marc Andreessen's paper "Why AI Will Save the World" (2023) argues that AI will not destroy the world, but rather save it. The paper argues that widespread fears about AI (death, societal destruction, unemployment, inequality) are unfounded, and that instead AI will increase human intelligence and accelerate economic growth. According to Andreessen, AI offers the opportunity to "profoundly increase" human intelligence, which could help us achieve better outcomes in many areas of life.

According to those who focus on the positive effects of this technology, AI can be used in fields as diverse as education, medicine, law and the creative arts. For example, in the field of education, every child could have an infinitely patient, knowledgeable and helpful AI teacher. This could improve education. Everyone can have an AI assistant, including students and teachers. Also, scientific discoveries and drug discovery processes can be accelerated (Andreessen, 2023; İlikhan et al., 2024; Özer, 2024; Schiff, 2021; Mohamed et al., 2022). Emphasizing the positive aspects of artificial intelligence, authors argue that artificial intelligence can provide a huge increase in productivity in all areas of society. Everything that is done with human intelligence today can be done much better with artificial intelligence. Andreessen goes even further and sees the development and deployment of AI as a moral obligation to our children and our future.

While the impact of AI on jobs may vary depending on the nature of demand (Bessen, 2019), there are also

major concerns about the possibility of AI leading to job losses, especially among students, unemployment anxiety stands out as a serious problem.

Many still see AI as a concept that belongs to the realm of science fiction and novels. As AI is used in various fields, it is inevitable that it will make its way into education as well (Lampou, 2023; Lane 2024). This means that the AI paradox in relation to education also exists with some favouring the advantages of AI in education. For instance, some authors (Lane, 2024), who think that the integration of AI into education is inevitable, state that while AI offers opportunities for efficiency and innovation, it can also create transparency and ethical issues. On the other hand, AI can both save time and waste time; it can encourage innovation and critical thinking on the one hand and hinder it on the other. However, Lane (2024) emphasizes that despite the risks, the potential benefits of using AI in teaching and learning outweigh the challenges.

Although the educational landscape of Maldives has evolved significantly over the years, the integration of AI in education and in higher education is still in its early stages. The education curriculum at the primary and secondary level places huge emphasis in digitisation. However, until the covid 19 pandemic, the use of technology in teaching and learning was considerably minimal (Adam et al, 2023). Hence, there is a gap in the literature on how students in the Maldives perceive AI, which is expected to profoundly impact humanity and education in the coming period. This research aims to contribute to the literature on this vital topic. By measuring students' perceptions of AI, this study will seek answers to the following questions:

1. Do students perceive AI as an opportunity or a threat? Or paradoxically both?
2. How does familiarity with generative AI affect the perception of AI as an opportunity or a threat?
3. What role do demographic factors such as age and gender play in the perception of AI as an opportunity or a threat?

2. Literature Review

AI paradox - the global perspective

Artificial Intelligence has transformed the education systems worldwide presenting both advantages and challenges often referred to as the AI paradox which explores the complex and often contradictory nature of AI. There are several recent studies that have explored the dual-edged nature of AI from various perspectives. For instance, a study by Bozkurt and Gursoy (2003) examined perception of AI as a threat or opportunity. They also looked at how demographic factors influence perception of AI. The findings support some existing literature that highlights that AI is perceived as both an opportunity and a threat. Wirawan and Saputri (2024) in their discussion of the AI paradox focused on two discussions: the importance of balancing the benefits of AI innovation with the risks of weakening critical thinking and autonomy with establishing ethical boundaries for AI usage. According to them, this requires a thoughtful approach from both individuals and the society as a whole. This will ensure that AI serves as a tool to enhance, rather than diminish human capacities. What has to be acknowledged is the fact that AI has revolutionised the various sectors globally by driving in-

novation and enhancing efficiency. It has improved decision making and optimised operations. In the field of education, AI has brought significant advancement including automation of administrative tasks thereby enhancing efficiency and effectiveness. AI also improves global accessibility to education by catering to students with specific needs, overcoming language barriers, promoting remote learning and boosting student engagement through immersive technologies (United Nations, 2025). In higher education AI is facilitating the development of new skills and competencies that are essential for future workforce, ensuring that graduates are well prepared for the demands of the job market today (Slimi 2023). However, discussions about the benefits of AI are invariably accompanied by cautionary notes and mentions of potential risks. Regardless of the direction it takes, AI will be a fundamental component of modern society and is here to stay. Therefore, it is crucial to maximize the benefits of AI while carefully considering and managing the associated risks.

Technology and AI in the Maldivian context

The Maldives is a small island developing nation with a population of 515,132 (Maldives National Bureau of Statistics, 2022). The island nation consists of 1200 islands out of which only 189 islands are inhabited. Despite its size and the unique geographical challenges, Maldives is one of the few developing countries in the Asia region making significant progress in its digital economy with high internet penetration and a strong network structure. Ookla speed directory ranked the Maldives as the 30th in the world among 146 countries indicating good internet speed and connectivity. Maldives also scored 95.1 in network coverage by GSMA mobile connectivity

index in 2022 (Digital Maldives Economy 2023).

The new curriculum places a lot of emphasis on technology in teaching and learning. However, integration of technology in education was minimal until Covid19 pandemic (Adam et al, 2023). This scenario is reflected in the higher education sector as well. However, according to a research by Hassan et al (2023), since Covid19 Pandemic the way lecturers perceive the use of technology and its benefit in teaching and learning is very positive. Recent statistics released in 2023 indicate that out of 360+ educational institutions situated in 200 islands in the Maldives, 70% of schools and colleges use smart devices in teaching and learning. The Maldives government places a lot emphasis on adopting Innovative digital technologies in various sectors including education. Following his recent official visit to Estonia, the president of Maldives announced plans to digitalise the education sector to enhance delivery of education across the nation. In an interview with PSM news, the President also shared his vision for advancing the nation's Artificial Intelligence (AI) sector, acknowledging AI's crucial role in national progress. He emphasized the administration's commitment to creating a National AI Masterplan, which will be essential for the country's development initiatives (PSM News, 2025).

Although technological access and use in all sectors including education is widespread, AI came into the picture quite recently (Moosa et al 2024). A recent study conducted in the Maldives revealed higher education students have a moderate level of AI literacy and that they use AI for various academic tasks including language support and personal development. The same students also indicated that while they acknowledge

AI's role in enhancing learning, they are also skeptical about its contribution to problem solving skills (Moosa et al, 2024).

Theoretical Framework

The Technology Acceptance Model (TAM) depicted below in figure 1.1, is a model developed by Davis (1989) that explains how individuals adopt and use technology, based on perceived usefulness (PU) and perceived ease of use (PEOU). PU indicates the extent to which a person believes that technology enhances performance whereas PEOU reflects on how easy and effortless the technology is to use (Slimi, 2023). This model is widely used to analyse technology acceptance in various fields, including education (Bozkurt & Gursoy, 2023). TAM was used in this study to examine how university students in the Maldives perceive AI and to find out the key determinants of whether they view it as a threat or an opportunity.

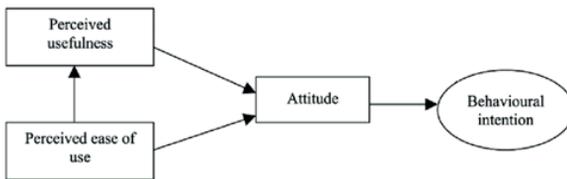


Figure 1.1 - Technology Acceptance Model (TAM) developed by Davis (1989)

The use of TAM in this study aided to analyse the survey responses systematically offering insights into how much students' attitudes towards AI are influenced by their demographics, exposure to AI, and technological confidence. In addition, it also helped to de-

termine whether increased exposure to and familiarity with AI tools lead to higher acceptance, which is in line with TAM's theory that greater experience improves PEOU and strengthens PU (Schiff, 2021). TAM also provided guidance for interpreting the correlation results, enabling the study to investigate the relationship between factors including perceptions of AI and variables including age, gender, and frequency of AI use and perceptions of AI.

Perception of AI as an opportunity

AI presents several opportunities by enhancing learning experiences through personalised education and improving student engagement. The integration of AI technologies and innovations in educational settings enables tailored learning and immediate feedback among many other benefits. Individual needs and differentiated learning are key terms that are frequently used in the literature on education. AI has the potential to address these by catering individual needs and promoting differentiated instruction (personalised learning). AI powered tools such adaptive learning systems, intelligent tutoring systems and learning analytics have the capacity to identify students' strengths and weaknesses. Based on this information AI powered tools are able to provide real time feedback and personalise learning to the needs of the students (Karmakar & Das, 2024). In addition, learning or educational analytics help educators to proactively provide intervention and support thereby improving learning. Timely intervention also improves students' motivation and academic performance (Silva et al, 2024). Additionally, AI powered learning systems foster a deeper connection between students and their content (Zaharuddin et al, 2024).

A study by Reyes and Meneses (2024) exploring AI's potential for inclusive education in a fully online environment highlights that AI facilitates accessibility and comprehension. A systematic review evaluating the current state of research on the impact of AI and Virtual Reality (VR) on enhancing educational accessibility, personalisation and social inclusion in education, presents some key findings, one of which is the transformative potential of AI and VR in enhancing learning. More specifically, the authors reveal that adaptive technologies can customise learning to cater to the disabilities of students. Similarly, VR promotes experiential learning by providing an immersive learning environment which is crucial for people with certain conditions (Chalkiadakis et al, 2024). Additionally, AI-driven solutions improve digital accessibility for visually impaired users through non-visual modalities like haptic and auditory feedback (Omitoyin, 2024). Technologies such as AI-powered screen readers and voice assistants enhance interaction with digital content, promoting independence (Eziamaka et al., 2024). The notion of accessibility is especially relevant to the context of the Maldives with geographically dispersed islands. Following the Covid19 pandemic, many students enrolled in higher education institutions left the capital, Male' to reside in their own islands. A few studies conducted in Maldives reveal that students prefer to study in their own islands (Hassan & Moosa, 2023). Due to this, the Maldives Qualification Authority (MQA) released guidelines for online teaching and learning for higher education institutions. Many of these institutions now offer online courses to cater to the needs of the student population residing in the outer islands of the Maldives. In this context, it is essential for higher education institutions to

ensure engaging and immersive learning experiences which AI tools and applications can provide. By leveraging these AI capabilities, the Maldives can overcome geographical barriers and provide equitable, high-quality education to all its students.

One of the primary goals of higher education is to prepare students for survival in today's world. Hence, it is crucial to focus on developing problem solving, critical thinking, leadership and communication skills. In addition, adaptability and resilience is important to survive in a rapidly changing world filled with uncertainty. Hence, it is equally essential to foster creativity and innovation and encourage students to think out of the box so that they can solve unique problems that they come across. In this digital age, digital literacy is also an essential skill that can help students to navigate the rapidly changing and evolving digital world. Literature highlights that AI has the potential to equip students with future ready skills and competencies. According to Subramanian et al (2024) AI can significantly contribute to skill development by reshaping workforce education strategies to meet the demands of an increasingly automated workforce. This point is emphasised by Sidhu et al (2024) highlighting that emerging economies face skill gaps in AI related competencies and this requires targeted training and collaboration between industries, government, and educational institutions to overcome these gaps and to prepare for an AI integrated workforce.

Perception of AI as a threat

Most literature discussing the potential of artificial intelligence (AI) also highlights the need for caution. While AI offers transformative possibilities across var-

ious sectors, it simultaneously presents significant risks that must be carefully managed. One of the negative concerns raised in the literature relates to job displacement and its impact on students' career prospects. This is explored in the study by Occhipiti et al (2024) revealing some disturbing statistics. The study investigated the impact of generative AI on job displacement and economic stability. While the authors acknowledge the positive aspect of AI, they focus more on the possibility of job loss due to AI advancement. Using a system dynamics model, the authors analyzed how an increase in the AI-capital-to-labour ratio affects labour underutilisation and demand in the economy. The results of the study indicate that even a moderate increase in the AI-capital-to-labour ratio could double current labour underutilisation levels. This is concerning as it means more people will struggle to find work and may be unemployed. The study also estimates that an increase in underutilisation could result in a 26% decrease in per capita disposable income which means people will have less money to spend affecting their quality of life. The consumption index could also drop by 21% indicating the possibility of lower level of spending leading to less business revenues resulting in more job losses. Based on the results, the authors highlight that a 10.8 fold increase in new jobs may be necessary (Occhipiti et al, 2024). Another study revealing similar findings predict that 30% of occupations may be at high risk and that it could impact over 800 million jobs globally, particularly in industries like transportation and manufacturing (Melemuku, 2023).

As AI technologies advance and are adopted in educational institutions, the possibility of data misuse and infringement of the right to privacy of students becomes

a concerning issue. AI systems contain vast amounts of personal data leading to the possibility of identity theft and unauthorised access to sensitive information (Choudhry et al, 2024, Ismail 2024) . For instance, AI systems used for monitoring and assessment of students have sensitive data about student performance and behaviour. It will be a breach of students' privacy in case these are not adequately protected or misused (Lowe, 2023) which is a reality in some contexts. Mukutu (2024) discusses this in the context of secondary schools in Kenya where AI incorporation has resulted in several unique challenges related to data privacy.

While AI has the potential to revolutionise education through personalised learning, there is also the risk of over-reliance on AI that can undermine the human touch or reduce human interaction and the social aspect of learning which could impact quality of education (Springer, 2023; Intech Open, 2023). Constant interaction with AI applications in education can also affect development of critical thinking and creativity as well as emotional intelligence that can be nurtured through human interaction (US Department of Education, UN 2025).

Exacerbation of existing inequalities in education is also a major concern raised in the literature. Firstly, only well funded institutions can afford AI tools which can widen the gap between privileged and the underprivileged (Reiss, 2021, UN 2025). Additionally, there is also the risk of the digital divide as some students do not have access to AI powered education tools (ERIC, 2023, UN 2025).

In general, students' perception of AI varies greatly. While some see the potential AI has in enhancing learn-

ing, improving efficiency and fostering innovation, others see it as more of a threat capable of replacing humans at certain jobs and reduced autonomy. However, since it is inevitable that AI will be an important aspect of modern life, it is important to balance the threats and opportunities of AI to maximize its benefits and minimize potential risks.

Factors influencing perception of AI as a threat or an opportunity

There are several factors that influence how students perceive AI. The amount of exposure and familiarity plays a significant role as tech savvy young people today are more likely to perceive AI more positively. The developmental and emotional stage of students are also influential in shaping students' perception of AI (Kundu and Bej, 2025). When considering gender and age, studies show conflicting results regarding perception of AI. Some research indicates that indicate that older students and females tend to perceive AI more positively associating it with benefits like facilitating learning and improving efficiency (Liu & Wu, 2024) while other studies suggest they are more apprehensive expressing ethical and privacy concerns (Rahman et al, 2024). Research also indicates that males have a more positive perception of AI than females (Brown et al, 2024). Although gender differences are evident, some studies suggest that the overall impact of gender on attitudes may be less significant than other factors, such as educational background or specific fields of study, indicating a complex interplay of influences on students' perceptions of AI(Hajam & Gahir, 2024).

These conflicting findings highlight the complexity of how demographic factors influence how students

perceive AI suggesting that cultural and social contexts as and individual experiences shape AI perception of people.

Based on the discussion of the literature, the hypothesis formulated for this study are as follows:

1a: Students perceive AI as an opportunity due to its potential to enhance educational outcomes and career opportunities.

1b: Students perceive AI as a threat because of concerns about job displacement and ethical issues related to AI deployment.

1c: Students perceive AI both as an opportunity and a threat, depending on the context in which AI is applied (e.g., education vs. employment).

Students who are more familiar with generative AI are likely to recognize its benefits and applications, reducing the perception of AI as a threat.

2. Increased familiarity with AI positively correlates with perception of AI as an opportunity.

Younger students and male students are more likely to perceive AI as an opportunity, while older students and female students may have a higher tendency to view AI as a threat due to varying levels of exposure and societal influences.

3. Demographic factors such as age and gender significantly influence the perception of AI

3. Method

The research methodology employed a close-ended online survey questionnaire developed to capture com-

prehensive insights across six distinct sections, including demographic profiling. To address the linguistic diversity of the Maldivian context, the survey instrument was designed in both English and Dhivehi languages. A rigorous back-to-back translation procedure was implemented to ensure semantic equivalence and linguistic accuracy between the two versions. Prior to full-scale implementation, the questionnaire underwent pilot testing involving 50 participants who were representative of the target population but excluded from the final research sample. This preliminary assessment allowed for critical evaluation of comprehension levels and instrument accuracy, enabling researchers to make necessary refinements and enhance the survey's overall reliability.

Sample and Data Collection

The data collection strategy focused on students from six private higher education institutions and two public universities across the Maldives, with a total population of 21,964 as documented by the Maldives Bureau of Statistics (2021). Utilizing Krejcie and Morgan's (1970) sampling framework, the sample size was determined to be 377 participants. The online survey methodology ultimately yielded 260 responses, representing a robust 69% response rate. Maintaining stringent statistical standards, the research was conducted with a 95% confidence level and a margin of error of 5%. The questionnaire links were distributed through selected institutional focal points, ensuring a systematic and targeted approach to data collection that maximized potential participant engagement and response quality.

Table1.Demographic characteristics participants

Variable	Category	n	%
Age	17-20	59	22.Tem
	21-30	103	39.6
	31-40	60	23.Oca
	41-50	29	11.Şub
	51 above	9	3.May
Gender	Female	189	72.7
	Male	71	27.Mar
Marital Status	Single	116	44.8
	Married	129	49.8
	Divorced	14	5.Nis
Employment Status	Waged Employee	128	49
	Not Employed	112	42.9
	Not Applicable	21	8
Occupation	Student Only	104	40
	Public Sector	79	30.Nis
	Employee		
	Private Sector	41	15.Ağu
	Employee		
Education Level	Self-Employed	26	10
	Other	10	3.Ağu
	Certificate	60	23.Mar
	Diploma	54	21
	Bachelor's Degree	105	40.9
	Master's Degree	28	10.Eyl
Field of Study	Doctoral Degree	4	1.Haz
	Education	77	29.May
	Health	58	22.Şub
	Business Management	44	16.Eyl
	Information Technology	17	6.May
	Other	65	24.Eyl

The participants of this study consisted of 260 students studying at HEIs in the Maldives. The ages of the participants ranged between 17 and 51 and above. When

the age distribution is analysed, it is seen that 22.7% of the participants are 20 years old and below. While the rate of participants aged 21-30 is 39.6%, the rate of participants aged 31 and above is 37.8%. In terms of gender, 72.7% of the participants were female and 27.3% were male. This distribution shows that the study is largely represented by female participants.

While 49.0% of the sample stated that they were employed, 42.9% stated that they were not. 8.0% of the participants answered 'not applicable' to this question. In terms of occupation, 40.0% of the participants stated that they were only students, 30.4% stated that they worked in the public sector, 15.8% stated that they worked in the private sector and 10.0% stated that they were self-employed. 3.8% of the participants represent other occupational groups.

While 40.9% of the sample had a bachelor's degree, 23.3% had a certificate, 21.0% had a diploma and 10.9% had a master's degree, while 1.6% have a doctorate degree. Again, 29.5% of the participants are studying in the field of education, 22.2% in health, 16.9% in business management and 6.5% in information technology. 16.9% of the participants are studying in other fields.

Instrument:

The two-dimensional 'Artificial Intelligence Paradox Scale' (Bozkurt & Gürsoy, 2023) was used to measure students' perceptions. The scale developed by Bozkurt and Gürsoy (2023) consists of two dimensions: AI as an opportunity and AI as a threat. As a matter of fact, the reliability coefficients of the scale were quite high in the study. The Cronbach's Alpha value of the AI as an opportunity factor is .846 and the AI as a threat factor is .863. Kaiser-Meyer-Olkin (KMO) measure of sampling

adequacy and Bartlett's test of sphericity were used to assess the suitability of the data set for factor analysis. KMO value was calculated as .819. Bartlett's test results were significant ($\chi^2(28) = 954.016, p < .001$). These findings indicate that there is a correlation structure between the variables suitable for factor analysis.

4. Results

As a result of Principal Component Analysis, two factors explain 70.912% of the total variance. The first factor explains 47.009% of the total variance and the second factor explains 23.903%. After rotation, the variance explained by the first factor was 36.448% and the variance explained by the second factor was 34.464% (See Table 1).

The mean of the AI factor as opportunity ($m=3.6$ on a 5-point Likert scale) is higher than the mean of the AI factor as threat ($m=3.23$) in the AI Paradox Scale regarding how students perceive AI as an opportunity or a threat. Most students tend to see AI as an opportunity.

Table 1. Exploratory Factor Analysis Results

	Component	
	AI as a threat	AI as an opportunity
5.8 I think AI will lead to mass unemployment	.880	
5.6 I worry that AI will increase unemployment	.874	
5.7 I think AI will increase inequalities in society	.829	
5.5 I worry that AI will bring about the end of humanity	.758	
5.3 I think AI will increase the efficiency of our work		.908
5.2 I think AI will make our lives easier		.861
5.1 I think the use of AI tools should be encouraged in HE		.755
5.4 The use of more robots (AI) in workplaces should be encouraged		.733
Explained total variance : 70,912	47.009	23.903

a. Rotation converged in 3 iterations.

At the item analysis level, 52.6% of the respondents are in favour of promoting the use of AI tools in higher education. The rate of those who oppose it remains at only 15.4%. Again, 79.6% of respondents claim that AI will make our lives easier and 75% claim that it will increase productivity in our jobs. Despite the risk of unemployment, 44% of students are in favour of encouraging the use of robots in workplaces. The rate of those who oppose the use of robots remains at 24.8%.

Table 2. Frequency Distribution of AI Paradox Scale Frequency Items

Questions	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
5.1 I think the use of AI tools should be encouraged	6.70%	8.70%	32.00%	36.80%	15.80%
5.2 I think AI will make our lives easier	3.50%	5.10%	12.20%	54.70%	24.40%
5.3 I think AI will increase the efficiency of our work	3.90%	7.80%	13.30%	51.20%	23.80%
5.4 The use of more robots (AI) in workplaces should be encouraged	5.50%	19.30%	31.10%	31.50%	12.60%
5.5 I worry that AI will bring about the end of humanity	14.50%	20.70%	24.60%	28.50%	11.70%
5.6 I worry that AI will increase unemployment	8.70%	13.80%	19.40%	38.70%	19.40%
5.7 I think AI will increase inequalities in society	5.90%	22.40%	28.30%	28.00%	15.40%
5.8 I think AI will lead to mass unemployment	7.80%	21.20%	27.50%	28.20%	15.30%

Although those who see AI as an opportunity are in the majority, almost half of them also see it as a threat. 58.1% of the students stated that they fear that AI will increase unemployment, 43.4% inequalities and 43.5% mass unemployment. In addition, a very high rate of 40.2% claim that AI will bring the end of humanity.

Both means and frequency distributions show that the attitudes of HEIs students in the Maldives towards AI technologies have both positive and negative aspects. While students recognise the opportunities AI provides in areas such as education and work productivity, they are also concerned about potential threats such as unemployment, social inequalities and existential risks.

Table 3. Correlation Analysis

		AI_threat	AI_opportunity	2.2 Generative AI Usage)	1.1 Age	1.2 Gender
AI_threat	Pearson Correlation	1	-.315**	-.198**	-.043	-.158*
	Sig. (2-tailed)		.000	.002	.493	.011
	N	257	257	253	251	256
AI_opportunity	Pearson Correlation	-.315**	1	.336**	.087	.116
	Sig. (2-tailed)	.000		.000	.169	.063
	N	257	258	254	252	257
2.2 Generative AI Usage	Pearson Correlation	-.198**	.336**	1	-.185**	-.048
	Sig. (2-tailed)	.002	.000		.003	.444
	N	253	254	256	250	255
1.1 Age	Pearson Correlation	-.043	.087	-.185**	1	.140*
	Sig. (2-tailed)	.493	.169	.003		.026
	N	251	252	250	255	254
1.2 Gender 0-Female, 1-Male	Pearson Correlation	-.158*	.116	-.048	.140*	1
	Sig. (2-tailed)	.011	.063	.444	.026	
	N	256	257	255	254	260

In this study, the relationships between perceptions of AI as opportunity and threat and demographic factors (age and gender) were analysed by Pearson correlation analysis. The results of the analysis show that there are significant relationships between the perception of AI as threat and opportunity and these factors. A negative, significant correlation was found between perceiving AI as a threat and perceiving AI as an opportunity ($r = -.315$, $p < .001$). This finding shows that perceiving AI as an opportunity reduces the perception of threat.

On the other hand, no significant relationship was found between perceiving AI as a threat and age ($r = -.043$, $p = .493$). However, a negative, significant correlation was found between perceiving AI as a threat and gender ($r = -.158$, $p = .011$). This result indicates that female participants tend to perceive AI as a threat more. On the other hand, no significant relationship was

found between the perception of AI as an opportunity or threat and the level of education.

On the other hand, a negative, significant correlation was found between the perception of AI as a threat and the use of generative AI ($r = -.198$, $p = .002$). This result shows that as the use of generative AI increases, the perception of AI as a threat decreases. On the other hand, a positive, significant correlation was obtained between the perception of AI as an opportunity and the use of generative AI ($r = .336$, $p < .001$). Findings reveal that as the use of AI (familiarity) increases, we see that the perception of opportunity strengthens and the perception of threat decreases.

5. Conclusion and Discussion

This study examined the perceptions of HEIs students in the Maldives towards artificial intelligence (AI) technologies. HEIs students paradoxically perceive AI as both an opportunity and a threat. Only the perception of opportunity ($m=3.6$ on a 5-point Likert scale) is slightly higher than the perception of threat ($m=3.23$). Although the findings on the effects of demographic variables (age, gender) and generative AI use on opportunity and threat perception partially confirm the arguments of similar studies in the literature (Andreessen, 2023; Bostrom, 2014; Hinton, cited in BBC, 2024), there are also differences.

According to the findings, the majority of students (79.6%) believe that AI will facilitate daily life, increase work efficiency (75%) and the use of AI tools in higher education should be encouraged (52.6%). In contrast, about half of the students are concerned that AI may increase unemployment (58.1%) and social inequalities

(43.4%). A significant number of participants (40.2%) believe that AI has the potential to bring about the end of humanity. These data show that students both embrace the benefits offered by AI and are concerned about potential risks.

Correlation analysis results also confirm this paradox. The finding of a negative and significant relationship ($r = -.315$, $p < .001$) between perceiving AI as an opportunity and perceiving it as a threat reveals that as the perception of opportunity increases, the perception of threat decreases as expected. In addition, gender-related findings show that female participants perceive AI as a threat more than male participants ($r = -.158$, $p = .011$). This finding brings up the interaction between gender roles and approach to technological innovations (Bozkurt & Gursoy, 2025).

On the other hand, it was found that threat perception decreased ($r = -.198$, $p = .002$) and opportunity perception increased ($r = .336$, $p < .001$) with the increase in generative AI use. This shows that technological familiarity and usage experience reduce the level of fear or uncertainty of individuals (Schiff, 2021). As the frequency of AI use increases, students witness increased efficiency in their work and perceive more opportunities.

The findings of this study are largely in line with the academic literature stating that AI offers opportunities for education, medicine, law and creative industries (Anderson, 2023; İlikhan et al. 2024). As a matter of fact, a significant portion of the students have a positive view on the use of AI.

On the other hand, other researchers (Acemoğlu and Johnson, 2023; BBC, 2024; Bostrom, 2014) emphasise the unemployment, social inequality and possible existen-

tial threats to the future of humanity that AI will create. In parallel with the views in the literature, HEIs students in the Maldives witnessed concerns about AI. In other words, the findings of the research overlap with the literature on the risk-opportunity balance discussed in the field of AI (Bessen, 2019; Lane, 2024).

The findings also coincide with the findings of the same research in Türkiye (Bozkurt, Gülerce, 2025). Based on the findings of this research, AI literacy and awareness training are recommended to policy makers. As the use of AI becomes widespread, the perception of it as a threat decreases, while the willingness to incorporate it in their work increases (Mohamed et al., 2022).

In addition, the fact that female students perceive AI as more threatening than males reveals the importance of incorporating a gender perspective into technology policies. In this direction, directing girls to STEM (Science, Technology, Engineering, Mathematics) fields and expanding mentoring programmes can help to foster a more positive perception of AI.

Hinton's (BBC, 2024) warning about AI should be taken seriously. AI brings risks as well as great opportunities for humanity. Hence, ensuring transparency and holding AI companies accountable is crucial. Policy makers must implement regulations that protect user privacy and data while minimizing the possibility for AI misuse (Lane, 2024; Özer, 2024).

A significant number of students are concerned that AI will increase social inequalities and unemployment. Therefore, labour transformation programmes and social protection mechanisms should be prioritised in the formulation of AI policies (Acemoğlu & Johnson, 2023). Efforts such as reskilling and upskilling can soften the

socioeconomic impacts of technological transformation (Bessen, 2019).

6. Recommendations, Policy Impact, and Future Research

The results of the study provide several key recommendations to promote a balanced approach to AI deployment. First, educational institutions should introduce AI literacy and awareness programs to enhance understanding and minimize misconceptions.. Additionally, increasing female participation in STEM fields through scholarships, mentorship programs, and awareness campaigns can help reduce gender disparities in AI perception. Regulating ethical AI development and encouraging responsible AI use are two more ways that policymakers may guarantee AI accountability and transparency. Furthermore, reskilling and upskilling programs should be prioritized as social protection measures to mitigate the impact of AI-driven job displacement. Lastly, establishing guidelines for ethical AI use in higher education is essential to ensure a balance between innovation and ethical responsibility.

The adoption of AI carries significant policy implications. Establishing a National AI Masterplan can facilitate the integration of AI into the education sector while managing its risks and maximizing its benefits. To address disparities in AI adoption and perception, gender-inclusive technology policies should be implemented. Additionally, labor transformation policies must be developed to protect jobs while promoting AI-driven advancements. Ensuring robust data privacy and security regulations is crucial for safeguarding users from potential AI-related risks. Moreover, univer-

sities and research institutions should introduce governance frameworks to uphold ethical AI use in higher education.

Future study should concentrate on long-term studies to better understand how people's attitudes toward AI evolve over time. Comparing groups based on age, gender, and field of study can provide more information about AI acceptability. Studying the consequences of AI education programs and how AI is used in universities can help policymakers develop better solutions. Finally, understanding how economic and social backgrounds influence AI opinions will be critical for developing equitable and inclusive AI policies.

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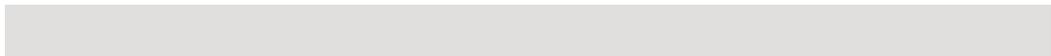
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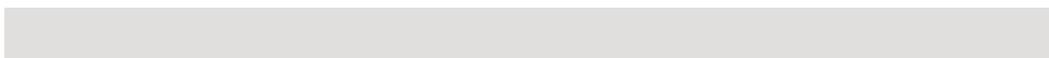
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ARTIFICIAL INTELLIGENCE IN EDUCATION: CHANCES OF AI- GENERATED IMAGES FOR ENHANCED LANDSCAPE ARCHITECTURE DESIGN

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Citation: Mertens, E. (2025). Artificial intelligence in education: Chances of AI-generated images for enhanced landscape architecture design. In V. Bozkurt & D. Moosa (Eds.), *Artificial intelligence in education* (pp. 169–199). TESAM Publications. <https://doi.org/10.17574/tesam.97862561484686>

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Introduction

In landscape architecture, a great part of planning, design and construction is developed and presented in drawings. The core question of an internal university research and student project is to what extent images can currently be generated with artificial intelligence and be utilized for implementation in real projects. The construction will be simulated with 3D printing, aiming to realize as many steps as possible from the initial image to the finished print using AI.

This paper discusses an ongoing research and student project exploring the use of AI in landscape architecture design projects. While there are high expectations to replace many time-consuming working hours using suitable AI-software, there are still gaps in the process and new questions arise. The paper describes current tests and possibilities, acknowledging that the situation may change quickly.

The University of Applied Sciences and Landscape Architecture

The student project, whose approach and results are presented here along with initial assessments runs from March to June 2024. It involves eleven students from the fourth and eighth semesters of the Bachelor's degree programme in Landscape Architecture at Neubrandenburg University of Applied Sciences in Germany. This university focuses on applied research and teaching, offering an eight semester Bachelor's programme in Landscape Architecture and an international Master's programme lasting 2 to 4 semesters.

According to IFLA, the International Federation of

Landscape Architects, “Landscape Architects plan, design and manage natural and built environments, applying aesthetic and scientific principles to address ecological sustainability, quality and health of landscapes, collective memory, heritage and culture, and territorial justice.” (IFLA World Council in September 2020). In Germany, landscape architecture also includes the supervision of landscapers during the implementation of planning and design. Therefore, they are involved from the first ideas for a site design until it is built and needs to be maintained.

The process for open space planning projects in Germany is divided into nine service phases, starting from basic evaluation to design and implementation to construction, each phase is described in detail. The profession of landscape architecture is currently extremely important, particularly regarding climate change and the biodiversity crisis, but little about its benefits is known to the general public. Given the broad range of tasks, and the relatively limited number of landscape architects, most professionals spend a significant amount of time producing drawings either by hand or, nowadays mostly, with software products and computers. As this work is very time-consuming, the idea is to out-source part of the work to AI to save time for developing better concepts, interdisciplinary cooperation and other important tasks. In the end, the use of AI should support the development of landscape architecture projects, improve the outcome and visibility of the projects and the profession and enhance our environment.

Research Questions

In the project presented here, objects and issues of open space and garden planning are considered, as they

are suitable for the use and above all the assessment of the use of image - generating AI in contrast to regular drawings. This article refers to a current internal university research and student project with the following questions:

- (how) can AI support the work of landscape architects with AI-generated images?
- Which service phases can be meaningfully processed or supported with AI?
- What added value can AI have for the training of future landscape architects?
- Can AI strengthen the importance of landscape architecture through better opportunities for interdisciplinary cooperation and make the functional parameters in planning more visible?
- Can students' interest in studying landscape architecture be increased through the use of AI in teaching and improved digitalisation?

Studio Description

At the beginning of the semester, most of the students had a great deal of curiosity, but little experience in the use of artificial intelligence. Due to the equal starting conditions and the initially open questions, which were then constantly developed further together, all students were equally challenged, but were also able to contribute similarly to the success and progress of the project and the shared findings. Compared to other projects, the motivation to learn together was and remained consistently high throughout the semester, and the learning success can be rated as high, even though the AI will continue to develop and thus change. The students and

also the lecturers are given a starting signal for the further use of AI, as it can no longer be negated.

Exercises and tasks

1. The project group first identified several free that are generally suitable for creating images in relation to landscapes from commands (“prompt to image”). The text input was free, the students worked in pairs. The results were very different between the groups, partly due to the software tested and partly due to the different focus of the students. Some stuck strictly to the patterns they had learnt during their studies, while others were more free to generate images from their imagination and in more fantasy-style.

This exercise has already inspired the students to engage with AI and create results as it was easy, fast, and of good quality. They have learnt that the command must be written in detail and correctly and that incorrect input can produce undesirable results. However, the results are usually very surprising, both as unwanted and unexpected but mainly positive results. Technical terms, for example botanical plant names, were not recognized and therefore ignored.

Communication with the software except for entering the prompt was not possible, but in some cases, it was possible to further develop previously generated results. This property of AI is very helpful for landscape architecture in order to improve initial results. Images that are generated from scratch are less useful, as they can rarely be reused in the further planning process. The speed with which images were generated was impressive; some displayed four comparable but different images immediately. The depiction of people, which

is often used to represent open spaces in perspectives, turned out to be very different. In some cases, they appeared without limbs or heads, rendering the images unusable overall; in other cases, they depicted people in an almost photo-realistic way.

Fig. 1 a-c: Selected prompts and results of first exercise:

1a) "A mountain landscape with a hut, it is raining and two hikers are on their way to the hut."



Comment: No rain. Not 2 hikers, but 3 hikers, missing heads.

Credit: Sarah Hartmann and Aurica Meißner

1b) “Children under a tree, with drinks bottles in their hands.”



Comment: very realistic result.

Credit: Ben Urban

1c) Example of a further development of a generated image:

A: "A mountain landscape with a river in the valley and a pasture with a hut at night with moon and stars."



B: “It is raining and stormy”



Credit: Sarah Hartmann and Aurica Meißner

2. After leaving the representation of the images open in the first exercise and generating images as perspectives, the next step was to create more common types of images in landscape architecture. As horizontal projections and sectional views are usually constructed first and axonometries and perspectives only last in project processing, the respective softwares were checked to see to what extent the type of representation can be requested.

This initially showed that the results are significant-

ly different, better, when the command is entered in English rather than in German. This is understandable, as the relatively small profession of landscape architecture can provide fewer inputs for training the AI than larger subject areas, and the restriction to German represents a further limitation. Fortunately, the change of language does not cause any difficulties for the students.

Some software proved to be unusable for generating garden layouts from a description, while others proved to be of limited use after several attempts. Often, if a two-dimensional representation was produced at all, a floor plan for a building with an open space was displayed. This does not correspond to the task in landscape architecture - but as a side effect encourages the building and the associated open space to be developed more in harmony with each other, which does not usually happen.

Often, apparent floor plans were often depicted, but the trees were not shown as a 2-dimensional representation, but in perspective. These images can nevertheless be helpful, as the landscape architect should be able to easily translate them into a 2-dimensional plan.

The focus on the drawing also sometimes produced additions such as coloured pencils at the edge of the image, which were undesirable but created an understanding of the software's approach when asked to create drawings.

The great advantage of AI in this area is certainly that alternatives can be generated in a short time, which can then be used at least in part for the designer's own strategies. This provides the designer with many suggestions that she would otherwise only have been able to realise through many hours of design work or that

he might not have been able to develop himself. As the designer's own work must always be adapted to the location and the AI's proposed solutions must be verified and adapted, it will not be possible to replace the designer's own work. However, a lot of time can be saved at the beginning of a planning process, especially if you are already familiar with working with AI. AI can also be used to test different visualisation styles, which is certainly an enrichment for every landscape architect, as the range of visualisation options available to people is usually rather limited.

Fig. 2 a-c: Selected prompts and results of second exercise:

2a) " Show me a top view from a garden with flowers and vegetables. "



Credit: Ben Urban

2b) „Landscape garden plan fenced garden with trees, benches, pond, flower bed”



Credit: Frauke Greiner and Rowena Riemer

Comment: partially illogical path layout, black and white floor plans not included, no flowers

2c) „a forest should surround 4mx 8m square garden enclosed by a fence on 3 sides on the 4th side there is a path leading to the entrance of the garden on the ridge there is a pergola, a swimming pond and several flower beds“



Credit: Rowena Riemer and Frauke Greiner

3. Another task that the students looked for independently was the processing of their own plans, which were to be further processed by the AI (image to image). Often, the representation of a 2D floor plan in a simple design is developed quite quickly and the design intentions are shown. However, the “beautiful” execution of the drawing takes much longer and when it comes to rendering, a lot of time and various softwares are required. AI could therefore also provide good support and save time here. However, experience showed different results, as the AI had to recognise and implement the content of the plans. This was surprisingly successful, usually better when the content of the templates was explained. The improved visualisation was very convincing for sectional views, which can either be calculated and rendered in the usual way over many hours or generated by the AI in a very short time.

A new difficulty arose in that the font usually used in plans could not be recognised by the software in any helpful way. Whether headings or plan labelling, all let-

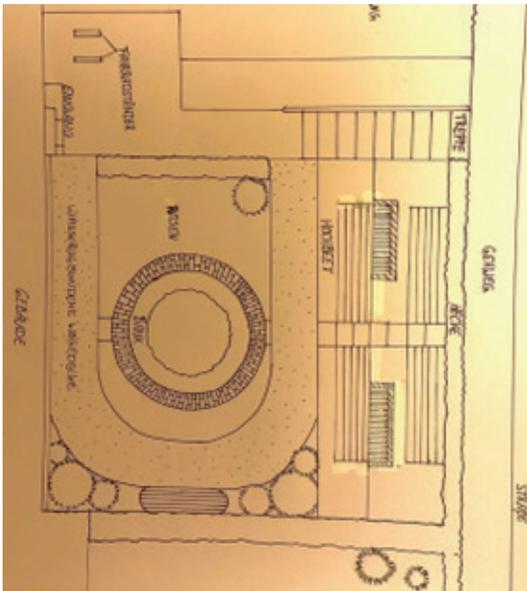
terings were transformed into cryptic characters. This would therefore be a first and very obvious feature for recognising the use of AI in the planning process.

An AI module was added to the CAD software normally used for design projects, but unfortunately, the students were not able to test it with their licence. They are informed and very motivated to try out the possibilities that will certainly be available in the near future.

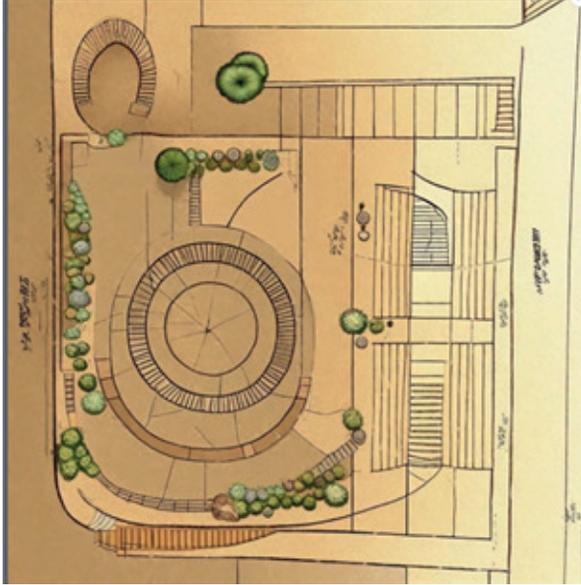
Figure 3 a-c: Selected prompts and results of the third exercise:

3a): Initial plan from a previous design seminar and “sketch-to- image” results: “This is a front garden, the round shapes are plants and the straight shapes are paths, benches or steps. Colour this site plan”

student’s sketch:



AI developed image from sketch:



Credit: Sarah Hartmann

3b) Initial plan from a previous design seminar and “sketch-to- image” results: “This is a landscape architecture design of a natural park in herringbone structure. The paths are the bones and the spine. Between the paths are trees. The tail at the top is a car park. The head at the bottom is a square.”



3c) Rendering of a CAD-produced section created with AI: CAD-Drawing:

CAD-Drawing:



AI-Rendering:



Credit: Benjamin Eisenbart

4. In the course of planning work, the technical execution drawing is created after the design; it contains all dimensions and construction methods. It turned out that the dimensioning, which consists of characters, was used, so that some AI-generated drawings look realistic, but the labelling is not useful. The results could still be used if they meet the requirements, either as a template for your own drawings or as a drawing to be supplemented by labelling.

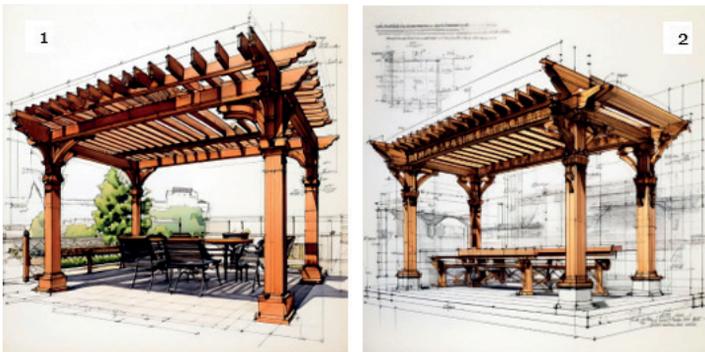
One example that was tested in several software programmes was the depiction of a playground with a red slide. This example illustrates how different the results of AI can be in terms of meaning and usefulness. The same commands were used to compare the results, making them comparable. It was impressive to see that they ranged, in part through slight changes to the prompt, from the representation as a picture to a plan drawing to the impression of a technical drawing. The visualisation of a double slide, for example, provides inspiration. This is not known in this form, but can certainly serve as a new game idea due to the possibility of being able to slide in parallel. Some suggestions were surprisingly difficult to realise if the slide could not be reached, if it

hit a wall at the end or if it could not be built twisted in on itself. Nevertheless, all the results encourage people to rethink the possibilities, question their own thought patterns and allow for new ideas. This is also a positive learning effect that teaches students important insights into their subject, digital media in general and social media in particular in a fun and motivating way.

The further steps in the planning process, the drafting of a specification and construction management, are hardly ever visualised and have therefore not yet been part of this project.

Figure 4 a-c: Selected prompts and results of fourth exercise:

4a) “Technical detail drawing of a pergola” (1) and Pergola detailed in technical drawing style, pencil on sketch paper, showing joined timbers, bracing, proposed vines climbing along, elevation and plan views juxtaposed, pg. Shading, detail of fastening systems, hatching shading technique, measured dimensions, annotated with notes, high precision, architectural concept sketching (2).



Credit: Jana Platonov

4b) “Ground plan, playground, red slide in sand” (1, 2) or “top down plan of a playground with a slide” (3)



Credit: Benjamin Dienst

4 c) Prompt created by AI:

“landscape architecture ground plan.

Welcome to Serene Haven Playground, where the harmony of nature and playful delights converge. This ground plan embodies a tranquil yet adventurous atmosphere, blending meandering stone paths, vibrant play equipment, and lush greenery to create a haven for exploration and joy.

Design Elements:

Meandering Stone Path: A winding stone path gracefully guides visitors through the playground, inviting them on a journey of discovery and wonder. The irregular arrangement of stones adds a rustic charm, enhancing the natural aesthetic of the space.

Red Slide in Sand: A striking red slide stands tall amidst a soft bed of sand, beckoning children to embark on thrilling adventures. The contrast between the vibrant slide and the neutral tones of the sand creates a focal point that captures attention and sparks excitement.

Grass Areas: Sprawling patches of lush green grass offer ample space for leisurely picnics, spontaneous games, and carefree frolicking. The verdant carpet of grass serves as a refreshing oasis, inviting visitors to unwind and connect with nature.

Play Equipment: Various play structures dot the landscape, providing endless opportunities for imaginative play and physical activity. From swings and climbing frames to monkey bars and balancing beams, each element is thoughtfully integrated to cater to diverse interests and abilities.

Sketch Style: The ground plan is rendered in a charming sketch style, exuding a whimsical charm that captures the essence of childhood nostalgia. Hand-drawn details add a personal touch and evoke a sense of warmth and familiarity.

Plants: A curated selection of native plants adorns one side of the playground, infusing the space with color, texture, and fragrance. Vibrant flowers, verdant shrubs, and graceful trees create a picturesque backdrop, enhancing the visual appeal and ecological diversity of the environment.

Overall, the ground plan of Serene Haven Playground embodies a harmonious blend of aesthetics and functionality, offering a serene retreat where laughter echoes and imaginations soar."

Result:



Credit: Benjamin Dienst

5. The university campus needs to be improved, as the budding landscape architects see every day. It therefore made sense to have the AI make suggestions as to how individual areas of the campus could look. Photos were entered into different software and parts that could be changed were marked. The results are attractive, largely correct in terms of perspective and in some cases very impressive. Even if the images cannot be fully realised, they could be used to stimulate a discussion within the university about wishes and goals for

the use of the campus. The software offers options for adjusting the appearance of the currently rather unusable areas, and some of the results are very exaggerated. But aren't exaggerations sometimes useful to stimulate the creativity of those who enter the grounds every day without thinking about the quality and to shake them up? Images can also be suitable for this purpose; the AI generates them in a variety of interesting ways in a very short space of time. The flood of images is particularly impressive in this test.

Figure 5 a - b: Selected prompts and results of fifth exercise:

5a) "Garden with Meandering Stone Path, lush planting and flowers, add façade greening", to change garden in front of a university building



Credit: Benjamin Dienst

5b) An area in the photograph of a site on Campus was marked to be changed, then the garden style was specified:



(1) English



(2) Mediterranean:



(3): Japanese:



Credits: Sarah Hartmann

6. The next step was to test the extent to which the AI-generated images of gardens and landscapes could be translated into reality. Since we as a university cannot directly realise and build plans, we should try to create three-dimensional objects using AI, which can then be printed to scale in the 3D printer. Converting two-dimensional images into a three-dimensional model of a garden or landscape proved to be a major challenge. In smaller sections, for example, it was possible to create a tree with a bench on a sloped base.

The other challenge was that the 3D printer usually has to print supporting structures for trees, which proved to be a technical problem for a while. The printing of all AI-generated trees or landscapes with trees was therefore suspended for a while. Instead, the students initially focused on producing models of furnishings for open spaces. The first object was a bench. This bench was generated by an AI as a template and then printed in a length of approx. 10 cm. In appearance, it resembles many of the benches found in open spaces that are offered by companies and were certainly not modelled using an AI. However, the development of this bench is purely the result of an AI and shows a possible way to produce new elements from an AI in 3D printing, even on a 1:1 scale. Further tests on the production of 3-dimensional bench models have led to much more imaginative models, such as the “frog bench”, which could be very well placed in kindergartens, or the “leaf bench”, which seems suitable for gardens and private open spaces. In any case, they encourage us to rethink products that are available in catalogues but can still be easily developed and adapted. During the trials, there were also results where it quickly became clear that although the idea was impressive, a bench with only two

legs, one on each side, still needed to be worked on to become stable.

Figure 6 a - c: Selected prompts and results of sixth exercise:

6a) "A red bench"

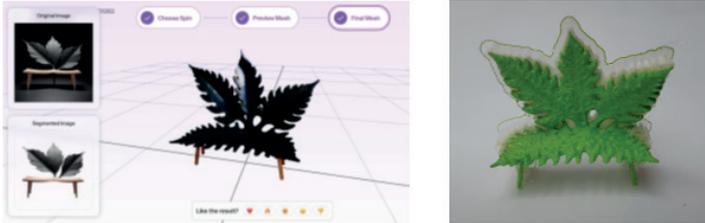


The results of the 3D-printer:



Credit: Jana Platonov

6b) a bench created from the shape of leaves, and the print



Credit: Benjamin Dienst

6c) a bench resembling a frog, could be used in a Kindergarten, and the print



Credit: Arthur Westphal

7. In the course of the project work, it was tested whether a three-dimensional model can be generated from a floor plan. This endeavour generally failed. Even floor plans could not be created clearly, and the AI can-

not recognise plan contents, so that it is hardly possible to translate the drawn objects into height. There is a need for further research in this area.

Conclusion and open questions

What do we learn from such projects? Is AI just a gimmick? Or can it be put to good use in teaching?

AI is an option that is becoming bigger and more important rather than something we can overlook. That's why all teachers and universities should look into the topic, the possibilities and the challenges. AI will not replace professors, but they must qualify themselves. AI can also change the content of courses and the way examinations are organised. It is good if and when universities plan which boundaries should be set and how.

Especially for at least partially creative professions and degree programmes, it makes sense to introduce students to the possibilities of AI - in the masses, they are faster than a teacher can be. In the project described above, it proved to be very useful to specify the question, but leave it open so that the students could try out their own ideas with a lot of motivation and vigour and thus all learn together and from each other. If the question remains as to whether this is still good teaching - yes, it is because the ability to think independently, to engage in constructive dialogue with one's own peer group, the knowledge of how everyone can help themselves, the joy of learning new skills and gaining new insights are certainly good prerequisites for good teaching. The students also become people at eye level, a very democratic idea for teaching.

For landscape architecture, AI is certainly a good

option for producing images more quickly, even if the results need to be scrutinised for their purpose. Its use may mean great time savings, greater creativity and improved visualisation of changes in location. These advantages predominate in the first service phases, from design to implementation planning. In the performance specification and construction supervision phase, AI can provide more support in managing and analysing data. These tasks were not analysed in this project. A big But puts the use of AI in perspective: students still need to know and learn the basics in order to be able to judge the proposed solutions. Without sound knowledge of materials and plants, knowledge of good and sustainable construction methods and ecological relationships, a project cannot become good landscape architecture. The subject is complex and must fulfil sustainable functional requirements such as current contributions to climate adaptation, increasing biodiversity and social justice.

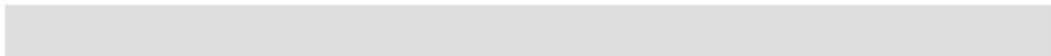
An additional benefit of AI is the proof of functional fulfilment for landscape architecture. It will become increasingly important to prove how much the green-blue infrastructure has an effect on cooling urban areas during heatwaves, how much evapotranspiration by plants and soils contributes to transpiration in an area, how much rainwater is stored, infiltrated or evaporated in soils, substrates or water surfaces during heavy rainfall. These statements are individual due to the great differences in soil and plant conditions, but predictions are essential. These facts would greatly contribute to the importance of the profession. At the same time, interdisciplinary cooperation could be strengthened, as the benefits of nature-based solutions can be better combined with methods from other spatial and urban planning

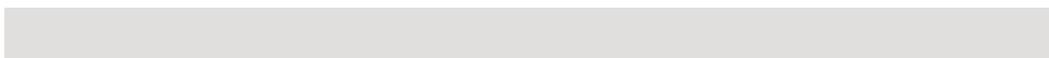
disciplines using this data.

The improved chances for landscape architecture are particularly convincing arguments in favour of using AI. As part of the necessarily greater digitalisation, it is very suitable for attracting students in high schools to study, promoting interdisciplinary cooperation and informing society about the goals and necessity of landscape architecture to create better habitats for people, fauna and flora.

Quote: <https://iflaeurope.eu/index.php/site/general/landscape-architecture-profession#:~:text=Landscape%20Architects%20plan%2C%20design%20and,and%20culture%2C%20and%20territorial%20justice.> [15.03.2025]

Images: All images were produced during the project by students, credits are given





ARTIFICIAL INTELLIGENCE AND MISINFORMATION IN TÜRKİYE

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Citation: Bozkurt, V., Gülerce, H., & Demir, N. (2025). Artificial intelligence and misinformation in Türkiye. In V. Bozkurt & D. Moosa (Eds.), *Artificial intelligence in education* (pp. 201–225). TESAM Publications. <https://doi.org/10.17574/tesam.97862561484687>

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Introduction

Artificial intelligence (AI) is rapidly impacting daily life, from academic production to marketing strategies, and from social media content production to personal health, education, and more. Creative AI models in audio and video content have introduced a new dimension to discussions on rethinking and redefining perceptions of truth and reality. The widespread use of artificial intelligence has brought advantages that facilitate daily workflows.

In this new era of increased machine-to-machine interaction and rapid information transfer, fundamental and phenomenal changes have occurred in traditional social development processes. Following human-machine communication, advances in machine-to-machine interaction have led to extraordinarily successful and efficient results in predicting the future using algorithms. These advances in communication have redefined daily routines with algorithmic logic-based applications that are independent of biological processes, ranging from personal relationships to economic forecasting and from academic assignments to medical diagnoses.

Generative AI is evolving at a rapid pace, increasing its potential to generate and disseminate misinformation and accurate information. For this reason, the ability of generative AI to create seemingly real text, images, audio, and video is of growing concern worldwide. AI-generated deepfakes used to manipulate public opinion pose a significant risk to humanity (Garimella & Chauchard, 2024; Monteith et al., 2023). Although misinformation is not a new phenomenon (Broda & Strömbäck, 2024), it has increased and become danger-

ous to an unprecedented degree with the advent of generative AI.

Today, people are concerned that artificial intelligence (AI) can manipulate information and spread misinformation. Therefore, this study examines how university students perceive the risk of misinformation posed by AI and its relationship to AI use and AI literacy. This topic has not been adequately addressed. Therefore, this study aims to fill this gap in the academic literature.

Literature Review: Artificial Intelligence and Misinformation

Researchers have expressed concern about the potential for AI systems to exploit human psychology and vulnerabilities through multifaceted cognitive mechanisms (Dezfouli, Nock, & Dayan, 2020). The concern of using time economically has led to artificial intelligence being seen as a personal health consultant, making it a fast and comfortable tool for patients' medical information needs, thus giving it an advantage as a preferred option. A study on psychiatric patients showed that generative AI technology can provide dangerous advice due to erroneous information, potentially leading to fatal consequences by spreading such misinformation (Monteith et al., 2023, pp. 33-35).

Despite the rapid and impressive advances in deep learning, these advances are still only 90% likely to produce accurate information through AI development techniques. The remaining 10% of misinformation can have serious negative consequences, and the process of detecting and eliminating these inaccuracies can cause significant time and investment cost issues (Mitchell, 2019).

In 2016, Microsoft launched Tay, a chatbot on Twitter that learned the offensive and sexist expressions of Twitter users in a very short time and produced a language that drew reactions. Because of the unsupervised learning process, Microsoft blocked Tay within 24 hours. Similarly, the sexist evaluation in the artificial intelligence tool used by Amazon for recruitment processes evaluated female candidates as disadvantaged, and Amazon consequently removed the algorithm from use (Dastin, 2018). These two global incidents can be considered concrete examples of the extent to which artificial intelligence applications can be trained using biased and deliberate data to spread discrimination. In this regard, measuring the quality of data used for AI learning, ensuring and auditing source security, algorithm transparency, and selecting algorithm evaluation techniques are of great importance. The possibility of bias and abuse in the data that AI is trained on should be considered, and feedback mechanisms should be made widely accessible. For example, the use of content verification tools can be expanded by simplifying reporting options.

The launch of ChatGPT in November 2022 marked a significant milestone in the widespread adoption of AI. ChatGPT's advanced typing and comprehension capabilities reached a wide audience with astonishing speed, garnering unprecedented interest. This was the first time an audience of outside machine-learning professionals realised the potential and immediate applicability of AI and responded with intense interest. In the context of widespread mass interest, education is among the areas most impacted by ChatGPT. ChatGPT's potential to offer smart tutoring systems regardless of location, while also being a tool for academic misconduct, has initiat-

ed discussions in the field. In the contemporary era, the concept of school can be perceived as a virtual space where students and teachers come together to collaborate and participate in the educational process (Timms, 2016, pp. 701-712).

The roots of the use of AI in education date back to the 1970s (Robertson, 1976, pp. 435-437). The use of multimodal education and training materials has also brought the negative potential of existing possibilities to the forefront. According to the consensus of the authors of "DeepFakes, Fake News and Misinformation in Online Teaching and Learning Technologies," edited by Rebecca J. Blankenship, the rapid development of learning technologies and the spread of false information or images through artificial intelligence have the potential to easily circulate among students. According to the general finding of the study, which is considered an important reference source in the field, students need to be equipped with the necessary skills to distinguish between fake and false information (Blankenship et al., 2021). According to the findings of the study, which analysed the content of 100 articles (63 empirical and 37 analytical) on the impact of AI in education, AI techniques are effective in various areas, ranging from the changing roles of teachers and students to new ethical challenges in education. Therefore, educators and artificial intelligence engineers should collaborate to create an educational perspective of the future. According to the study, students who encounter misleading information are at risk of developing negative attitudes towards learning through negative experiences in new learning contexts. On the other hand, developing artificial intelligence designs in this direction by considering the pedagogical needs of education or designing target-

ed programs open to student-teacher interaction can be considered a solution (Zhai et al., 2021; Humble & Mozelius, 2022).

In a study involving 5894 students from Swedish universities, a survey of chatbots (ChatGPT etc.) and other artificial intelligence language tools (Grammarly etc.) found that 95% of the students were aware of ChatGPT; 56% had a positive attitude towards using chat tools in their studies; 35% used ChatGPT regularly; and 60% were against bans on chat tools. Furthermore, 77% of students opposed bans on functional AI tools (e.g. Grammarly) in education (Malmström et al., 2023). Online education has become increasingly common, especially during the COVID-19 pandemic. In an environment where chat apps are easy to access and use, the problems of AI plagiarism and academic misconduct detection have become more pressing. According to a study conducted in Pakistan among a population with low digital literacy, limited to a sample of 750 people, which aimed to measure the impact of educational methods on preventing the unquestioning acceptance of false or inaccurate information, images, and videos related to COVID-19, it was concluded that while educational interventions were effective in distinguishing between true and false information (5%), content presentation was more effective in the process of accepting information (Ali & Qazi, 2023).

New technology can be used as a clear threat to higher education institutions' academic integrity, which may require a series of regulations both in practice and at the legal level. In Australia, schools in Queensland and Tasmania have banned the use of ChatGPT on students' devices and networks. Similarly, in the United States,

schools in New York City and Seattle have implemented the same ban (Kamalov et al., 2023). With the widespread use of ChatGPT, studies have been conducted on its negative impact on the higher-order thinking skills of students who use the application frequently (Putra et al., 2023). Two months after the release of ChatGPT, 16,830,997 tweets from 5,541,457 users were analysed to measure user reactions to the application. The findings show that 40% of respondents approached ChatGPT positively, 30% were neutral, and 30% approached it negatively. According to the same study, 22% of tweets were related to education; the most general scope of these tweets was about prerequisites for educators and students, awareness of the advantages and limitations of ChatGPT, and the need to discuss ethical aspects (Fütterer et al., 2023).

In a limited empirical study conducted with 5% of undergraduate medical students in Canada (17 medical schools), students emphasised that they have ethical and inequality problems in keeping up with the increase in competitiveness and speed in their field and that they are not yet adequately equipped in the use of artificial intelligence. However, 94% of the participants thought that the use of artificial intelligence in medicine would increase, 84% thought that it would improve medical science, and 67% said that training in the use of artificial intelligence was necessary in the future (Pucchio et al., 2022). Similarly, according to a study conducted to measure the attitudes of 206 medical students from 7 medical faculties in Lebanon towards artificial intelligence, 26.8% stated that developments in the field of artificial intelligence affected students' choice of medical specialty, and only a quarter of the participants (26.5%) were in favour of having their performance evaluated

by artificial intelligence (Doumat et al., 2022).

AI applications offer several advantages for students. Applications geared towards students' abilities and learning pace offer major advantages, such as independence from time constraints for learning, ease of access to motivational tools for individual learning, and increased possibilities for personalised learning (Karsenti, 2019). In a study involving 2240 participants from Iraq, Kuwait, Egypt, Lebanon, and Jordan, 46.8% of the students were aware of ChatGPT, and 52.6% had previously used ChatGPT. The results of the study indicated the advantages of ChatGPT's ease of use, positive attitude towards technology, social convenience, a positive behavioural/cognitive or facilitating effect, and low-risk perception (Abdaljaleel et al., 2024). The fact that AI outperforms humans in some specific areas and offers more efficient analysis, regardless of whether AI is "conscious" or not, needs to be evaluated from multiple perspectives across a wider range of fields, and this is an ongoing debate.

A survey of academics from Türkiye obtained findings on the role and experience of ChatGPT in their academic work. According to the study, which was completed in March 2023, academics primarily used ChatGPT for creative idea generation and assistant tasks. The general usage pattern of the participants was defined as functional tasks in many areas, such as finding topics for academic articles, designing article structures, accessing literature, and making both content and formal corrections or edits in text. The main concern of the participants was academic ethics. Ethical issues concern both academic knowledge production approaches and the flow of academic education and

training. The fact that academics produce scientific articles using ChatGPT or use more than acceptable levels of ChatGPT output in articles and create student assignments using ChatGPT raises serious concerns. In particular, the use of inaccurate and erroneous information and misinformed images obtained with ChatGPT data in student assignments carries the danger of turning it into academic knowledge that may be difficult to rectify (Liverber & Ayvaz, 2023, pp. 1-11).

The findings of a study aiming to measure the content and nature of the ethical concerns of university students in Japan regarding the use of AI are also noteworthy. According to a study conducted with a total of 228 university students, 63% of whom were Japanese, the most important element of students' ethical concerns is that artificial intelligence may cause unemployment (65%), and second is the concern that it will manipulate human behaviour and emotions (13%) (Ghotbi et al., 2022, pp. 283-290). According to the World Economic Forum (WEF, 2016), the top ethical concern regarding AI is unemployment related to the labour hierarchy, inequality, and manipulation of human behaviour. According to the UNESCO (2019) Beijing Consensus on Artificial Intelligence and Education, the multidisciplinary nature of AI should be harmonised with social policies, and legal arrangements should be made to ensure that AI is ethical, transparent, and auditable (UNESCO, 2019).

In summary, while artificial intelligence offers important opportunities for humankind, it also poses risks (Bozkurt & Gürsoy, 2023). The most prominent risk is AI's potential to spread misinformation at unprecedented rates. Considering that misinformation has become one of the most significant problems of our time,

the main research question of this paper is to explore how students perceive the risk of AI-induced misinformation and the relationship between this perception and their AI literacy and familiarity with AI.

Method

Participants and Samples

In this study, data were collected from 452 university students using a snowball sampling method through the networks of faculty members. The sample does not represent the general student population in Türkiye. Initially expert opinions were first obtained from relevant academics regarding the questions developed in line with the study objectives. A pilot study was then conducted, and in the final stage, the “AI Misinformation Risk Perception Scale” used in the research was developed using the factor analysis method.

Scale Development and Validity Tests

In the first stage of the study, the structural validity of the scale was tested using Exploratory Factor Analysis (EFA). Considering students’ reluctance in responding to lengthy questionnaires, an easily applicable factor was obtained.

In the second stage, a confirmatory factor analysis (CFA) was conducted on a different group. The accuracy of the structural model of the scale was tested using CFA, and the model fit indices were calculated. The CFA results showed that the model had acceptable fit indices.

Scale Characteristics

According to the EFA results, the obtained one-dimensional “AI Misinformation Risk Perception Scale” consists of five questions. In the exploratory factor analysis, the KMO value was 0.859, and the variance explained was 61.693%. The Cronbach’s alpha value, indicating the reliability coefficient of the scale consisting of five questions, was 0.843.

The model fit according to various fit indices was as follows: $\chi^2(5) = 1.627$, $p = 0.898$, $\text{CMIN/DF} = 0.325$, $\text{GFI} = 0.999$, $\text{AGFI} = 0.996$, $\text{RMR} = 0.007$, $\text{CFI} = 1.000$, and $\text{RMSEA} = 0.000$ (90% CI [0.000, 0.028]). These indices indicate an excellent model fit to the data. No additional modifications were required to improve the model. The CFA results provide strong evidence for the validity of the measurement model and indicate that the latent variable of misinformation risk perception is well represented by the five observed variables. The model fit indices are in excellent ranges, and there is an excellent fit between the model and the observed data.

In addition, the AI Literacy Scale, a shortened version of the one by Wang et al. (Bozkurt, Gülerce, & Moosa, 2025), was used in the analyses. In addition, the threat variable from the AI Paradox Scale was also used. The scale comprises four questions. In the correlation analysis, the use of generative AI and Google Translate-type AI was evaluated using dummy coding.

Use of AI

AI-based language tools, such as Trink AI, ChatGPT o1, Gemini 2.0, and DeepL Pro, were used to edit the grammar and style of this article, its translation into English, the reporting of some findings, and the ar-

rangement of references. These tools were used to improve the fluency and intelligibility of the paper, but no changes were made to the content. The authors bear full responsibility for the study.

Results

AI Misinformation Risk Perception

The findings of this study, which measured students' awareness of the misinformation produced by artificial intelligence (AI), reveal students' concerns about AI. As shown in Table 1, most respondents (60.4%) believe that AI does not always provide accurate information. Only a small group (10.6%) expressed a more optimistic attitude toward the accuracy of AI and challenged the view that AI does not always provide accurate information.

For this reason, more than half of the students (51.6%) stated that AI can manipulate information. Similar to the responses to the previous question, the percentage of respondents who objected was very low (10.8%). On the other hand, more than one-third of the students (37.4%) stated that they were undecided on this issue. These data demonstrate that the uncertainty in students' minds about AI is quite high.

The percentage of those who agree with the idea that "AI may spread misinformation in society" is more than half of the participants (51.1%). In other words, more than half of the students perceive AI as a potential threat to spreading misinformation. The percentage of respondents who disagreed was low (12.3%). Furthermore, a significant portion of the students (36.5%) stated that they were undecided about AI's potential to spread misinformation

Frequency Distributions of AI Misinformation Risk Perception Scale (%)

Item	Strongly Disagree (%)	Disagree (%)	Undecided (%)	Agree (%)	Strongly Agree (%)
AI does not always provide accurate information.	3.1	7.5	29.0	38.7	21.7
AI can manipulate information.	3.5	7.3	37.6	37.4	14.2
I think AI can spread misinformation in society.	3.5	8.8	36.5	36.9	14.2
AI may pose security and privacy risks.	2.2	6.6	25.4	43.4	22.3
I evaluate AI content critically.	2.9	6.4	31.0	42.3	17.5

Nearly two out of every three students (65.7%) say that “AI poses security and privacy risks.” One in four students remained undecided (25.4%). These data demonstrate that students’ perceptions of risk are high, especially regarding personal data and privacy. This concern is not limited to students; it is also present in society as a whole.

For the most part, students indicated that they were aware of the misinformation that AI can create, with 59.8% responding “I Critically Evaluate AI Content.” However, a small group (9.3%) admitted that they do not have the skills to critically evaluate AI content. In addition, a rather high percentage of respondents (31%) did not have a clear opinion on the issue. These data show that most students are concerned about the potential risks of AI and are critical of it. Therefore, more than half of the students (59.3%) tended to verify their AI knowledge from other sources.

The correlations of AI Misinformation Risk

Perception

Variables	1	2	3	4	5	6	7
1. AI Misinformation Risk Perception	1	.382**	.454**	.246**	.131**	-.025	.014
2. AI Literacy Scale	.382**	1	.074	.374**	.317**	-.006	.054
3. AI as Threat	.454**	.074	1	-.008	-.165**	-.056	-.199**
4. AI Usage (Google Translate, etc.)	.246**	.374**	-.008	1	.446**	.002	.016
5. Generative AI Usage (ChatGPT, etc.)	.131**	.317**	-.165**	.446**	1	.134**	.211**
6. Age	-.025	-.006	-.056	.002	.134**	1	.178**
7. Sex	.014	.054	-.199**	.016	.211**	.178**	1

*Note: *. *The correlation is significant at the 0.01 level (two-tailed).*

As expected, a positive correlation was found between AI Misinformation Risk Perception and AI Literacy ($r = .382, p < .01$). This indicates that as AI literacy increases, AI misinformation risk perception also increases. This is because as AI literacy increases, individuals' awareness and risk perceptions of potential risks arising from AI also increase. Students become more aware of the potential risks of artificial intelligence.

The variable "AI as Threat" also has a positive relationship with AI Misinformation Risk Perception ($r = .454, p < .01$). Both variables express scepticism toward artificial intelligence. General AI scepticism may affect both variables similarly.

Furthermore, a significant positive correlation was found between AI Usage (Google Translate, DeepL,

Grammarly, Quillbot, etc.) and AI Misinformation Risk Perception ($r = .246, p < .01$). Similarly, as the use of generative AI (ChatGPT, Gemini, etc.) increases, suspicion of misinformation also increases ($r = .131, p < .01$).

On the other hand, no statistically significant relationship was found between AI Misinformation Risk Perception and variables such as age ($r = -.025, p = .593$) and gender ($r = .014, p = .763$). This may be because the students' ages were negligible. These results suggest a significant relationship between students' usage habits and AI misinformation risk perception.

Conclusion and Discussion

Artificial intelligence (AI) misinformation risk awareness is an important indicator of AI literacy. Therefore, as expected, misinformation risk perception also increases as AI literacy increases. In other words, AI literacy facilitates a greater awareness of the risks associated with AI. Therefore, promoting AI literacy can increase the level of awareness in this area.

On the other hand, it is observed that misinformation risk perception is also high in individuals who perceive AI as a threat. This may be associated with the general distrust of AI. In fact, individuals who have lost trust in AI in different areas and who think that AI will cause great harm to humanity also have higher perceptions of AI's capacity to spread misinformation (Kamalov et al., 2023).

It is noteworthy that the use of both general and generative AI tools (e.g., ChatGPT, Google Translate, Grammarly, etc.) is positively correlated with AI literacy. This suggests that as students become more famil-

iar with AI technologies, they will be better able to critically evaluate produced content. However, weak but significant negative correlations were also observed, suggesting that those who view AI as a threat are less inclined to use generative AI tools. These findings suggest a complex relationship between usage patterns and threat perception.

The results demonstrate that more than half of the respondents believe that AI does not always provide accurate information (60.4%) and can spread misinformation (51.1%). This confirms the emphasis placed on studies in the literature, such as Garimella and Chauchard (2024), Broda and Strömbäck (2024), and Monteith et al. (2023). Our study revealed the concerns of younger generations regarding the accuracy of AI, demonstrating that a similar perception of distrust exists among students.

The findings are also noteworthy because 59.8% of the students stated that they could critically evaluate the information generated by AI. In the literature (e.g., Blankenship et al., 2021), it is often stated that students' critical thinking skills should be supported against rapidly disseminated fake information. However, there may be a gap between students' perceptions of themselves as "critical" and their actual ability to apply these skills (Ali & Qazi, 2023). Therefore, the actual level of students' critical thinking skills could be assessed more objectively in the future, especially through practical tests or experimental methods.

Security and privacy concerns were another prominent finding in our study (65.7%). As emphasized by researchers such as Dezfouli et al. (2020) and Mitchell (2019), the use of AI may pose significant risks to data

security and privacy. The correlation obtained in our study for the variable “AI as Threat” ($r = 0.454$) confirms the relationship between students’ perception of “threat” and misinformation risk perception in this respect (Kamalov et al., 2023).

However, it is noteworthy that there is a positive correlation between the frequency of AI use and misinformation risk perception (Google Translate, Grammarly, ChatGPT, etc.). Malmström et al. (2023) and Zhai et al. (2021) emphasized that students who interact more with AI technologies may be more aware of the potential to generate false or misleading content. However, there are concerns in the literature (e.g., Putra et al., 2023) that intensive use of these tools may undermine higher-order cognitive skills such as critical thinking. Although the current study did not specifically examine the relationship between critical thinking ability and intensity of use, it can be said that these concerns in the literature overlap with our findings.

The results demonstrate that university students’ “misinformation risk perception” toward AI-based applications can be examined using a measurable scale. The “AI Misinformation Risk Perception Scale” (5-item, one-dimensional) developed in this framework has a high level of reliability and validity according to both EFA and CFA results. While other scales in the literature (e.g., Wang et al.’s AI literacy scale) focus more on the general perception of AI technologies, our study provides a targeted measurement tool limited to misinformation risk. Therefore, it provides a concrete response to the need for “misinformation” focused measurement despite the rapidly increasing impact of AI on society.

With this approach, in response to the question “So

What?”, our study serves the purpose of “systematically measuring university students’ perception of AI misinformation and making visible the relationship of this perception with AI literacy and AI usage habits”.

Recommendations for Policymakers

The use of AI can offer opportunities, such as personalized learning schemes and personalized educational materials for students. It also has advantages, such as significantly overcoming the foreign language barrier, objectively measuring performances, and fostering innovative learning environments. On the other hand, the existing literature also reveals reservations such that students may be exposed to personal security and privacy manipulation; their problem-solving abilities may be weakened due to the overuse of AI applications; and the risk of being led to erroneous information may increase. Therefore, it is important to inform teachers and students about educational ethics; it may even be worth considering the inclusion of “AI Literacy” as a course in curricula.

The research findings show that students are concerned about the risk of misinformation arising from AI. Therefore, policymakers should consider adding courses or modules on “AI Ethics and Misinformation Awareness” to higher education curricula (Blankenship et al., 2021). Furthermore, setting data security and privacy standards and increasing the auditability of AI applications are important policy recommendations (UNESCO, 2019).

In addition, making fact-checking tools free and accessible to students can reduce the spread of AI-based misinformation. Awareness campaigns at universities through seminars, workshops and digital resources can

help students learn how to access accurate information and verification techniques, as well as address privacy and data protection issues.

Limitations of the Study and Implications for the Results

This research is based on data collected from 452 university students using a snowball sampling method; therefore, it does not represent the entire student population in Türkiye. In addition, due to the nature of the survey method, self-reporting of participants' AI perceptions and attitudes may lead to biases, such as social desirability or over/under perception of self-efficacy. The fact that AI is a rapidly evolving technology that is constantly expanding with new applications also points to the periodic limitation of this study.

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