

GENERATIVE AI AND ENGINEERING EDUCATION: MEASURING ACADEMIC PERFORMANCE AMIDST SOCIOECONOMIC CHALLENGES IN YEMEN

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Generative AI and Engineering Education: Measuring Academic Performance Amidst Socioeconomic Challenges in Yemen

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Abstract— This study assessed the impact of generative artificial intelligence (GenAI) usage on the academic outcomes of engineering students within the context of Yemen's unique socioeconomic challenges. This study employed a quantitative approach through a structured 5-point Likert-scale questionnaire, which was distributed to 277 engineering students from Taiz University, Yemen. In a resource-constrained environment, the results exhibited a strong correlation between GenAI usage and engineering students' overall grades and skills development. Additionally, findings showed that socioeconomic challenges that students face in Yemen have moderately hindered students from the effective usage of GenAI for educational purposes, which is a key finding for higher education institutions (HEIs). Also, statistical results showed that almost all respondents are familiar with GenAI tool usage, while 89.17% use ChatGPT as a fundamental component of learning. Of course, the integration of GenAI into education has become inevitable, compelling HEI policymakers to regulate its use and formally adopt it as a primary source of learning systems. Students and educators should obtain continuous training to effectively benefit from GenAI while conforming to ethics and boosting their intellectual capabilities and skills. Raised concerns that the students' overreliance on AI tools could undermine their problem-solving abilities and practical skills development while complicating students' evaluation process for educators. The outcomes of this study could serve as a foundational reference for policymakers, educators, and students in Yemen and similar settings. It also recommends in-depth studies that cover other educational contexts and respondents from other states, rather than undergraduate engineering students in the present study.

Keywords— Academic Achievement; Generative Artificial Intelligence; Engineering Education; ChatGPT; Academic Achievement; Engineering; Students; Socioeconomic; Challenges, Higher Education Institutions (HEIs).

I. INTRODUCTION

The rapid pace of technological advancement has compelled both public and private organizations to adapt swiftly to these changes. Beyond mere adaptation, organizations must now focus on training and upskilling their workforce while modernizing their infrastructure to effectively integrate these advancements. Among the most transformative developments is the remarkable evolution of AI software and big data visualization tools [1]. These technologies are designed to empower intelligent machines and computer programs to replicate human cognitive processes, revolutionizing how tasks are performed and decisions are made. By integrating these tools with advanced intelligent programs, such systems can not only mimic but also surpass human intelligence in many tasks.

AI has become a transformative force across a wide range of sectors, including military, industrial, commercial, and technological fields. Its applications have steadily expanded into critical areas such as healthcare, agriculture, education, and beyond, revolutionizing processes, enhancing efficiency, saving time and money, and enabling innovative solutions to complex systems [1-3]. It alters all people's daily life perspectives, including their communication, education, health, well-being, family, social, and economic affairs [4-8]. HEIs today face significant challenges in improving the quality of education and enhancing students' academic achievement, particularly considering rapid technological advancements in information resources and data mining. It was proposed that integrating technology into the HEIs improves education sustainability and quality and boosts institutions' competitiveness [9, 10]. Among these technological advancements, AI algorithms have begun to play a pivotal role in the educational process. It is now considered a primary source of learning in school and university education systems. However, there is widespread speculation about the potential risks of AI tools replacing human thought and reasoning, especially at the university level, a critical stage for shaping students' minds and equipping them with the knowledge and skills needed to enter the workforce and overcome life challenges.

University students in Yemen, particularly engineering students, face unique challenges shaped by the country's distinct sociopolitical and economic context and HEIs' poor infrastructure [11, 12, 13, 14]. Key factors such as political conflict and division, economic collapse, and social restrictions significantly influence their educational experiences and outcomes [11-15]. Recent research highlights the profound impact of socioeconomic factors on the academic achievement of engineering students [11]. Political instability has further compounded these challenges, creating obstacles not only during their undergraduate studies but also in securing employment after graduation [15, 15]. Additionally, the conservative nature of Yemeni society imposes extra barriers, particularly for female engineering students and graduates [11, 15].

In response to the lack of official educational platforms, engineering students in Yemen have turned to social media as a tool for learning and collaboration [12]. However, a survey study conducted across engineering colleges in Yemen revealed that universities lack the necessary technological infrastructure to support diversifying modern educational resources, such as online education platforms and AI-based models [15]. Given these circumstances, it is crucial to

consider these variables when examining the potential impact of integrating AI models into the educational system. Understanding these challenges is essential for developing effective strategies to enhance the quality of education and support the academic and professional success of engineering students in Yemen. Additionally, there is a dearth of research studies examining these variables among university students in Yemen, especially given the exceptional circumstances Yemen is experiencing at all levels. This study aims to investigate the impact of GenAI usage on the educational achievement of engineering students in Yemen amidst socioeconomic challenges specific to the Yemeni situation.

II. LITERATURE REVIEW

GenAI belongs to AI algorithms that are extensively pre-trained, with the ability to generate new content, such as texts, images, videos, etc. They behave like intelligent humans and even surpass them. They can generate interactive conversations, visuals, audio, meetings, presentations, research, programming, and data analysis [17]. In terms of coding, GenAI models are built based on the principles of machine learning algorithms in which an output could be released without prior programming to perform a predefined outcome [18]. Put simply, various learning algorithms are used to achieve these complicated tasks. Furthermore, GenAI consists of effective and fast-response models that perform various language processing tasks and smart problem-solving capabilities with ultimately high accuracy [19]. Notably, it can perform text generation, data analysis, translation over dozens of languages, original essay writing, summarization, interactive question answering, etc.

The early stages of AI tools were rooted in the prediction of rule-based decision-making theories during the 1940s. After World War II, the science of operations research was developed, which is considered the base of AI-based generative decision-making models. During the 1950s, Alan Turing and John von Neumann announced the first attempt at AI models. Their exceptional prediction was to examine a machine's ability to exhibit intelligent behavior [20]. Throughout the last five decades, numerous algorithms have been developed to help provide human-like interactive decisions with slow progress. The rapid development of robots, automation, programming, control systems, and advanced electronic circuits paved the way for effective AI tools [20, 21].

ChatGPT received the most attention from researchers globally due to its wide popularity and miraculous features [18, 19]. A large experimental survey investigation showed that ChatGPT improves students' problem-solving and self-efficacy skills [22]. Following the emergence of ChatGPT with its exceptional features, international companies rapidly competed to launch similar programs with even better features. Initially, competition was limited to US companies, but the emergence of the Chinese-made DeepSeek program was considered a breakthrough in this field, breaking the US monopoly [23, 24].

Integration of GenAI models with higher education is today's pressing topic that has shown a dramatic change in HEI

policies [17, 25, 26, 27]. However, the integration process faces various barriers, including funds, community acceptance, digital literacy, data availability and reliability, and HEIs' infrastructures, among many other challenges [26]. One significant benefit of GenAI models for students is their ability to support asynchronous communication, enhancing student engagement and collaboration. They enable students' discussion' engagement and asking questions without the need to be online simultaneously [17]. Additionally, certain GenAI models, such as chat APIs, can facilitate collaboration by enabling the creation of student groups, allowing students to work together on projects and assignments in real-time or asynchronously [28]. Additionally, GenAI tools are valuable for supporting remote learning, offering critical assistance to students who face physical or mental health challenges [29]. GenAI models can effectively promote learning approaches by directing seekers to the preferred resources, including books, articles, consultants, and websites, to satisfy their needs and preferences. This easy access to technology and services assists students to engage more deeply with the resources and emphasize self-directed learning [17]. Additionally, AI-powered chatbot applications allow instant access to educational resources, such as study guides, lecture notes, and practice exercises, further supporting students in mastering complex concepts. By delivering targeted assistance and resources, AI not only improves comprehension but also empowers learners to take ownership of their educational process.

Focused studies have investigated the relationships between GenAI tools and educational achievement from student views [17] and educator views [30, 31, 32]. It was reported that students interact with new technologies better than their educators [13, 33]. Overall, the impact of GenAI on the education system has become an unavoidable reality, raising voices to HEI policymakers to establish controls and regulations to organize its use, maximize its benefits, and mitigate its potential negative effects. The impact is volumetric; integrating GenAI into education has raised voices to redesign the HEI curriculum, enabling sustainable education and expanding learning resources [34, 35].

Conversely, there are rising global concerns about the potential negative excessive use of GenAI models on students' critical thinking and their ability to develop problem-solving skills for complex challenges [29]. Although these concerns are fundamental and require in-depth survey analysis, this topic is beyond the scope of this study.

Integration of GenAI into education has emerged as a pivotal and dynamic topic in recent years, attracting focused evaluation from sociologists, educationalists, programmers, and policymakers across diverse educational settings worldwide. This study aims to investigate the impact of GenAI use on educational attainment within an economically and politically unstable environment and amidst educational institutions with poor infrastructure to engage with such technologies. The study's outcomes could provide unique insights far beyond those observed in more stable contexts.

III. METHODS & RESEARCH DESIGN

A. Research Design

This study was mainly structured to explore the importance of adopting GenAI tools as a supporting learning resource and the impact of their frequent usage on engineering students' educational achievement. The research study extends to study many students' surrounding variables, such as social, economic, and educational influences, as illustrated in Figure 1. Specifically, this study investigated the effects of students' gender, marital status, financial conditions, living stability, engineering specialization, study level, and internet access facilities such as personal computers and smartphones.

The study's independent variable is students' use of GenAI models, while the dependent variable is academic

achievement. Students' usage of AI tools was measured by introducing three questions in the questionnaire; these questions are (1) their usage density of AI tools (always, often, sometimes, seldom, and never), (2) the period between each entry to the AI sites (daily, weekly, monthly, etc.), and (3) students were asked to select from a predefined list of many AI tools frequently used by university students. Accordingly, this study identified the students' usage of AI tools among these questions. These measures were standardized by many studies from the literature review [36].

Academic achievement was measured using students' overall grades in the university and high secondary schools.

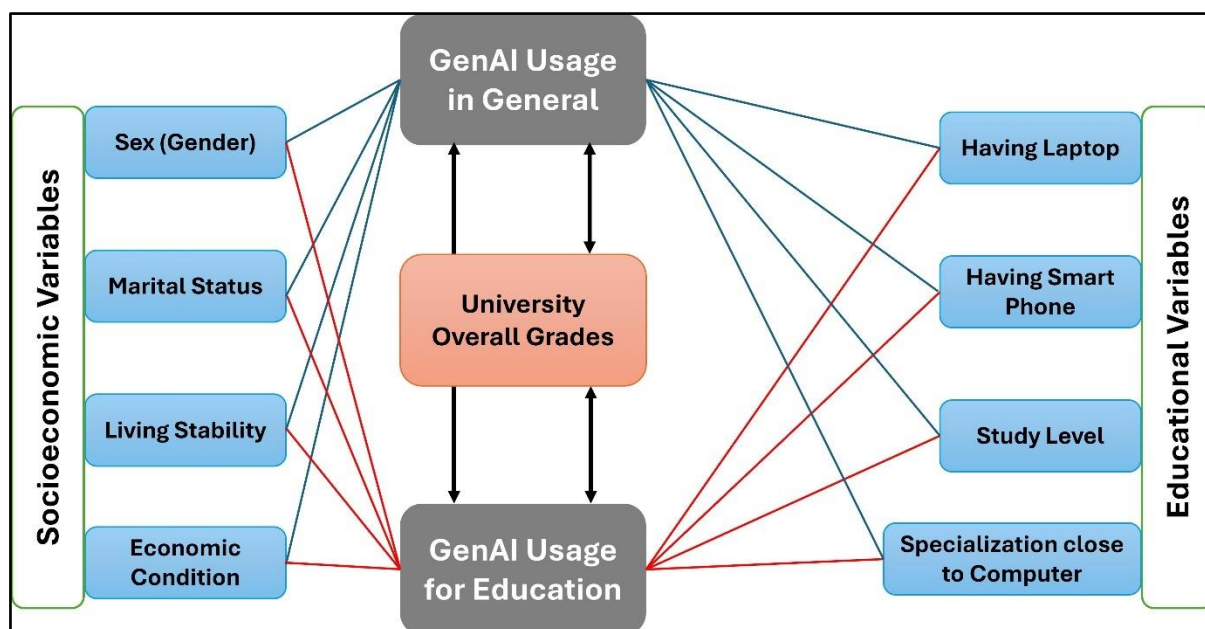


Fig. 1. Turbine Test Schematic Diagram

Students were directly asked many demographic questions, such as their sex, marital status, study level, specialization, and whether they have personal computers and smartphones. Demographic data were examined as variables in this study to investigate their effects on students' usage of GenAI models for educational purposes. "Living stability" is a socioeconomic variable that has been proven to negatively impacts on university students' overall grades in Yemen [11]. To measure the "living stability" variable, engineering students were asked if they constantly lived with their families, in university hostels, with relatives' homes, or with friends and classmates.

The harsh economic conditions in Yemen undoubtedly affect students' performance, attendance rate, academic achievement, and access to technology and GenAI tools at university. For that, it was considered a variable in this study, and it was measured by asking students about their average

daily expenses within many ranges. These measures align well with other studies from the literature [11].

Finally, students were asked many questions to explore their views regarding four aspects: (1) the extent to which students use AI programs and their impact on their educational attainment, (2) students' awareness of the importance of AI as a primary learning resource for undergraduate students, (3) the dimension of developing practical skills, and (4) expected drawbacks and challenges associated with using AI tools. These research dimensions are in line with other studies performed on similar works worldwide [17].

B. Research Hypotheses

H1: The use of GenAI tools for education positively impacts students' academic achievement.

H2: Students in computer-related majors benefit more from AI tools compared to other majors.

- H3:** Senior students derive greater benefits from AI tools than fresh ones.
H4: Students' gender has a neutral effect on the use of AI tools for educational purposes.
H5: Socioeconomic variables of Yemeni students have a negligible effect on their usage of AI tools.
H6: Students who have personal computers show higher interaction with AI tools than other students.
H7: Frequent use of AI technologies enhances students' overall academic performance at the university.
H8: Frequent use of AI tools contributes to the improvement of students' practical and technical skills.

C. Data collection

This study employs a quantitative approach for answering research questions. A structured questionnaire was developed to address research questions and hypotheses. It targeted engineering students from the Faculty of Engineering and Information Technology at Taiz University, Yemen. Engineering students were selected as a sample of undergraduate students in Yemen due to their proximity to technology and computing advancements. Questions were structured based on a 5-point Likert scale and first asked for demographic information of respondents, followed by

questions related to research variables, both dependent and independent variables.

The questionnaire was reviewed by two statistical specialists to ensure that its questions effectively validated the research questions and hypotheses. After that, the questionnaire was randomly distributed to engineering students in lecture rooms during classes in February 2025. The research population was limited to undergraduate engineering students at Taiz University during the academic year 2024–2025, totaling approximately 1,830 students. A total of 300 responses were collected from students across various study levels and specializations. Of these, 277 responses were complete and accurately recorded in an Excel file for further analysis.

Demographic questions were included in the survey to gather information about the respondents' characteristics. The respondents were classified by their sex, with 84 female students and 193 male students participating in the survey. Additionally, among all respondents, 20 students were married, while 257 were single. These demographic classifications were structured as key research variables to examine the potential influence of sex and marital status on the relationship between AI tool usage and educational attainment.

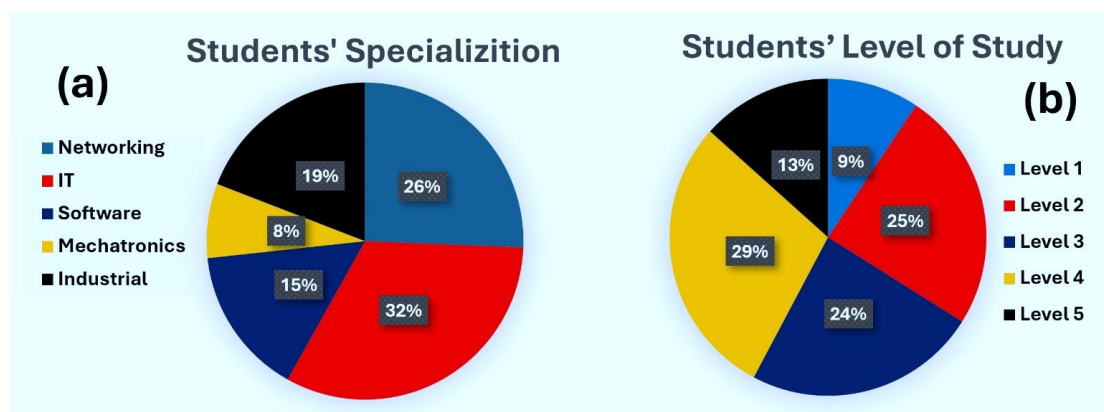


Figure 2. Questionnaire respondents' classifications based on their (a) discipline and (b) study level.

The engineering specializations of the students were categorized as illustrated in Figure 2(a). The distribution of respondents across specializations was as follows: 53 from the Industrial Engineering department, 21 from Mechatronics, 42 from Software Engineering, 90 from Information Technology, and 71 from Computer Networks and Cyber Security. Similarly, Figure 2(b) displays respondents' classification based on their study level. The division of students was as follows: 26 students from the 1ST level, 68 from the 2ND level, 66 from the 3RD level, 80 from the 4TH level, and 37 from the 5TH level. This diversity and uniformity of respondents across both specializations and academic levels make them effective variables influencing the correlation between GenAI usage and educational achievement. Furthermore, a good selection of respondents' frameworks enhances the quality of the research sample to effectively validate the research questions and the study's hypotheses.

Statistical analysis was conducted using SPSS software, which was used to calculate the mean, standard deviation, and variance of the variables. Additionally, the correlation coefficient between the variables was also assessed. The data were exhibited in the form of tables, diagrams, and graphs for better understanding of the relation between various variables.

IV. RESULTS AND DISCUSSION

This section presents the analysis of questionnaire responses of 277 engineering students from different engineering disciplines in Yemen. Many variables were studied to predict the relationship between GenAI usage and educational attainment. These variables are, for example, sex, marital status, engineering specialization (with a focus on its proximity to computer-related fields), living stability, economic condition, study level, and having a personal computer and smartphone.

The interactions of these variables were systematically analyzed, and the results are presented in tables and charts. Figure 3 demonstrates the percentage of various AI tools frequently used by engineering students in Yemen for educational purposes and general knowledge acquisition. The results indicated that 89.17% of engineering students rely on ChatGPT as their primary AI tool. This finding is in consistent with other studies highlighting ChatGPT's dominance as the most widely promoted GenAI model for higher education after its release in November 2022 [18, 19,

32]. For instance, a 2023 survey study performed in Germany indicated that two-thirds of university students use ChatGPT as a main AI model for their studies [37]. However, this survey was conducted just a few months after its initial release by OpenAI.

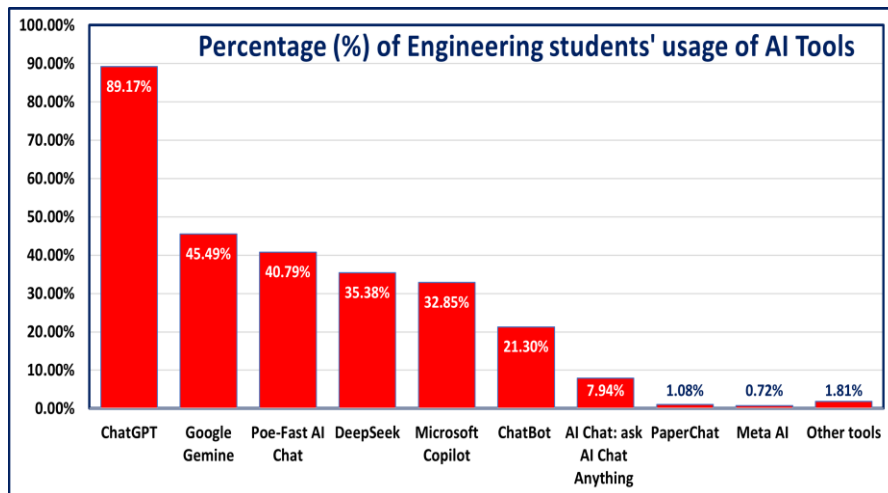


Figure 3. A diagram of percentage (%) of student users among list of GenAI tools. Sample size, n=277.

According to Figure 3, Google Gemini and Poe-Fast AI Chat came in second and third orders, with usage rates of 45.5% and 40.8%, respectively. Although DeepSeek was officially launched on January 27, 2025, it quickly gained popularity, likely because it is an open-source and cost-effective model. It demonstrated very good results comparable to what can be obtained by ChatGPT. Its Chinese origin, which filled a gap in an AI market previously dominated by U.S.-based tools, also raised its popularity. Accordingly, the survey results of this study indicated that over 35% of Yemeni engineering students began using DeepSeek frequently within a few weeks of its global release. Additionally, about 32.85% and 21.3% of students use Microsoft Copilot and ChatBot AI tools, respectively. Other tools, such as PaperChat and Meta AI,

are rarely used by Yemeni engineering students, with only about 1% reporting using them.

Table 1 elucidates the statistical values of the main variables corresponding to this study. There are identical matching mean value results of secondary school grades and university grades at $\mu = 3.516$ and $\mu = 3.58$, respectively. Most students showed higher "living stability" at $\mu = 4.018$, while the "economic conditions" of engineering students in Yemen are ultimately bad at $\mu = 2.516$. Students who frequently use GenAI tools for general purposes are at $\mu = 3.92$, but students' usage for educational purposes is high at $\mu = 4.246$. These values provide an initial indication about the respondents' characteristics and variables' features in the context of the Yemeni environment.

Table 1. Statistical analysis (Range, Mean, and Standard Division) of main variables. Sample size, n = 277.

| Code | Variable | n | Range | Mean (μ) | S. D. |
|------|----------------------------------|-----|-------|----------|-------|
| A1 | Sex (Male 1, Female 2) | 277 | 1 -2 | 1.30 | 0.46 |
| A2 | Marital Status | 277 | 1 -2 | 1.072 | 0.259 |
| A3 | Specialization close to computer | 277 | 1 -5 | 3.841 | 1.614 |
| A4 | Study level | 277 | 1 -5 | 3.11 | 1.187 |
| A5 | Having computer | 277 | 1 -2 | 1.144 | 0.352 |
| A6 | Having smart phone | 277 | 1 -2 | 1.011 | 0.104 |
| A7 | Secondary school score | 277 | 1 -5 | 3.516 | 1.153 |
| A8 | University Score | 277 | 1 -5 | 3.58 | .947 |
| A9 | Living stability | 277 | 1 -5 | 4.018 | 1.392 |
| A10 | AI Usage, in general | 277 | 1 -5 | 3.92 | .885 |
| A11 | AI Usage for Education | 277 | 1 -5 | 4.246 | .764 |
| A12 | Economic conditions | 277 | 1 -5 | 2.516 | 1.082 |

Table 2. Statistical analysis based on variables' significance (P< 0.05) with dependent variables.

| Code | Variable | Uni. Overall Grades (A8) | | Students' AI Usage (A10) | |
|------|----------------------------------|--------------------------|--------------|--------------------------|--------------|
| | | F | P | F | P |
| A1 | Sex (Male 1, Female 2) | .850 | 0.357 | 4.662 | 0.032 |
| A2 | Marital Status | 0.155 | 0.694 | 0.624 | 0.430 |
| A3 | Specialization close to computer | 1.049 | 0.383 | 2.638 | 0.035 |
| A4 | Study level | 2.419 | 0.049 | 2.395 | 0.050 |
| A5 | Having computer | 0.000 | 0.995 | 1.142 | 0.286 |
| A6 | Having smart phone | 0.956 | 0.564 | 0.363 | 0.547 |
| A7 | Secondary school score | 6.465 | 0.000 | 0.615 | 0.652 |
| A8 | University Overall Grade | XXX | XXX | 1.581 | 0.180 |
| A9 | Living stability | 0.387 | 0.818 | 1.336 | 0.257 |
| A10 | AI Usage, in general | 1.425 | 0.226 | XXX | XXX |
| A11 | AI Usage for Education | 4.741 | 0.003 | 20.822 | 0.000 |
| A12 | Economic condition | 1.052 | 0.381 | 1.549 | 0.189 |

The results of the survey indicated that three factors—study level (F = 2.419, p < 0.049), secondary school score (F = 6.465, p < 0.0001), and AI usage for education (F = 4.741, p < 0.003)—had a significant effect on A8, as shown in **Table 2**. Similarly, the results of the survey indicated that four variables—sex (F = 4.662, p < 0.032), study level (F = 2.395, p < 0.050), specialization close to computer (F = 2.638, p < 0.035), and AI usage for education (F = 20.822, p < 0.000)—

had a significant effect on A10. Notably, gender, a key social variable in Yemeni conservative society, represents a significant barrier to students' AI usage (F = 4.662, p < 0.032), which agrees with a recent study confirming the effect of gender on female students' effective communication with new technologies and computer-based models [13]. This significant analysis will be validated in the coming subsections.

Table 3. Correlation coefficient (f) values based on linear Pearson's model. $n = 277$ engineering students, data was collected in February 2025.

| Code | Variable | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 |
|------|----------------------------------|----|--------|-------------|--------|--------|--------|--------|--------------|--------------|--------------|--------------|---------------|
| A1 | Sex (Male 1, Female 2) | 1 | -0.002 | 0.26 | -0.12 | -0.092 | -0.07 | 0.127 | 0.076 | 0.376 | 0.086 | -0.086 | -0.30 |
| A2 | Marital Status | | 1 | 0.062 | 0.092 | -0.075 | -0.029 | -0.04 | 0.035 | -0.164 | 0.072 | -0.017 | 0.164 |
| A3 | Specialization close to computer | | | 1 | -0.019 | -0.157 | -0.011 | 0.091 | 0.084 | 0.146 | 0.118 | 0.002 | 0.041 |
| A4 | Study level | | | | 1 | -0.159 | 0.049 | 0.147 | -0.021 | 0.016 | 0.136 | 0.026 | 0.233 |
| A5 | Having computer | | | | | 1 | 0.155 | -0.077 | 0.008 | -0.109 | -0.114 | 0.029 | -0.025 |
| A6 | Having smart phone | | | | | | 1 | -0.047 | -0.101 | -0.052 | -0.03 | -0.079 | 0.176 |
| A7 | Secondary school score | | | | | | | 1 | 0.288 | 0.184 | 0.115 | 0.057 | -0.145 |
| A8 | University Overall Grade | | | | | | | | 1 | 0.000 | 0.185 | 0.213 | 0.014 |
| A9 | Living stability | | | | | | | | | 1 | 0.060 | -0.031 | -0.252 |
| A10 | AI Usage, in general | | | | | | | | | | 1 | 0.447 | 0.153 |
| A11 | AI Usage for Education | | | | | | | | | | | 1 | 0.043 |
| A12 | Economic condition | | | | | | | | | | | | 1 |

Table 3 demonstrates crucial findings of the correlation between research variables. The interaction coefficient results reveal a strong correlation between the frequent use of AI tools and students' overall university grades. Specifically, students who regularly use GenAI tools, both in general ($f = 0.185$) and for educational purposes ($f = 0.213$), achieved higher overall grades compared to their peers, which aligns well with the first hypothesis. Although the correlation factors have positive values ($f = 0.185$ and $f = 0.213$), their values are close to zero, indicating that the role of GenAI for enhancing education is still facing diverse barriers and requires continuous investigation in the future. Moreover, students who frequently utilize GenAI tools tend to leverage them positively to enhance their educational performance ($f = 0.447$). These findings are particularly encouraging for the educational landscape in Yemen, despite the country's limited technological infrastructure and internet accessibility. The living stability of engineering students exhibited a neutral impact on both their frequency of GenAI usage ($f = 0.06$) and their overall academic performance ($f = 0.000$), as shown in Table 3. In contrast, the economic condition variable behaves in another way, it showed a minimal effect on the university overall grades ($f = 0.014$) but had a more pronounced influence on students' access ability to GenAI tools ($f = 0.153$), indicating that economic condition is crucial for students boosting their accessibility to GenAI models. These findings hold particular significance for policymakers and educators in Yemen and any similar settings, especially given Yemen's ongoing political and economic challenges.

Despite facing financial hardships, engineering students have demonstrated resilience, refusing to let their difficult economic circumstances hinder their academic pursuits [11]. In other words, these students have not succumbed to the pressures of their financial constraints or family situations, and they continue to strive for academic excellence [15].

Consequently, the challenging financial conditions faced by students in Yemen have moderately hindered students from engaging with technology and AI tools to enhance their education and expand their knowledge.

Students' social variables, such as gender and marital status, exhibit only slight influences on their usage of GenAI tools and their overall university grades. The results indicate that female students use GenAI tools more frequently than male students ($f = 0.086$), though they are less likely to use these tools specifically for educational purposes ($f = -0.086$). These findings slightly deviate from the fourth hypothesis of this study, plausibly due to the conservative nature of society in Yemen. Similarly, married students show slightly higher usage of GenAI tools compared to unmarried students, as well as marginally better overall university grades.

Engineering students from computer-related specializations interact with GenAI tools more frequently than those from other engineering disciplines ($f = 0.118$); this result matches the second hypothesis of this research. That is because students from computer-related disciplines deal with AI advancements as a vital part of their core specializations. Additionally, senior students demonstrated greater engagement with GenAI tools compared to freshmen ($f = 0.136$), which supports the third hypothesis of this study. Students from the first and second study levels are focusing on fundamental and applied sciences courses at this stage of the engineering curriculum.

Finally, the ownership of personal computers or smartphones among engineering students has only a minor impact on their engagement with GenAI tools, matching well with the sixth hypothesis. This is likely due to the widespread availability of fast internet connections through personal phones, which supports all students with almost equal opportunities to internet access.

Table 4. Students' opinions about their skills in dealing with GenAI tools and skills' development. Sample size $n = 277$ engineering students.

| Code | Statement | Range | Mean (μ) | S.D. | Variance |
|------|---|-------|----------------|-------|----------|
| B1 | I use several AI tools to help me for studying | 1 - 5 | 4.25 | 0.764 | 0.584 |
| B2 | I can select suitable AI tools for my education purposes | 1 - 5 | 4.11 | 0.824 | 0.679 |
| B3 | I can deal with technical and design AI tools during their use. | 1 - 5 | 3.84 | 0.988 | 0.977 |
| B4 | I can predict the best AI tools for specific use. | 1 - 5 | 3.74 | 0.919 | 0.845 |
| B5 | I often go for GenAI tools for more knowledge | 1 - 5 | 4.22 | 0.940 | 0.885 |
| B6 | I can evaluate the quality of AI tools used for education purposes | 1 - 5 | 3.73 | 1.091 | 1.191 |
| C1 | GenAI tools constantly help students with cooperative education | 1 - 5 | 3.61 | 1.210 | 1.464 |
| C2 | GenAI tools improve students' self-education and continuous education | 1 - 5 | 4.06 | 0.954 | 0.910 |
| C3 | The use of AI tools helps students perform their duties in time | 1 - 5 | 4.29 | 0.819 | 0.671 |
| C4 | The use of AI tools increases students' motivation to learn. | 1 - 5 | 3.77 | 1.109 | 1.229 |
| C5 | The use of AI tools allows students with diverse teaching approaches. | 1 - 5 | 3.97 | 0.918 | 0.843 |
| C6 | The use of AI tools enhances students' thinking skills | 1 - 5 | 3.51 | 1.218 | 1.483 |

Table 4 presents the statistical analysis of the questionnaire responses, including the mean, standard deviation, and variance for each statement. It reflects students' perspectives on their awareness and understanding of the benefits

associated with the frequent use of GenAI tools for educational purposes. Overall, most students expressed positive attitudes toward AI tools, viewing them as a reliable and continuous source of information and knowledge. This

trend is evident from the high mean values (μ) for all statements listed in Table 4.

Students believe that GenAI tools significantly aid their studies ($\mu = 4.25$), enhance their general knowledge ($\mu = 4.22$), and provide quick and timely answers ($\mu = 4.29$). However, their self-reported experience and interaction with GenAI tools received relatively lower scores compared to other general statements. Specifically, engineering students feel moderately confident in selecting the appropriate AI tool for specific tasks ($\mu = 3.74$), effectively using technical and design-oriented AI tools ($\mu = 3.84$), and evaluating the quality of data and information generated by AI tools ($\mu = 3.61$). Notably, students are more familiar with GenAI tools that are directly related to their educational purposes ($\mu = 4.11$).

Students displayed good agreement with several statements, shedding light on the role of GenAI tools in enhancing their practical and technical skills. These include fostering cooperative learning ($\mu = 3.61$), promoting self-directed and continuous learning ($\mu = 3.74$), increasing motivation to learn ($\mu = 3.77$), and improving critical thinking abilities ($\mu = 3.51$). Additionally, students acknowledged that AI tools have diversified teaching methods and expanded approaches to acquiring information ($\mu = 3.97$), moving beyond the conventional face-to-face education model of direct information reception. Although students' perspectives towards these measures are not fully supported, this study proposes that students' beliefs in effective usage of GenAI for enhancing education will grow exponentially shortly.

Table 5. Students' opinions about the drawbacks and challenges associated with their AI use. Sample size $n = 277$ engineering students.

| Code | Statement | Range | Mean (μ) | S.D. | Variance |
|------|--|-------|----------------|-------|----------|
| F1 | GenAI tools weaken students' ability to think creatively | 1 - 5 | 3.69 | 1.243 | 1.547 |
| F2 | Students don't have sufficient skills and experience to deal with GenAI tools. | 1 - 5 | 3.49 | 1.058 | 1.120 |
| F3 | GenAI tools increase reliance on technology and dismiss practical skills. | 1 - 5 | 4.00 | 1.005 | 1.011 |
| F4 | Technological and financial resources required for accessing AI tools are weak in Yemen. | 1 - 5 | 4.03 | 1.088 | 1.184 |
| F5 | I don't believe information provided by GenAI tools | 1 - 5 | 3.40 | 1.063 | 1.130 |
| F6 | GenAI tools boost motivation for scientific research | 1 - 5 | 3.96 | 0.896 | 0.803 |
| F7 | GenAI tools help conduct scientific research at time. | 1 - 5 | 4.08 | 0.901 | 0.813 |

There is growing concern among education policymakers that excessive reliance on AI tools by university students may undermine their self-reflection skills and make it increasingly challenging to differentiate between students' true intelligence levels. Table 5 highlights engineering students' perspectives on the drawbacks and challenges associated with the frequent use of GenAI tools for educational purposes. Students believe that over-reliance on AI tools as a primary source of information, without putting in sufficient effort, diminishes their creative thinking abilities and negatively impacts their reading skills ($\mu = 3.69$). Additionally, students strongly agree that GenAI tools increase dependency on technology and reduce the development of practical skills (μ

$= 4.00$). They also expressed skepticism about the accuracy and reliability of information provided by these tools ($\mu = 3.40$). Finally, students highlighted the challenges of accessing AI tools in the Yemeni context, citing limited technological and financial resources ($\mu = 4.03$) and a lack of training on how to effectively select and interact with the most suitable AI tool for specific tasks ($\mu = 3.49$). These concerns, clearly expressed by engineering students, should be taken seriously by policymakers of HEIs, ensuring that access to GenAI tools is not unfettered. This sensitive topic requires in-depth studies that examine these growing concerns and propose recommendations to control them.

Students also provided valuable insights into the role of GenAI tools in scientific research. Students believe that these tools are not only essential for improving their projects and homework reports but also enhance their motivation to conduct high-quality scientific research ($\mu = 3.96$) in a quick and timely manner ($\mu = 4.08$). However, the use of AI tools in scientific research remains a controversial topic, with

conflicting studies on how they can be effectively integrated without undermining the researcher's role [34]. In other words, GenAI tools should complement, not replace, human effort. Another concern is the potential for AI tools to generate virtual or fabricated data, which could compromise the quality and reliability of scientific research and undermine HEIs' reputation.

Table 6. Students' opinions about the influence of GenAI tools on University Education in general. The sample size was 277 respondents from engineering students in Yemen.

| Code | Statement | Range | mean (μ) | S.D. | Variance |
|------|---|-------|----------------|-------|----------|
| G1 | GenAI tools enhance students' education attainment | 1 - 5 | 3.80 | 0.849 | 0.721 |
| G2 | GenAI tools enhance students' education skills | 1 - 5 | 3.34 | 0.982 | 0.964 |
| G3 | Students who use GenAI tools are intelligent and excel academically | 1 - 5 | 3.63 | 1.050 | 1.103 |
| G4 | Using AI tools boosts students' ability to solve problems. | 1 - 5 | 3.75 | 1.074 | 1.154 |
| G5 | There is a positive relationship between the use of AI tools and students' academic achievement | 1 - 5 | 3.80 | 0.969 | 0.940 |

Table 6 summarizes students' thoughts and fears about the relationship between the reliance on GenAI tools and their educational attainment. Students expressed support for adopting AI tools as a supporting learning resource, but with some reservations. This is evident from the low mean values in Table 6. Students' responses to issues such as (1) GenAI tools boost students' education skills ($\mu = 3.34$), and (2) using AI tools effectively is an indication of intelligence and excellent academic performance ($\mu = 3.63$). Finally, students agreed with the research statement: There is a positive relationship between the use of GenAI tools and students' academic achievement.

The outcomes of this study align well with almost all studies in the literature review discussing this unique topic [38-40]. Although the correlation between primary variables varies from one society to another, the correlation results are moderately accepted in Yemeni, considering the socioeconomic challenges. Indicators from this study infer that university education in Yemen relatively benefits from the most advanced AI tools to support technology-based cognitive learning and reinforce their knowledge.

Overall, the integration of GenAI tools into higher education in Yemen is a critical, dynamic, and timely topic that requires further in-depth studies across primary, secondary, university, graduate, and vocational education. Studies that entail other student respondents from different states in Yemen with varied sociocultural norms are needed for a comprehensive understanding of this sustainable integration. This study provides positive indicators useful to decision-makers, educators, and students in HEIs.

Conclusions and Recommendations

This study surveyed 277 engineering students from Taiz University in Yemen to explore how the frequent usage of GenAI models enhances their education. Many socioeconomic variables peculiar to Yemeni students were investigated to demonstrate their impact on the relationship between GenAI tools and educational performance. The study showed a strong and positive correlation between the frequent use of GenAI tools and students' university overall grades, encouraging their integration into the educational system in Yemen as a supporting source of learning and knowledge seeking. Despite the worse socioeconomic conditions of Yemeni Engineering students, the results of this study showed their moderate effect on the relationship between the usage of AI models and students' university overall grades. These findings hold particular significance for policymakers and educators in Yemen and any similar settings, especially given Yemen's ongoing political and economic challenges.

The results showed that almost all students use GenAI tools with varying usage levels. Interesting results showed that 89.17% of engineering students in Yemeni Universities rely on ChatGPT as a primary AI tool that satisfies their needs. Other AI models showed less interest, but the DeepSeek GenAI model has been observed as a strong AI competitor, despite its being a few weeks old since its launch on 27th January 2025.

This study recommends that HEIs establish guidelines to control students' effective usage of GenAI tools without breaking research ethics and dismissing their intellectual and problem-solving capabilities. In terms of the wide variety of

GenAI tools, students should be trained and upskilled to identify their features, merits, and drawbacks to get the most appropriate AI tools for their specific needs.

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