



MODELLING STUDENTS' PERCEPTIONS OF ARTIFICIAL INTELLIGENCE (AI) TOOL USAGE IN LEARNING STATISTICS: AN EMPIRICAL STUDY

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Abstract:

In learning Statistics, students often perceive the course as challenging because they are required to understand statistical concepts, various statistical methods and formulas, and analytical and critical thinking skills. Nowadays, technology can effectively assist students in strengthening their statistical reasoning. Educators need to progressively transform their approaches by adopting innovative methodologies and integrating AI tools in the teaching and learning of Statistics. Most existing studies have focused on general learning contexts rather than discipline-specific applications, such as statistical education. Therefore, this study aims to examine university students' perceptions of AI tool usage among those currently enrolled in a Statistics course. A total of 377 students participated in this study. An online questionnaire was employed to collect the data. The results indicate that students' engagement and interaction with AI tools significantly influence their academic performance in learning Statistics. Meanwhile, behavioural intention and student satisfaction were found to be insignificant. Overall, the development of AI tools in education plays an important role in shaping students' academic

outcomes, particularly in the context of rapid technological advancement within the learning environment. The educational paradigm has shifted with the rapid adoption of AI tools, enabling flexible learning anytime and anywhere. This study suggests that educators should enhance students' cognitive engagement through well-structured AI tools and refined pedagogical approaches. While wider access to AI tools and appropriate training are encouraged, reliance on AI tools alone is insufficient to improve academic performance by formulating techniques and policies to guarantee effortless, ethical, and pedagogically robust integration into education.

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Keyword:

Academic Performance, Artificial Intelligence, Higher Education, Learning Statistics, Students' Perceptions



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Introduction

Artificial Intelligence (AI) tool refers to any software or system that uses AI methods such as machine learning, natural language processing or expert systems. AI tools execute activities that often require human intellect, like language comprehension, pattern recognition, decision-making, and content personalisation (Chen et al., 2020; Shrivastava et al., 2024). AI acts through the combination of massive amounts of data with rapid, iterative processing and intelligent algorithms. This process allows the software to autonomously learn from patterns or characteristics within the data. Nowadays, the usage of AI tools, especially in education fields, has become popular and garnered considerable attention due to their capacity to improve learning experiences. According to Rodway and Schepman (2023), the AI tools usage provides exciting opportunities for personalised instruction, enhanced student engagement, and increased education efficiency as educational institutions attempt to improve learning outcomes. AI tools have greatly changed the ways people interact with technology as well as the learning process. The development of AI tools provides various opportunities for innovation in education, greatly impacting students' learning, information assimilation, and future capability (Chen et al., 2023; Ouyang & Jiao, 2021).

Abbas et al. (2023) state that the use of AI tools in teaching and learning can enhance academic achievement, improve engagement and support various learning methods. One of the main advantages of AI tools is that they can support personalised teaching and learning experiences that cater to various students' demands. The usage of AI tools in the learning environment can decrease the time needed for educational tasks like doing assignments and at the same time allows students to find essential information at their own convenience. This aspect provides considerable freedom, particularly for those students who are involved in distance learning or managing challenging schedules (Salem & Shaalan, 2023). With the demands of the 21st century, AI tool usage has provided a learning environment that aligns with current technology.

For those students who are engaged with AI tools in their learning, they can build important skills, including problem-solving, critical thinking, cooperation and adaptability. A study by Uğraş et al. (2024) proved that teachers in primary schools acknowledge AI tools such as ChatGPT as beneficial to enrich teaching through varied materials, personalized resources, and decreased preparation time, especially in core subjects, although they worry about inaccurate information and draw attention to the need for teacher supervision and critical use of AI in classrooms. The usage of ChatGPT in school needs careful and coordinated integration by formulating techniques and policies to guarantee effortless, ethical, and pedagogically robust integration into early STEM education (Uğraş et al., 2024).

In learning statistics, students feel that this course is challenging since they need to understand the concept of statistics, various statistical methods including formulas, and the need for analytical and critical thinking skills, especially when they come up with a group project that requires them to conduct a survey on relevant topics. This assignment involves an array of technological uses, such as spreadsheets, programs, multimedia resources, statistical software suites, and educational software. Most of the students found difficulties in statistics theory, manipulating and interpreting the data, as well as employing suitable statistical methods to real-world problems. These challenges have a negative impact on the students' academic performance in studying Statistics. Traditional classroom environments frequently fail to satisfy the different learning styles of each student (Henny et al., 2024). Biehler et al. (2013) suggested a prospective method for employing technology to enhance students' statistical reasoning. A study by Wahba et al. (2024) proved that technology nowadays can effectively help students strengthen their statistical reasoning. Thus, educators today need to progressively transform their approaches to innovative methodologies by integrating AI tools in the teaching and learning of Statistics. AI tools can dynamically modify learning difficulties by providing supplementary resources to boost learning and enhance students' engagement and interaction, making it easier for students to understand statistical knowledge in the overall learning experience.

Although previous studies have investigated students' perceptions of AI tool usage in educational settings, there remains limited empirical evidence on the use of AI tools specifically in the learning of Statistics in Malaysia. Most existing studies have focused on general learning contexts rather than discipline-specific applications such as statistical education. Therefore, this study aims to examine university students' perceptions of AI tool usage among those currently enrolled in a Statistics course. This study examines students' perceptions across several domains, namely engagement, interaction, behavioural intention, and satisfaction with AI tool usage. Understanding these perceptions is important, as the findings may provide valuable insights for educators to enhance their pedagogical practices and strengthen instructional effectiveness in Statistics through the appropriate integration of AI tools, thereby ensuring alignment with ongoing technological advancements in education.

Literature Review

There are five points that will be discussed in the literature review, which are students' engagement, students' interaction, behavioural intention, students' satisfaction and improved students' academic performance.

Students' Engagement

Griffiths et al. (2009) define students' engagement as a developmental process involving students' thoughts, emotions, attitudes, and behaviours in connection with the educational environment and their learning journey. The definition of student engagement includes behavioural, emotional, psychological, and more recently known as cognitive elements. Student engagement is one of the key factors in academic success and achievement and is more than just doing classwork and knowing what is being taught. Participation in class activities or just attendance is not equivalent to true engagement. Engagement beyond the comprehension of knowledge, which requires active participation in the learning process (Aljehani, 2024). Bedenlier et al. (2020) stated that in technology-rich learning environments, students' active engagement with digital educational resources is associated with increased motivation and interest in learning. Currently, the education sector can use AI tools like ChatGPT to better engage students and determine their learning objectives. It may also enhance students' motivation to learn (Mhlanga, 2023; Rudolph et al., 2023). Based on Rahman and Watanobe (2023), interactive AI tools can generate new dynamics, such as student involvement and engagement with instructional materials. It will enable a student to alter their educational experience according to their unique interests and aptitudes. Therefore, the following hypothesis is proposed:

H1: There is a relationship between students' engagement in AI tool usage and improved academic performance among university students.

Students' Interaction

Students' interaction can be defined as the process where students interact with one another to ask for assistance, create relationships, and work together (Kui et al., 2022). Meanwhile, Student engagement comes from the reciprocal connection between learners and their educational environments, where learning is perceived as a social, contextual, and transactional activity inside genuine contexts and learning communities (Shernoff et al., 2016). The utilization of technology in classrooms may enhance student interaction. Previous studies showed that students' interaction with the application of AI tools is related to higher engagement and better attitudes. Khairuddin et al. (2024) claimed that students receive positive feedback from their interactions with AI tools, as these tools help them find answers more easily. Furthermore, a study by Tindowen et al. (2025) found that the use of AI tools in a learning environment can improve interactions between students and academic content. AI tools provide a dynamic and participative learning environment. This technology provides tailored support, maintaining student involvement in the learning process and enhancing their engagement levels. Therefore, the following hypothesis is proposed:

H1: There is a relationship between students' interaction in AI tool usage and improved academic performance among university students.

Behavioural Intentions

Behavioural intention is a determinant that directly influences conduct within the framework of the theory of planned behaviour. Generally, the implementation of behaviour is influenced by numerous circumstances and may also constrain the formation of behavioural intention (Chen et al., 2023). In this study, the behavioural intentions primarily examine the students' attitudes and their willingness to engage with AI tool usage. The factors like perceived usefulness and perceived ease of use can influence the behavioural intention to use AI. Based

on Garcia Reyes & Reaiche (2022), students who perceive AI as user-friendly and requiring low effort are more likely to use it consistently. Following that, behavioural intention and actual usage are directly related, indicating how frequently and how students use AI in their learning. Additionally, students exhibited positive behavioural intentions towards the continued utilization of AI tools, indicating a robust commitment to their regular use for academic inquiries and endorsing them to peers (Tindowen et al., 2025). Sometimes, AI tools can be perceived as a negative impact since they can cause laziness among students' critical thinking abilities. Most students believed that AI tools can be relied upon because they provide accurate content, which indicates credibility and emotional support. AI tools can be considered to improve their learning and provide assistance as well as valuable information (Almufarreh, 2024). Therefore, the following hypothesis is proposed:

H1: There is a relationship between behavioural intention in AI tool usage and improved academic performance among university students.

Students' Satisfaction

In the learning process, students' satisfaction refers to a short-term mindset that emerges from an assessment of students' experience in educational services and facilities (Elliott & Healy, 2001). In the meantime, Mukhtar et al. (2015) define student satisfaction as the relative level of experiences and perceived performance of educational services during the study term. Information systems like generative AI can meet the different learning and development demands of students (Malakul & Park, 2024). With the rise of AI technology, most of the previous research conducted surveys on how satisfied the students were with AI tools. Khairuddin et al. (2024) claimed that the majority of students are satisfied with AI tools as a learning tool that helps them in the learning process. Students' satisfaction is a multifaceted concept that can be influenced by various factors when using AI tools, including usefulness, trust, transparency, engagement, accuracy, and emotional response. Almufarreh (2024) found that some elements, including content quality, emotional well-being, and perceived utility, are statistically significant in determining satisfaction with the usage of AI tools among students. However, another study by Abd Manaf et al. (2025) revealed that only two factors, which are emotional well-being and perceived utility, are significant in students' satisfaction with AI tool usage in education. Therefore, the following hypothesis is proposed:

H1: There is a relationship between students' satisfaction in AI tool usage and improved academic performance among university students.

Improve Students' Academic Performance

The usage of AI tools, particularly in the education field, has increased nowadays. Most institutions and educators attempt to integrate technology as instructional tools within the teaching and learning process (Ahada et al. 2024). Various studies have shown that AI tools improve students' academic performance, particularly in knowledge development, and that they enhance the ability to encourage critical thinking, creativity, and self-efficacy. Chaudhary et al. (2024) suggest that students' preferences and experiences can modify the usage of AI tools. AI tool usage is able to personalize examinations to better evaluate student comprehension, thereby improving their academic achievement. In addition, by employing AI tools, it also helps students to write the literature review for their written report better than traditional methods. These techniques can help students to produce a good report and upgrade their writing skills (Ouyang et al., 2023). AI could help students understand since it could adapt to their learning styles and abilities, which could enhance their educational experience

(Mallillin, 2024). It was also agreed by Khan et al. (2025). The usage of AI tools in the learning process increases students' grades, improves students' independence, deepens comprehension, and thereby promotes sustained academic development. Students can use these AI tools based on the convenience of learning at any time and from anywhere. Furthermore, Lampropoulos and Papadakis (2025) stated that AI tools have important possibilities to revolutionize education, especially through individualized learning and interactive teaching. Conversely, their efficacy relies on suitable educational integration, ethical utilization, and ongoing research to address current issues.

Methodology

Research Design and Sampling

A cross-sectional study has been conducted where the data was gathered within four weeks. This study was conducted at Universiti Teknologi MARA (UiTM), Segamat Campus. The sampling technique used in this study was convenience sampling. This technique was used since the study targeted students enrolled in Statistics courses at UiTM Segamat Campus, where the researcher had direct access to participants. Implementing probability sampling across several universities was not feasible due to logistical constraints, institutional permissions, and time restrictions. The population for this study was all students taking a statistics course at Universiti Teknologi MARA (UiTM), Segamat Campus, consisting of diploma and degree students. This study used a Raosoft calculator to determine the sample size, ensuring a 95% confidence level and a 5% margin of error. The minimum recommended sample size for this study was 341 respondents. Thus, a total of 377 students participated in this study.

Research Instrument

An online questionnaire has been employed as a data collection method. The questionnaire was developed using Google Forms and is accessible through the link we created and shared. The link form has been distributed to the students via WhatsApp and Telegram. The reason we choose online questionnaires is due to their speed, cost-effectiveness, and ease of analysis. The questionnaire was adapted by Khairuddin et al. (2024). This questionnaire is divided into seven sections. The first section, which is Section A, refers to the demographic profile that examines the characteristics of the respondents. Section B refers to general questions related to AI tools and consists of two. The next section used the interval scale of five points to determine the extent of the respondent's view for these sections. Strongly agree receives a score of 5, and strongly disagree receives a score of 1. Sections C to F examine the domain of students' perceptions towards AI tools, which are students' engagement, students' interactions, behavioural intentions, and students' satisfaction, while Section G refers to questions related to improving students' academic performance. For improved academic performance, it was measured using students' self-perceived performance compared to objective grade. Self-reported academic measures are often employed in educational research, especially when access to official academic records is limited and most students keep their results confidential and have ethical concerns. Much previous research indicated that self-reported performance is a reasonable proxy for real achievement, although it may introduce subjective bias. Table 1 shows the distribution of items.

Table 1: Distribution of Items

Section	Variables	Number of Items
C	Students' engagement	4
D	Students' interactions	5
E	Behavioural intentions	3
F	Students' satisfaction	4
G	Students' academic performance	4

To assess the internal consistency of a survey, the Cronbach's coefficient alpha was applied to indicate how closely related a set of items are as a group. A pilot study that involved 33 respondents was conducted to determine if the respondents answered all items consistently. Table 2 shows that all the values of Cronbach's alpha reliability coefficient are above 0.7, indicating that the instrument was reliable. Thus, the questionnaire was valid and can be used for further analysis.

Table 2: Reliability Tests

Variables	Cronbach's alpha
Students' engagement	0.712
Students' interactions	0.830
Behavioural intentions	0.755
Students' satisfaction	0.701
Students' academic performance	0.740

Research Framework

The research framework of this study is shown in Figure 1. There are four independent variables, which are students' engagement, students' interactions, behavioural intentions, and students' satisfaction. Meanwhile, the dependent variable is students' academic performance. This research is based on the Technology Acceptance Model (TAM), which discusses the adoption of technology by individuals through perceived utility and attitudes towards usage. In the realm of AI-assisted learning, student engagement and interaction represent perceived utility, whereas satisfaction denotes attitudes towards AI technologies. Behavioral intention reflects students' readiness to persist in using AI technologies for educational purposes. Academic performance is seen as the result of efficient technology utilization. This study investigates the impact of students' perceptions of AI tool usage on their learning outcomes in Statistics through the integration of these constructs.

Results and Discussion

Demographic Profile

Table 3 demonstrates the frequency table of demographic profiles. The results indicate that most respondents are from the female group, which is 53.05%, and the male group is 46.95%. Meanwhile, the largest percentage of respondents comes from the age range 21-23 with 35.28%, followed by 24-26 with 30.77%. There are 21.22% of respondents in the age range 18–20, followed by the age range 27 and above, with the lowest percentage of 12.73%. Most of the respondents are diploma students, with the highest percentage (56.23%), whereas respondents from the degree program have a percentage of 43.77%. Furthermore, most students are taking the subject of STA104 Introduction to Statistics, with a percentage of 63.39%, followed by the subject of STA404 Statistics for Business and Social Sciences (20.16%) and STA111 Fundamentals of Statistics, with the lowest percentage of 16.45%.

Table 3: Demographic Profile of Respondents

Variables	Frequency	Percentage (%)
Gender		
Male	177	46.95
Female	200	53.05
Age (in years)		
18 – 20	80	21.22
21 – 23	133	35.28
24 – 26	116	30.77
27 and above	46	12.73
Level of Education		
Diploma	212	56.23
Degree	165	43.77
Statistics subjects taken		
STA104 Introduction to Statistics	239	63.39
STA111 Fundamentals of Statistics	62	16.45
STA404 Statistics for Business and Social Sciences	76	20.16

Most Preferred AI Tools Among Students

Figure 2 presents the most preferred AI tools that are used among students when learning Statistics. About 74.5% of the students prefer to use the ChatGPT tool when learning Statistics. The results show that Microsoft Copilot is the least preferred AI tool, with only 43.2% of the respondents using it.

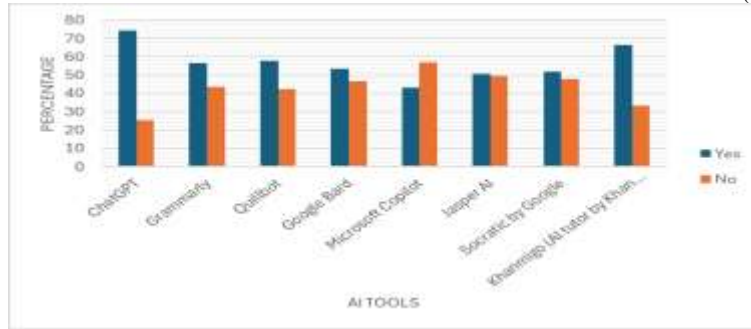


Figure 2: Most Preferred AI Tools

The Relationship between Students’ Perceptions of AI Tools in Learning Statistics and Academic Performance

Table 4 presents the relationship between students’ engagement, students’ interactions, behavioural intentions and students’ satisfaction of AI tool usage towards academic achievement among students learning Statistics. Based on the findings, we can see that there is a positive relationship between students’ engagement and their academic performance, indicated by a correlation value of $R = 0.168$. There is also a positive relationship between students’ interaction ($R = 0.149$), behavioural intention ($R = 0.117$), and academic performance among students. Meanwhile, the relationship between students’ satisfaction and students’ academic performance also shows a positive relationship, with the value of R being 0.121. Therefore, we can conclude that university students with positive perceptions of AI tools tend to have good academic performances in learning Statistics. Anghel et al. (2025) found a significant correlation between higher AI proficiency and positive perceptions and improved academic performance among students. It was also supported by Khan et al. (2025) that positive perceptions on AI learning tools significantly enhanced students’ grades and understanding that will affect their academic performance. Students with positive perceptions of their proficiency in using AI tools often believe that AI positively influences their academic performance, individualised learning, and enhanced motivation and critical thinking abilities. This indicates that students’ positive perceptions of AI tool usage in learning Statistics can act as a significant predictor of the technology’s beneficial influence on their academic learning outcome.

Table 4: Correlations between Students’ Perceptions of AI Tools in Learning Statistics and Academic Performance

Variables	Students’ Engagement	Students’ Interactions	Behavioural Intentions	Students’ Satisfaction	Students’ Academic Performance
Students’ Engagement	1	0.164	0.086	0.131	0.168**
Students’ Interactions		1	0.032	0.015	0.149**
Behavioural Intentions			1	0.153	0.117**
Students’ Satisfaction				1	0.121**

** Correlation is significant at the 0.01 level

Normality Test

The normality test is a critical assumption for parametric analyses, such as multiple regression analyses, as it determines whether the data follow a normal distribution. In this study, skewness and kurtosis were used to assess the normality of the data. According to Hair et al. (2010), skewness and kurtosis values within the range of -2 to +2 indicate that the data are normally distributed. As shown in Table 5, all skewness and kurtosis values fall within this acceptable range, confirming that the data for this study are normally distributed.

Table 5: Normality Results

Variables	Skewness	Kurtosis
Students' Engagement	-0.105	0.214
Students' Interactions	0.213	0.184
Behavioural Intentions	0.202	0.073
Students' Satisfaction	0.021	0.092
Students' Academic Performance	0.178	0.252

The Influence Students' Perceptions of AI Tools in Learning Statistics and Academic Performance

Based on Table 6, the value of R, which is 0.247, indicates a positive relationship between students' perceptions of AI tools and their engagement, interactions, behavioural intentions, and satisfaction regarding academic achievement in Statistics. The R-squared of 0.061 means that only 6.1% of the total variation of students' academic performance in learning Statistics can be explained by students' perceptions of AI tools. The remaining 93.9% of the variation can be attributed to factors that are not included in this study. Although this explanatory power seems limited, such results are typical in educational research, as academic achievement is affected by several cognitive, behavioral, and environmental factors. Factors including prior academic aptitude, study practices, motivation, and learning environment may significantly influence results but were excluded from the current model.

Table 6: Model Summary

	Values
R	0.247
R ²	0.061

Table 7 reveals that the model is significant since the value of the F test is 6.040, with a p-value of 0.000, less than 0.05. It indicates that at least one of the independent variables can be used to predict the students' academic performance while learning Statistics. According to Table 8, there are two independent variables, which are students' engagement (p-value = 0.013) and students' interaction (p-value = 0.016), which are statistically significant effects on students' academic performance as both p-values are less than 0.05. Meanwhile, the other two independent variables, behavioural intentions (p-value = 0.082) and students' satisfaction (p-

value = 0.084), are not significant since both p-values are greater than 0.05. The final model can be written as follows:

$$Y = 1.825 + 0.120 (\text{Students' Engagement}) + 0.128 (\text{Students' Interaction}) + \epsilon$$

Table 7: Analysis of Variance (ANOVA)

	Values
F	6.040
p-value	0.000

Table 8: Coefficient of Regression

	B	t	p-value
Constant	1.825	7.076	0.000
Students' Engagement	0.120	2.494	0.013**
Students' Interactions	0.128	2.421	0.016**
Behavioural Intentions	0.076	1.742	0.082
Students' Satisfaction	0.085	1.730	0.084

** Dependent variable: Students' academic performance

Thus, the evidence indicates that, in this model, only students' engagement and their interactions with AI tool usage significantly influence academic performance in learning Statistics. These converging findings support the conclusion that how actively students engage and interact with AI tools matters more for academic performance than their general intentions or satisfaction levels. The study was consistent with Khan et al. (2025) and Vilvaer and Cabigas (2025). They stated that AI tool usage improves academic performance by promoting student engagement in their education and facilitates the achievement of educational objectives. Students' engagement in using AI tools found enjoyment in helping them improve their academic performance while learning Statistics. Students can use AI tools to improve their academic performance but should not rely on them mainly. However, in contrast, the students' engagement of AI tool usage among students has not significantly affected the students' learning outcomes (Dahri et al., 2024). Furthermore, this study also shows a consistent result with Liang et al. (2023). They claimed that there is a statistically significant relationship between students' interaction with AI tool usage and learning achievement. Students' interaction with AI tools was a strong predictor of enhanced understanding, which in turn reflected academic performance (Dahri et al., 2024).

Conclusions and Recommendations

This study was conducted to identify significant predictors of students' perceptions of AI tool usage in terms of academic performance in learning Statistics. The findings reveal that students' engagement and interaction with AI tools significantly influence their academic performance in learning Statistics. Overall, the development of AI tools in education plays a little bit of an important role in shaping students' academic outcomes. Students partially depend on AI tools to learn Statistics, and these tools impact students' learning. Although students' perceptions of AI tool usage exhibit a weak positive relationship with academic performance, the use of AI

tools continues to have a meaningful impact, particularly in the context of rapid technological advancement within the learning environment. The educational paradigm has shifted with the rapid adoption of AI tools, enabling flexible learning at anytime and anywhere. This study suggests that educators who are teaching statistics courses should enhance students' cognitive engagement through well-structured AI tools and refined pedagogical approaches. While wider access to AI tools and appropriate training are encouraged, reliance on AI tools alone is not sufficient to improve academic performance.

Future research should include a larger and more diverse sample of students from universities across Malaysia. Furthermore, the relatively low explanatory power of the model, as indicated by the R-squared value, suggests that other additional AI-related factors influencing academic performance in Statistics learning should be considered and incorporated into objective measures such as GPA or examination scores. Future studies may also employ more advanced statistical techniques to further develop and extend the modelling framework.

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