Assessment of Teaching Effectiveness, Digital Literacy, and Feedback on Student Assignments using ChatGPT

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INFO ARTIKEL	ABSTRAK
	Abstract: This study aims to evaluate the Teaching Effectiveness, Digital Literacy, and Feedback on Student Assignments using ChatGPT in the context of mathematics education in higher education settings. A quantitative method was employed with a sample of 29 students from various semesters. The research instrument utilized was a questionnaire using the Likert Scale, comprising 10 items to measure Teaching Effectiveness, 9 items for Digital Literacy, and 7 items for Feedback on Student Assignments. Descriptive statistical analysis revealed average scores of 73.586 for Teaching Effectiveness, 73.180 for Digital Literacy, and 73.990 for Feedback on Student Assignments. These findings provide deeper insights into students' perceptions of ChatGPT usage in mathematics education and offer insights into the distribution and characteristics of values obtained from respondents. The implications of this research can be utilized for the development and enhancement of ChatGPT's utilization in providing effective feedback on student assignments in academic environments.

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A. INTRODUCTION

ChatGPT, an artificial intelligence language model, demonstrates adaptability across a spectrum of conversational applications, encompassing succinct responses to more intricate exchanges. Its proficiency extends to the comprehension and generation of text in multiple languages (Chen & Donin, 1997). Nonetheless, it is not exempt from limitations, necessitating substantial data for effective model training and exhibiting a reliance on antecedent context. The assessment of AI language models, such as ChatGPT, within the educational domain, especially at the tertiary level, assumes significance in evaluating their efficacy across diverse instructional contexts and digital literacy domains (Kasneci et al., 2023). In its capacity as an educational instrument, ChatGPT can contribute by furnishing problem-solving support, delivering expeditious feedback, tailoring responses to individual learning styles, and more. However, the selection of an AI chatbot should be contingent upon specific project requisites and circumstances (Niederman, 2021).

ChatGPT has become a widely used tool among university students in the course of their academic pursuits. The incorporation of ChatGPT into student practices can yield various advantages, particularly in terms of teaching efficiency, digital literacy, and feedback (Adeshola & Adepoju, 2023). Students can leverage ChatGPT for diverse

purposes, such as honing communication skills, managing schedules, seeking advice, generating structured content, acquiring supplementary information, testing comprehension, conducting research, and crafting academic works. The utilization of ChatGPT can also enhance the accessibility and flexibility of learning resources, providing personalized assistance tailored to individual student needs. However, it is imperative to approach the use of ChatGPT judiciously, considering potential drawbacks like the erosion of students' proficiency in natural language usage and the risk of dependence on technology (Harini, 2023). Therefore, it is crucial for universities to carefully weigh the benefits and risks associated with the incorporation of ChatGPT within the learning context.

Digital literacy in the context of mathematics learning involves students' ability to judiciously use digital media and information technology to comprehend, evaluate, and generate mathematical information. Several studies highlight the implementation of digital literacy in mathematics learning through various mediums, such as Space Geometry Flipbook (SGF) and interactive multimedia (Bris et al., 2021). Research findings indicate that the integration of digital literacy can enhance students' understanding of mathematical concepts and foster critical thinking and active engagement. Additionally, digital literacy can also be implemented through the Blended Learning approach, which combines conventional learning methods with digital technology (Bordoloi et al., 2021). However, there are internal and external challenges in implementing digital literacy, including students' attitudes towards digital media and infrastructure limitations.

AI technology, specifically ChatGPT, has the potential to be used in mathematics teaching and to improve student digital literacy. ChatGPT has been recognized for its improved math capabilities and ability to provide users with basic knowledge of mathematics and various topics. It can offer comprehensive instruction and assistance in the study of geometry, and there is generally positive enthusiasm for its use in teaching mathematics and educational settings (Wardat et al., 2023). However, there are also concerns about ChatGPT's limitations, such as its lack of deep understanding of geometry and its inability to effectively correct misconceptions. The accuracy and effectiveness of ChatGPT solutions may depend on the complexity of the equation, input data, and instructions given (Adiguzel et al., 2023). Despite these limitations, AI technologies like ChatGPT have the potential to revolutionize the educational landscape by providing effective support for learners in a range of subjects, including mathematics (Santos et al., 2023).

ChatGPT has the potential to improve the efficiency of delivering teaching materials by providing individualized support to students. It can offer personalized and interactive learning experiences, catering to individual needs and learning styles, thereby enhancing learner engagement and motivation (Keiper, 2023). ChatGPT can also automate administrative tasks, generate instructional materials, and deliver

personalized feedback to students, optimizing instruction and allowing educators to adapt to diverse student needs ("Abstracts of the 17th International Symposium on Bioluminescence and Chemiluminescence - (ISBC 2012)," 2012). Furthermore, the use of ChatGPT in education has shown positive results in various domains. It has been found to enhance student achievement and perception of learning in specific academic subjects, such as electronic magnetism (Shaikh Zikra Riyaz & Shaikh Suvaid Salim, 2023). Additionally, ChatGPT has been effective in improving students' knowledge and understanding of complex topics, such as medical terminology (Graefen & Fazal, 2023). These findings suggest that ChatGPT can be a valuable tool in providing individualized support and improving the efficiency of teaching materials delivery.

ChatGPT has shown promise in meeting students' needs for task feedback in mathematics learning in the digital age. It has the capability to provide detailed and coherent feedback that summarizes students' performance better than human instructors (Ghosh & Bir, 2023). Additionally, ChatGPT can accurately assess the correctness of students' answers and generate high-quality feedback, similar to human instructors (Bergener et al., 2023). However, there are limitations to ChatGPT's ability in solving certain types of math problems, such as decimal place values and number line problems (Alejandro Guadalupe Rincón Castillo et al., 2023). It also lacks a deep understanding of geometry and may struggle to effectively correct misconceptions (Eager & Brunton, 2023). Despite these limitations, ChatGPT has been recognized for its improved math capabilities and ability to increase educational success by providing users with basic knowledge of mathematics and various topics (Wardat et al., 2023). Further research is needed to explore ways to enhance ChatGPT's efficiency in resolving complex mathematical problems and ensure its secure and conscientious integration into mathematics education and learning.

This research aims to assess the impact of utilizing ChatGPT in the context of mathematics education, focusing on teaching efficiency, students' digital literacy, and feedback on their assignments. Firstly, the study will delve into the extent to which ChatGPT can enhance efficiency in delivering instructional content, both in providing instructional assistance and individual support for students. Subsequently, the research will explore the influence of ChatGPT on students' digital literacy, measuring how this technology can enrich their understanding of digital literacy within the context of mathematics learning. The third aspect of the research will center on the feedback provided by ChatGPT on students' assignments, evaluating the quality of feedback and its potential to enhance the overall quality of students' work.

Additionally, the research will pay attention to the user acceptance and responses to the use of ChatGPT in mathematics education. By understanding students' perceptions of this technology, the research will investigate how ChatGPT can effectively motivate and increase students' engagement in learning mathematics. Furthermore, the research will open discussions on the potential development of AI-

based learning strategies to enhance the quality of mathematics teaching and learning at the higher education level. Consequently, the findings of this research are expected to make a significant contribution to understanding both the potential and challenges of using ChatGPT in the context of mathematics education.

B. RESEARCH METHODOLOGY

This study adopts a quantitative approach, utilizing a survey or questionnaire among university students as the data collection method. The research subjects consist of 29 students from various semesters, ranging from the first to the seventh semester, specializing in the field of mathematics. The research instrument employed is a questionnaire utilizing the Likert Scale. There are 10 questions designed to measure the Teaching Efficiency variable, 9 questions for the Digital Literacy variable, and 7 questions for the Feedback on Student Assignments variable. The questionnaire is distributed to students through Google Form with the link (https://bit.ly/AngketChatGPT). Subsequently, the collected data will be tabulated and presented to analyze the individual scores of each student and the response levels for each measured variable.

Data collection and analysis are conducted using descriptive statistical methods. The analysis aims to (1) ascertain the distribution of student responses regarding the evaluation of ChatGPT utilization in the learning process, (2) assess the level of student responses based on semester levels, and (3) evaluate the level of student responses based on each indicator of every research variable. With this approach, it is anticipated that this study will provide a deeper understanding of students' perceptions and responses regarding the utilization of ChatGPT in the context of mathematics learning.

C. RESULTS AND DISCUSSION

The data collection process was carried out through the use of a questionnaire, with each variable having 10 questions for Teaching Efficiency, 9 questions for Digital Literacy, and 7 questions for Feedback on Student Assignments. This questionnaire was specifically distributed to students in the field of mathematics with the aim of evaluating the utilization of ChatGPT during the course. Responses to the questionnaire were obtained from first-semester students (13 respondents), third-semester students (5 respondents), fifth-semester students (3 respondents), and seventh-semester students (8 respondents), resulting in a total of 29 respondents. Descriptive statistical analysis was conducted to evaluate the distribution of data and the outcomes of student responses, as illustrated in Figure 1 and Table 1.
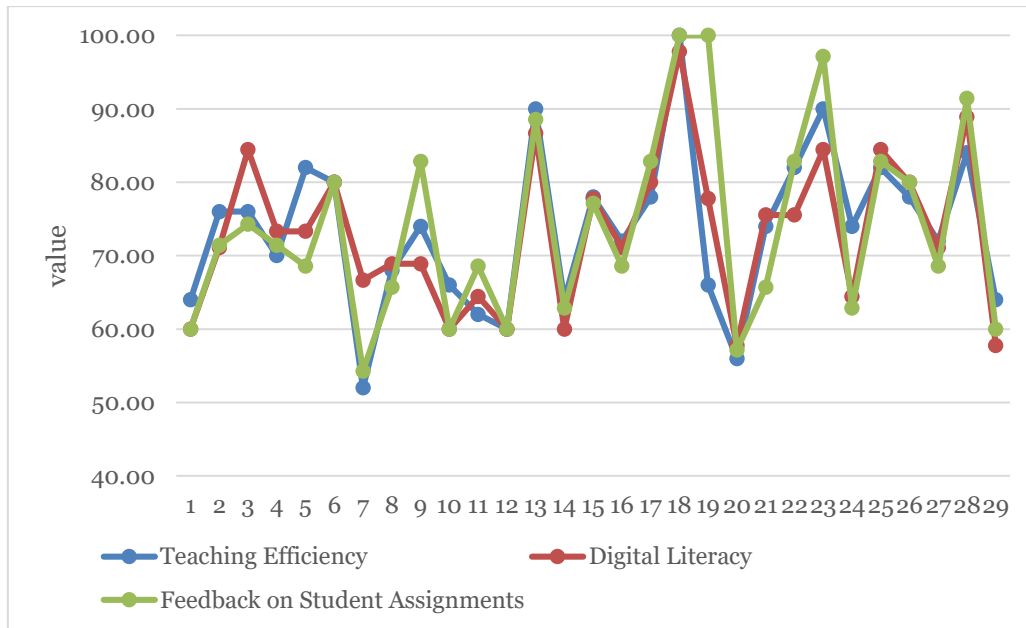
Figure 1. Student Responses to the Utilization of ChatGPT

Table 1. Descriptive Statistics

	Teaching Efficiency	Digital Literacy	Feedback on Student Assignments
Valid	29	29	29
Missing	0	0	0
Mean	73.586	73.180	73.990
Std. Deviation	10.696	10.388	13.056
MAD robust	11.861	9.889	16.946
Variance	114.394	107.912	170.465
Range	48.000	40.000	45.710
Minimum	52.000	57.780	54.290
Maximum	100.000	97.780	100.000

The descriptive statistical results regarding the variables of Teaching Efficiency, Digital Literacy, and Feedback on Student Assignments provide insights into the distribution and characteristics of values obtained from 29 respondents in this study. The average scores for Teaching Efficiency, Digital Literacy, and Feedback on Student Assignments are 73.586, 73.180, and 73.990, respectively. The relatively low standard deviation indicates that the values tend to be close to the mean, signaling consistency in students' responses to the use of ChatGPT. The analysis also reveals the values of the robust Mean Absolute Deviation (MAD), depicting a level of variation more resistant to outliers. The relatively small MAD for Digital Literacy indicates consistent responses to this variable. However, the higher MAD for Feedback on Student Assignments suggests greater variation in students' responses to tasks involving ChatGPT.

In the context of variability, the variance values for Teaching Efficiency, Digital Literacy, and Feedback on Student Assignments are 114.394, 107.912, and 170.465,

respectively. The higher variance in Feedback on Student Assignments indicates more significant variability in students' assessments of the feedback provided by ChatGPT. The range of values provides information about the maximum and minimum spread in the data. The relatively high range value for the Feedback on Student Assignments variable, at 45.710, indicates substantial variation in students' responses to task feedback. Overall, this descriptive statistical analysis offers crucial insights into the consistency, variation, and distribution of student responses to the efficiency of teaching, digital literacy, and feedback on student assignments involving ChatGPT. This interpretation can serve as a foundation for a deeper understanding of the effectiveness of ChatGPT usage in the context of mathematics education at the university level.

Table 2. Student Responses Based on Semester

Semester	TE	DL	FSA
I	70,77	70,60	69,67
III	78,40	77,33	78,29
V	65,33	70,37	74,29
VII	78,25	75,83	78,21

Student responses, as delineated for Semester I, reveal scores for Teaching Efficiency (TE) at 70.77, Digital Literacy (DL) at 70.60, and Feedback on Student Assignments (FSA) at 69.67. These numerical representations encapsulate the students' assessments of ChatGPT's efficacy in teaching, their level of digital literacy, and their feedback on assignments during the initial semester. The relatively consistent scores across these three variables suggest a balanced perception of ChatGPT's performance, with minimal fluctuations in evaluations related to teaching efficiency, digital literacy, and feedback on assignments during this specific academic period.

In Semester III, students exhibited responses denoted by scores for Teaching Efficiency (TE) at 78.40, Digital Literacy (DL) at 77.33, and Feedback on Student Assignments (FSA) at 78.29. These numerical values depict the students' evaluations of ChatGPT's performance in teaching, their digital literacy level, and their feedback on assignments during the third semester. The notable increase in scores across these three variables compared to Semester I suggests a potentially positive evolution in students' perceptions and experiences with ChatGPT over the course of their academic journey. The elevated scores may signify a growing comfort and proficiency in utilizing ChatGPT, resulting in higher evaluations of teaching efficiency, digital literacy, and assignment feedback during this particular academic phase.

During Semester V, students conveyed their responses, indicating scores for Teaching Efficiency (TE) at 65.33, Digital Literacy (DL) at 70.37, and Feedback on Student Assignments (FSA) at 74.29. These numerical representations reflect the students' assessments of ChatGPT's efficacy in teaching, their digital literacy

proficiency, and their feedback on assignments during the fifth semester. The fluctuation in scores across these three variables compared to previous semesters suggests potential variations in students' experiences and perceptions of ChatGPT during this specific academic phase. The decrease in Teaching Efficiency may indicate evolving dynamics in their engagement with ChatGPT, while the increased scores in Digital Literacy and Feedback on Student Assignments may suggest an enhanced familiarity and positive evaluation of ChatGPT's contribution to their learning experiences.

In Semester VII, students expressed their responses, illustrating scores for Teaching Efficiency (TE) at 78.25, Digital Literacy (DL) at 75.83, and Feedback on Student Assignments (FSA) at 78.21. These numerical values encapsulate the students' evaluations of ChatGPT's effectiveness in teaching, their proficiency in digital literacy, and their feedback on assignments during the seventh semester. The relatively consistent and elevated scores across these three variables compared to previous semesters suggest a sustained positive trajectory in students' perceptions and experiences with ChatGPT as they progress in their academic journey. The steady or increased scores may indicate an ongoing and favorable integration of ChatGPT into their learning processes, resulting in continued positive evaluations of teaching efficiency, digital literacy, and assignment feedback during this advanced academic phase.

From the data of student responses presented for Semester I to Semester VII, there is an evident shift in students' evaluations of teaching efficiency (TE), digital literacy (DL), and feedback on student assignments (FSA) involving ChatGPT. In Semester I, the scores for TE, DL, and FSA were 70.77, 70.60, and 69.67, respectively. In Semester III, a significant increase is observed, with values for each variable rising to 78.40, 77.33, and 78.29. However, in Semester V, fluctuations occur with TE decreasing to 65.33, while DL and FSA experience an increase to 70.37 and 74.29. In Semester VII, there is consistency with an increase in TE to 78.25, while DL and FSA remain high with values of 75.83 and 78.21. The improvement in TE, DL, and FSA scores from Semester I to Semester VII indicates a potential positive evolution in students' perceptions and experiences with the use of ChatGPT throughout their academic journey. This enhancement may reflect an increase in students' comfort and proficiency in utilizing ChatGPT, contributing to higher assessments of teaching efficiency, digital literacy, and assignment feedback during specific academic phases. The utilization of ChatGPT for early-semester students in higher education can offer significant benefits in enhancing learning efficiency, digital literacy, and assignment feedback. In the early stages of academic journeys, students can experience advantages from these aspects to support their understanding of course materials, communicate more effectively, and receive instant feedback. Therefore, the integration of ChatGPT in higher education learning can be an effective tool to enhance students' learning experiences.
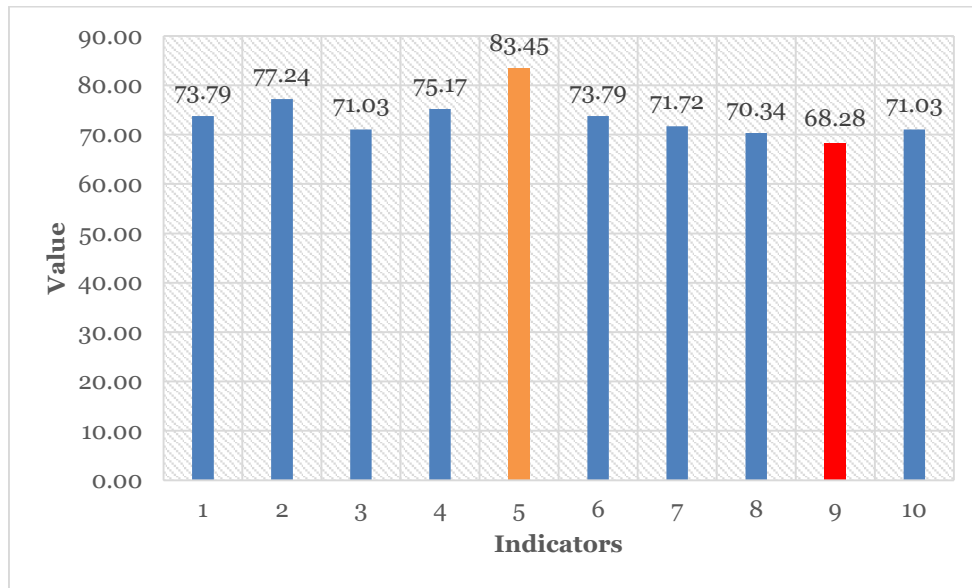
Figure 2. Student Responses on the Use of ChatGPT to Enhance Teaching Efficiency

Student responses regarding the use of ChatGPT to enhance teaching efficiency depict scores across ten different indicators. These values represent students' perceptions of ChatGPT's capability to improve teaching efficiency. In indicators 1 to 10, the sequential values are 73.79, 77.24, 71.03, 75.17, 83.45, 73.79, 71.72, 70.34, 68.28, and 71.03. Overall, these values reflect variations in students' responses to various aspects of teaching efficiency involving ChatGPT. Indicator 5 obtains the highest score, indicating that students have a high perception of ChatGPT's ability to enhance teaching efficiency in that aspect. Meanwhile, indicator 9 obtains the lowest score, signaling an area that may require attention or improvement. In this context, further interpretation and in-depth analysis can be conducted to understand the factors that may influence students' responses to each indicator. This can provide richer insights for the development and enhancement of ChatGPT's use in improving teaching efficiency in an academic setting.
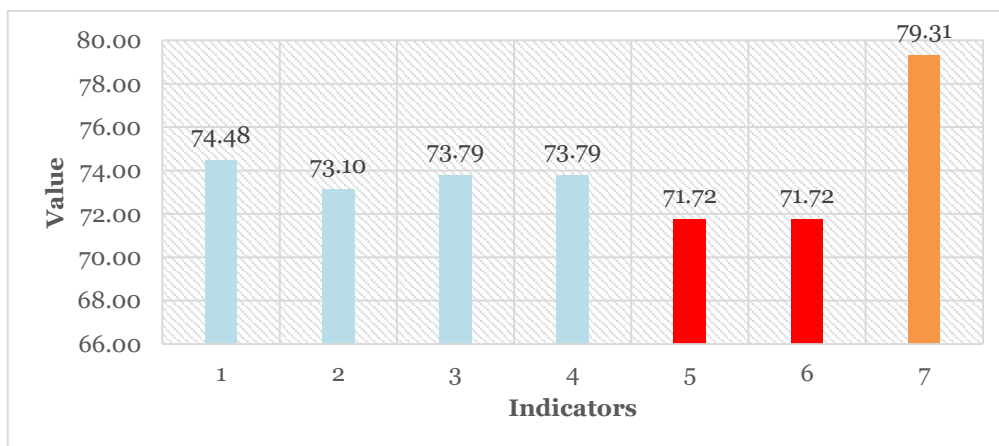
Figure 3. Student Responses on the Use of ChatGPT to Enhance
Feedback on Student Assignments

Student responses regarding the use of ChatGPT to enhance feedback on student assignments illustrate scores across seven different indicators. These values reflect students' perceptions of ChatGPT's ability to improve feedback on student assignments. In indicators 1 to 7, the sequential values are 74.48, 73.10, 73.79, 73.79, 71.72, 71.72, and 79.31. Overall, these values mirror variations in students' responses to various aspects of feedback on student assignments involving ChatGPT. Indicator 7 obtains the highest score, indicating that students have a high perception of ChatGPT's ability to enhance feedback on student assignments in that aspect. Meanwhile, indicators 5 and 6 obtain the lowest scores, signaling areas that may require attention or improvement. In this context, further interpretation and in-depth analysis can be conducted to understand the factors that may influence students' responses to each indicator. This can provide richer insights for the development and enhancement of ChatGPT's use in improving feedback on student assignments in an academic environment.

The adoption of technology by students is a crucial aspect in the context of higher education, particularly in enhancing the effectiveness of learning. The factors influencing technology adoption involve psychological, social, and technological aspects. Psychologically, students' perceptions of the usefulness and ease of use of technology can play a significant role in the decision to adopt a particular platform or application. Additionally, social factors such as support from instructors and peers can influence students' attitudes toward educational technology. In this context, ChatGPT, as an artificial intelligence technology, can make a significant contribution by providing more personalized interactions and supporting various learning needs (Alshahrani, 2023). Digital literacy is also a crucial factor in determining the extent to which students can maximize the potential of technology in learning. Students' understanding of technology usage, navigation skills in digital platforms, and the ability to filter online information are integral components of digital literacy. The use of ChatGPT in this context can help enhance students' digital literacy by providing relevant assistance and guidance in the learning process. With adaptive and responsive interactions, ChatGPT can support students in developing higher-level digital literacy skills (Alshahrani, 2023). It is essential to create a learning environment that supports technology adoption and the improvement of digital literacy. Instructors and educational institutions need to provide adequate training and support to students to understand, appreciate, and optimize technologies like ChatGPT. With this approach, it is expected that students can reap maximum benefits from educational technology and enhance their digital literacy skills, preparing them for challenges in the current digital era.

D. CONCLUSION

The assessment of teaching effectiveness, digital literacy, and feedback on student assignments using ChatGPT revealed dynamic shifts in students' perceptions across various semesters. The progression from Semester I to Semester VII demonstrated an overall positive trend, indicating an evolution in students' evaluations of ChatGPT's impact on teaching efficiency, digital literacy, and feedback on assignments. While there were fluctuations in certain semesters, such as a decrease in teaching efficiency in Semester V, the consistency and notable increases observed in other indicators suggest a growing comfort and proficiency in utilizing ChatGPT over the academic journey. The values obtained for teaching efficiency indicators (1 to 10) and feedback on student assignments indicators (1 to 7) provide a comprehensive understanding of students' nuanced perceptions of ChatGPT's capabilities. This study contributes valuable insights into the potential of ChatGPT as a tool for enhancing the educational experience by addressing teaching effectiveness, digital literacy, and feedback on student assignments in higher education settings.

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