# ChatGPT on STEM 12 Students' Perception, Motivation, Engagement and Understanding Graphs in Kinematics: An Exploration.

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## ABSTRACT

The study explores the utilization of ChatGPT on STEM 12 students' perception, motivation, engagement, and understanding graphs in kinematics. Specifically, it aims to determine the level of students' perception of ChatGPT's usefulness, ease of use, attitude towards using ChatGPT, behavioral intention to use ChatGPT, credibility, social influence, and privacy and security before and after its use. It also seeks to assess the influence of ChatGPT on students' motivation, engagement, and pretest and post-test scores in learning kinematics graphs. Furthermore, the study investigates the relationship between students' perception, motivation, and engagement and their understanding of kinematics graphs. Finally, it explores the views and perceptions of students on the use of ChatGPT.

The study utilized a convergent-parallel mixed methods design combined with one-group pretest-posttest methodology, involving 99 students. The results revealed positive modifications in the students' perceptions regarding ease of use and attitudes toward ChatGPT. Motivation did not alter significantly, while engagement was highly improved in most of the behavioral and social dimensions. More importantly, students' understanding of kinematics concepts presented a strong improvement after the intervention with the use of ChatGPT. A highly significant relationship existed between engagement and understanding, which suggests that an active participation style may have had an indirect positive effect on learning. In contrast, perception and motivation did not indirectly influence understanding. These findings highlight the possibility of ChatGPT as a valuable learning tool, while, at the same time, placing emphasis on careful integration and further study in the face of its limitations and to optimize the effectiveness of the tool in educational settings.

**Keywords:** ChatGPT, kinematics, motivation, engagement

## BACKGROUND OF THE STUDY

Artificial Intelligence (AI) has advanced quickly, revolutionizing a number of industries through increased productivity, better judgment, and inventive problem-solving. Artificial intelligence is significantly impacting technology, finance, healthcare, the environment, and construction, with the most significant impact in Europe and Asia (Espina-Romero et al., 2023).

Several tasks that are currently performed in educational settings, like finding information, asking specific questions, learning about any subject, having open discussions, writing and editing reports and essays, creating software codes, tutoring students by explaining codes, providing data samples for databases and analysis, solving mathematical calculations and statistical analysis, and translating texts into other languages, could all be revolutionized by this technology (Halaweh, 2023). Moreover, by giving students individualized learning experiences, enhancing their language and writing abilities, and automating time-consuming activities for teachers, Generative Pre-Trained Transformer has the potential to completely transform the educational landscape (Božić & Poola, 2023).

Positive effects on student learning outcomes have been consistently demonstrated by the use of AI in science education. Students' motivation is increased, their grasp of the material is improved, and engagement in the

educational process is encouraged. Positive opinions on AI's usability and efficacy were expressed by both teachers and pupils. Both recognized its ability to improve educational opportunities (Almasri, 2024).

AI can help students comprehend the fundamental ideas behind physics problems, encourage critical thinking through leading questions, and provide step-by-step guidance (Suhonen, 2024). Based on each student's unique strengths, weaknesses, and learning style, AI algorithms can tailor their learning route. Students who utilize this adaptive learning strategy receive more individualized instruction and support, which improves comprehension and retention of physics subjects (Jho, 2020). In a feasibility study on artificial intelligence (AI) grading of student problem solutions in basic physics, Kortemeyer (2023) demonstrated how AI might improve learning by giving students consistent, timely feedback. Science teachers approved the utilization of AI during teaching and learning in science class (Nja et al., 2023; Darayseh, 2023).

ChatGPT is built to create the most human-like conversations because it will understand the conversation context and generate the relevant responses (Deng and Lin, 2023). ChatGPT has the potential to revolutionize academic learning by offering students customized explanations and interactive guidance to overcome difficult concepts (Kalla et al., 2023). Additionally, it is proven that the inclusion of ChatGPT into learning activities will bring about marked improvement in student learning outcomes according to the study of Hakiki et al. (2023). Similar to the study of Tlili et al. (2023) that the results revealed that the application of ChatGPT greatly improved the learning outcomes of students while learning.

In terms of experiments, Tan (2022) suggests that ChatGPT has the potential to produce simulations of physics experiments by training it on descriptions of those experiments. Kinematics Graphs can be interpreted by ChatGPT, according to Polverini and Gregorcic (2024). Additionally, ChatGPT 3.5 can produce scripts for plotting kinematics graphs and creating 1-D motion graphs using free programming languages like Python and GNU Octave, based on research by Ramkorun (2024). The use of such graphs has the possibility of taking physics education a step forward where options are limited to manual graph drawing.

In terms of kinematics which includes the visual representation and interpretation, quantitative analysis by Zavala et al. (2017) reveals that ChatGPT’s performance in Test in Understanding Graphs in Kinematics (TUG-K) is far from an expert. For the average and median performance, it appears to be as good as a sample of students taking a physics course in the high school level. Moreover, ChatGPT seems not yet to be a tool meant for outsourcing physics conceptual reasoning. However, with the release of the Advanced Data Analysis mode-sometimes called Code Interpreter plugin that seems to be changing for computing-intensive tasks. According to Kumar and Kats (2023) ChatGPT’s responses to kinematics questions reflected common student difficulties distinguishing velocity and acceleration and a tendency to add velocities as scalars rather than vectors.

With its ability to provide interactive content and individualized learning experiences, artificial intelligence (AI) has become a game-changing technology in education. There is an increasing amount of research on the application of AI in education, but not much of it focuses on using ChatGPT to teach kinematics. Studies that are now available primarily concentrate on the general uses of AI tools in science education or their use in other scientific fields. Existing literature insufficiently addresses how AI tools like ChatGPT impact student engagement and motivation in learning kinematics. While general studies on student engagement and motivation exist, they often do not consider the unique dynamics introduced by AI-driven tools like ChatGPT. On the other hand, it is possible to use ChatGPT to boost motivation and engagement among students (Muñoz et al., 2023).

This study explored the use of ChatGPT as an educational tool for learning kinematics graphs in senior high school – STEM strand. Specifically, it aimed to determine the students’ perceptions in using ChatGPT and determine the influence of using ChatGPT on students’ engagement and motivation in learning Kinematics. Moreover, it delves on the relationship of the students’ perception, motivation and engagement towards understanding kinematics when using ChatGPT.

During the intervention, the study uses the ChatGPT 3.5 version. The results of the study of Amaro et al. (2023), revealed that even if the present version of ChatGPT sometimes is unreliable, people still plan to use

it. Thus, it is recommended to use the present version of ChatGPT always with the support of human verification and interpretation.

To address these challenges, effective integration strategies and deeper alignment with educational needs are suggested. Researchers like Malik et al. (2019) emphasize the necessity of a tailored implementation approach that considers both cognitive and affective factors, which can help transition AI tools from supplementary aids to primary educational resources. Without such alignment, the potential of tools like ChatGPT remains limited in fostering deep, meaningful learning experiences.

## Conceptual Framework

### Constructivism Learning Theory

Constructivism, pioneered by Jian Piaget, sees learning as an active process of knowledge construction. It emphasizes the role of prior knowledge, cognitive structures, and individual interpretation in learning and sees students as active participants who construct meaning and knowledge through their interactions with the world. Constructivism places a strong emphasis on the role of the teacher as a facilitator or guide who supports students' active engagement and exploration (Wu, 2024). According to the study of Huang et al., (2024), the combination of AI technologies with constructivist principles promotes knowledge construction and enhances learning experiences for students. Also, AI systems can provide resources and feedback tailored to each student's unique needs and learning style.

### ChatGPT

ChatGPT (Chat Generative Pre-Trained Transformer) is a chatbot developed by OpenAI based on the Generative Pre-Trained Transformer model which makes it understand natural language input and respond accordingly (Salvagno et al., 2023). Based on each student's unique strengths, weaknesses, and learning style, AI algorithms can tailor learning routes. Students who utilize this adaptive learning strategy receive more individualized instruction and support, which improves comprehension and retention of physics subjects (Jho, 2020). The availability of ChatGPT as a learning tool can encourage independent study and provide students the confidence to investigate ideas outside of the classroom. It provides a tailored learning experience by adjusting to each learner's unique needs and giving focused feedback (Bruneau et al., 2023).

### Motivation and Engagement

Motivation in classrooms is socially negotiated, influenced by the instructional process and the classroom environment, leading to internal interest, cognitive and affective engagement, and motivated behaviors. Cetin-Dindar (2015) emphasized that students were more driven to learn science when they had more chances to connect science to real-world problems in a constructivist learning environment. The integration model of Learning Analytics (LA) and learning design based on constructivist learning theory has a positive impact on the learners' engagement and self-regulation (Banihashem et al., 2021).

The social cognitive theory explains self-efficacy which refers to an individual's belief in one's ability to successfully complete a specific task or achieve a particular goal (Bandura, 1997). In addition, Wigield and Eccles (2000) explained that self-efficacy beliefs have shown to impact learners' choice of tasks, persistence, effort and enthusiasm, and overall performance. Conversely, intrinsic motivation often involves engaging in learning activities for personal satisfaction, enjoyment, or a desire to learn and explore new things. It may also stem from a preference for challenging academic work or a desire for independent mastery of the subject matter (Boiché et al., 2008). The study of Chow and Yong (2013) elaborated intrinsic motivation is an internal drive that propels students to participate in academic exercise simply because one is interested in learning and enjoys the process of learning.

Cognitive engagement is the level to which students are invested in learning and self-regulation. It is also about involvement, effort, and behavior (Fredricks et al., 2004). Involvement through school activities and the use of efforts to accomplish task requirements for learning such as quizzes and homework of students have

high levels of behavioral engagement. At the same time, positive behavior such as following school rules and classroom rules and exhibiting minimal disruptive conduct.

Prohaska et al. (2012) defined social engagement by the level of involvement where people participate with many contacts with other people with the same interest, personality, and activities. Moreover, social activities help develop the long-term relationship, strengthen the relations among people and the patterns of society, and facilitate cohesion and collective activities (Shanker, 2024). Student emotional engagement has been linked with affective responses such as interest, satisfaction, emotions, and anxiety toward learning (Fredricks et al., 2004). Ideally, teachers should, therefore, create an atmosphere that evokes positive students' emotions while reducing students' anxiety toward learning (Hernández-Barco et al., 2021).

**Understanding Kinematics Graphs**

Understanding and interpreting graphs can help students develop their graphical reasoning skills and grasp the nature of graphical representations (Friel et al., 2001). Moreover, factors such as the reader's background, the context of the graph, and the reader's ability to visually interpret the graph can influence their understanding of the graph.

Learning outcomes are quantifiable accomplishments that the student will be able to comprehend upon completion of the course. These achievements aid in the student's understanding of the significance of the material and the benefits of participating in the learning activity (Andreev, 2024). This is also aligned with the study of Tanjung et al., (2023) which indicates that constructivist theory has great effectiveness in improving student learning outcomes.

This research aims to contribute to the field of education and technology by investigating the impact of ChatGPT on student learning in kinematics. It explores students' perception, motivation, and engagement in learning kinematics graphs when using ChatGPT, both quantitatively and qualitatively. Additionally, the research identified potential challenges and limitations associated with the use of ChatGPT in education, providing valuable insights for educators, policymakers, and researchers.

Figure 1 presents the input-process-output framework. The input of the study is the level of motivation, engagement and students' understanding of kinematics graphs prior to the implementation of the ChatGPT intervention. The output of the study outlined the students' pre-test and post-test scores in motivation, engagement, and understanding of graphs in kinematics. It also compares the relationship between students' understanding of kinematics graphs and students' perception toward ChatGPT, motivation, and engagement. Additionally, the study offers insight into students' views and perceptions regarding the use of ChatGPT in the learning process.

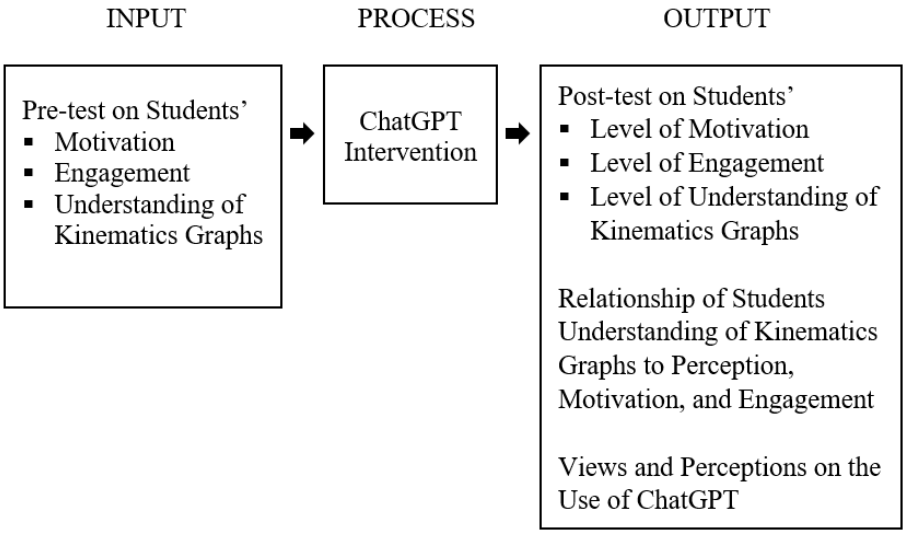


Figure 1. Paradigm of the study

**Statement of the Problem**

The study explored students' perception, motivation, and engagement in learning kinematics when using ChatGPT. It also explored the relationship between students' perception, engagement and motivation to their understanding of kinematics concepts when using ChatGPT. Additionally, it aimed to qualitatively determine the views and experiences of STEM 12 students in the use of ChatGPT. The study specifically sought to answer the following questions:

1. What is the difference in the level of perception of students on the utilization of ChatGPT before and after using it, across the following dimensions:

a. usefulness?
b. ease of use?
c. attitude towards using ChatGPT?
d. behavioral intention to use ChatGPT?
e. credibility?
f. social influence? and
g. privacy and security?

2. What is the difference in the level of motivation of students before and after using ChatGPT on learning kinematics graphs?

3. What is the difference in the level of engagement of students before and after using ChatGPT on learning kinematics graphs?

4. What is the difference between the pre-test and post-test scores of students in learning kinematics graphs?

5. What is the relationship between post-test scores of students in kinematics graphs and the following factors:

a. students' perception of ChatGPT across different dimensions
b. students' motivation when using ChatGPT
c. students' engagement with ChatGPT

6. What are students' experiences in using ChatGPT towards learning kinematics graphs?

**Hypotheses of the Study**

The following are the research hypotheses tested in the study:

1. There is a significant difference in the level of perception of students on the utilization of ChatGPT before and after using it, across the following dimensions:

a. usefulness,
b. ease of use,
c. Attitude towards using ChatGPT,
d. behavioral intention to use ChatGPT,
e. credibility,
f. social influence, and
g. privacy and security.

2. There is a significant difference in the level of motivation of students before and after using ChatGPT on learning kinematics graphs.

3. There is a significant difference in the level of engagement of students before and after using ChatGPT on learning kinematics graphs.

4. There is a significant difference between the pre-test and post-test scores of students in learning kinematics graphs.

5. There is a significant relationship between post-test scores of students in kinematics and the following factors:

a. students' perception of ChatGPT across different dimensions
b. students' motivation when using ChatGPT
c. students' engagement with ChatGPT

# METHODOLOGY

## Research Design

This study used convergent parallel mixed-methods design to achieve the goals of the study. According to Creswell and Pablo-Clark (2011), a convergent parallel design comprises the researcher conducting both the quantitative and qualitative elements concurrently in the same phase of the research process, weighing the methods equally, analyzing the two components independently, and interpreting the results jointly.

For the quantitative component, the researcher used a one-group pretest-posttest design to determine the level of perception, engagement, motivation, and post-test scores of students before and after using ChatGPT in learning kinematics graphs. Moreover, the relationship of the post-test score with the other variables were also determined. In the qualitative part, a descriptive phenomenological approach was used in determining the experiences of students in using the ChatGPT in learning kinematics graphs. Descriptive phenomenological research studies on lived experiences provided further insights into the nature of how one understands those experiences (Ho & Limpaecher, 2022). Generally, the study integrates quantitative analysis with qualitative insights to comprehensively explore ChatGPT as an educational tool in learning kinematics graphs.

## Population and Locale of the Study

Grade 12 senior high school students under the Science, Technology, Engineering, and Mathematics (STEM) strand were the respondents of the study. Moreover, simple random sampling was used to select respondents from a population of 124, and eighty percent of the population was used to determine the sample size of 99 respondents for the study. The focus group discussion, ten (10) randomly selected students were the participants.

This study was conducted at a private basic and higher education institution in Baguio City. The data gathering was carried out at this institution and the school's demographics and educational practices were directly relevant to the research topic, ensuring the applicability of the findings.

## Data Collection Instruments

Three (3) survey questionnaires was used to measure students' perceptions, motivation and engagement and one (1) standard questionnaire in understanding Kinematics before and after using ChatGPT. First, 17 multiple-choice items from the revised Test of Understanding Graphs in Kinematics (TUG-K) version 4.0 by Zavala et al. (2017) were used for understanding concepts of Kinematics graphs.

Second, a 5-point Likert scale survey questionnaire was distributed. The questionnaire was adapted from "Student's Perception of ChatGPT" by Yilmaz et al. (2023). It consisted of seven dimensions: perceived usefulness, attitude towards using ChatGPT, perceived credibility, perceived social influence, perceived privacy and security, perceived ease of use, and behavioral intentions to use ChatGPT. Each dimension included three items. The scale for the dimensions of perceived usefulness, attitude towards using ChatGPT, perceived credibility, perceived social influence, and perceived privacy and security was as follows: Strongly

Agree - 5, Agree - 4, Uncertain - 3, Disagree - 2, and Strongly Disagree - 1. For perceived ease of use, the scale was: Very Easy - 5, Easy - 4, Neither Difficult nor Easy - 3, Difficult - 2, and Very Difficult - 1. For behavioral intention to use ChatGPT, the scale was: Very Likely - 5, Likely - 4, Neutral - 3, Unlikely - 2, and Very Unlikely - 1.

Furthermore, the 25-item Likert-type Physics Motivation Questionnaire (PMQ-II) by Benben and Bug-os (2022) was also used. It comprised a 25-item questionnaire with a 5-point scale: Always - 1, Never - 2, Rarely - 3, Sometimes - 4, and Usually - 5. All PMQ-II elements were classified into the categories of intrinsic motivation (IM), self-determination (SD), self-efficacy (SE), career motivation (CM), or grade motivation (GM).

Lastly, the Student Engagement in Physics (SEP) scale was utilized in the study. The 33-item SEP scale was taken from Wang et al. (2016) and adopted by Segumpan (2021). The tool used a 5-point Likert scale ranging from Never Engaged - 1, Sometimes Engaged - 2, Occasionally Engaged - 3, Often Engaged - 4, to Always Engaged - 5.

Three experts reviewed the instrument to ensure the validity of the questionnaires. A pilot test was then conducted to assess the reliability of the questionnaires at Data Center College of the Philippines - Baguio City, Inc. The Test of Understanding Graphs in Kinematics, students' perception of ChatGPT, physics motivation questionnaire, and student engagement in physics questionnaire achieved Cronbach's alpha coefficients of 0.77, 0.89, 0.96, and 0.96, respectively. The instruments demonstrated strong reliability, with Cronbach's alpha values ranging from 0.77 to 0.96, indicating consistently measuring the intended constructs. These findings suggest that the research questionnaires are reliable and valid.

In contrast, a semi-structured open-ended questionnaire was administered through focus group discussion. The questions were developed with the assistance of ChatGPT and a disclaimer was incorporated to acknowledge the involvement of AI in their formulation. The questionnaires consisted of 8 key questions with follow-up questions in order to gather data on students' experiences in using ChatGPT in learning kinematics graphs. The questionnaire was subjected for validation by experts and necessary revisions were made based on the feedback (Appendix I).

**Data Collection Procedure**

The researcher sought and received permission from the developers of the Modified TUG-K, the Senior High School Principal, and the researcher's adviser. An orientation was then conducted aside from the written instructions on the questionnaires. The study was implemented over a 3-week learning session aligning with the MELCs (Most Essential Learning Competencies) outlined by the Department of Education. Three lessons for the first quarter of General Physics 1 focused on kinematics graphs. Participants were required to attend a 4-hour synchronous class once a week, where the lessons were taught using ChatGPT.

Before the learning sessions, the respondents received preliminary training on how to use of ChatGPT. To ensure consistency, the Plan-and-Solve prompt was used to guide the presentation of ChatGPT's output. Additionally, pre-tests and pre-surveys were administered.

In every intervention of ChatGPT on learning kinematic graphs, the researcher provided a brief overview of the topic and presented guided questions, along with instructions for the learning session. Students then constructed the prompt question to answer the guided questions with the aid of ChatGPT. The guided questions were designed to probe students' comprehension of the key concepts covered. To ensure timely feedback, answers were checked immediately, allowing immediate clarification or reinforcement as needed.

After the intervention, a validated post-test and post-surveys were then administered to the respondents after using ChatGPT. The gathered quantitative data were then analyzed and computed. Meanwhile the focus group discussion was conducted and the participants gave their consent to record the discussions. The data were later

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transcribed and subjected to content analysis. The identified themes were presented and validated with the participants to uphold accuracy and the relevance of the findings. Another orientation was conducted after both quantitative and qualitative analysis.

**Treatment of Data**

Data gathered in the study are presented in a series of tables, classified and analyzed. For the quantitative data, the level of perception, motivation, and engagement of students were interpreted based on the mean scores. The following scale was used in the interpretation of mean scores:

| Mean Range | Qualitative Description | Qualitative Interpretation |
|---|---|---|
| 5.00 - 4.21 | Strongly Agree | Very High (VH) |
| 4.20 - 3.41 | Agree | High (H) |
| 3.40 - 2.61 | Neutral/Uncertain | Moderately High (MH) |
| 2.60 - 1.81 | Disagree | Low (L) |
| 1.80 - 1.01 | Strongly Disagree | Very Low (VL) |

Pearson correlation was used to determine the relationship of the post-test scores between students with the other variables. The following description was used:

| r Values | Relationship Strength |
|---|---|
| 0.91 to 1.00 | Very Strong (VS) |
| 0.71 to 0.90 | Strong (S) |
| 0.51 to 0.70 | Average Strong (AS) |
| 0.31 to 0.50 | Weak (W) |
| 0.01 to 0.30 | Very Weak (VW) |
| 0 | No Relationship (NR) |

Furthermore, paired sample t-tests were used to compare the pre-test and post-test scores of students across the different variables. Conversely, qualitative data from the focus group discussion were analyzed using thematic analysis to identify the repeating themes and patterns on how students perceive, motivate, engage, and understand kinematics graphs through the use of ChatGPT.

## RESULTS AND DISCUSSION

This chapter presents the results of the study on students' perceptions, motivation, and engagement towards learning kinematics graphs using ChatGPT, both quantitatively and qualitatively. It also explores the relationship between students' perceptions, motivation and engagement and their subsequent understanding of kinematics graphs when using ChatGPT. Additionally, the chapter delves into students' specific views regarding the use of ChatGPT during the students' learning process.

**Difference in the Level of Perception of Students on the Utilization of ChatGPT**

**Before and After Using It Across the Different Dimensions**

Table 1 shows the comparison of the students' perceptions levels on the utilization of ChatGPT across different dimensions before and after its intervention. The data shows various dimensions, including usefulness, ease of use, attitude towards ChatGPT, behavioral intention to use ChatGPT, credibility, social influence, and privacy and security. The mean scores and descriptive equivalent for each dimension are presented, along with the t-test results to determine the significance of the differences between pre- and post-intervention motivation levels. The p-values indicate the statistical significance of these differences, with p-values less than 0.05 considered statistically significant.

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Table 1. Comparison on the level of perception of students before and after the utilization of ChatGPT across different dimensions

| DIMENSIONS | BEFORE | | AFTER | | t-VALUE | p-VALUE |
|---|---|---|---|---|---|---|
| | MEAN | DE | MEAN | DE | | |
| Usefulness | 3.33 | MH | 3.49 | H | -1.32 | $0.19^{ns}$ |
| Ease of use | 3.81 | H | 4.08 | H | -2.08 | $0.04^{*}$ |
| Attitude towards using ChatGPT | 3.11 | MH | 3.42 | H | -2.67 | $0.01^{**}$ |
| Behavioral Intention to use ChatGPT | 3.07 | MH | 3.27 | MH | -1.86 | $0.07^{ns}$ |
| Credibility | 3.06 | MH | 3.25 | MH | -1.59 | $0.12^{ns}$ |
| Social Influence | 3.30 | MH | 3.36 | MH | -0.50 | $0.62^{ns}$ |
| Privacy and Security | 3.04 | MH | 3.14 | MH | -0.92 | $0.36^{ns}$ |

Legend: MH = moderately high, H = high, ** - highly significant, * - significant, ns - not significant

The result indicates that the mean score for the usefulness dimension increased from 3.33 interpreted as moderately high to 3.49 interpreted as high after the utilization of ChatGPT. This indicates a change on how students perceive ChatGPT as a tool in learning kinematics graphs. However, based on the p-value the change is not significant. Hence, the hypothesis that there is a significant difference in the level of perception before and after using ChatGPT in this domain is rejected. This result agrees with the findings of Thuy and Mai-Thi (2024) where they found that the perceptions of the participants on ChatGPT's usefulness are high, influencing influences the participants' active engagement and acceptance. Furthermore, Tarhini et al. (2014) identified perceived usefulness as a key predictor of technology acceptance in higher education, which aligns with the improved scores in the present data. However, both researches also aligns the same study since there was no significant difference in their perception before and after.

The perceived usefulness of ChatGPT as a tool for academic tasks and learning has been highlighted in several studies. For instance, Adams et al. (2024), elaborated that the students felt ChatGPT was very useful in accomplishing work or coursework and the material resource for learning activities. This is further agreed by participants in the study of Ngo et al. (2023) who claim that ChatGPT is a useful learning aid. Furthermore, Rahman et al. (2023) highlighted that perceived usefulness is a predictor of behavioral intention to use ChatGPT. In line with these findings, Ofuso-Ampong et al. (2023) emphasized that perceived usefulness is strongly associated with the acceptance of ChatGPT in educational settings.

In terms of the dimension ease-of-use, result show that the mean scores increased from 3.81 to 4.08 both interpreted as high. This high level, indicating that students found ChatGPT user-friendly before the intervention and even more so afterward. Based on the results, the computed p-value is less than 0.05 which results in the acceptance of the hypothesis. Hence, there is a significant difference in the ChatGPT's ease of use after using it in learning kinematics graphs. Abdullah and Ward (2016) emphasized that when technology is perceived as simple to use, students are more likely to adopt it, which is consistent with the positive change observed in this study. Moreover, Shoufan (2023) highlighted that students appreciated the structured and well-formed responses provided by ChatGPT. Similarly, Kayali et al. (2023) found that ChatGPT's user-friendly interface, combined with its concise, fast, and relevant responses, was well-received by students. However, according to a study by Bello et al. (2024), ChatGPT's ease of use was perceived as moderate. Additionally, perceived ease of use did not turn out to be a major determinant in the adoption and utilization of ChatGPT among the students (Tiwari et al., 2024).

In reference to the dimension students' attitudes toward ChatGPT, results show a favorable view of using the tool from a mean score of 3.11 interpreted as moderately high to 3.42 interpreted as high. The computed p-value of 0.01 which is lesser than 0.05 validates that there is a significant difference in the students' attitudes toward ChatGPT. Thus, the hypothesis is accepted at 0.05 level of significance. This suggests that students' overall feelings, beliefs, and opinions about ChatGPT are positive, reflecting their acceptance and support of ChatGPT as a learning tool.

These findings align with the results of Yilmaz et al. (2023) and Sánchez et al. (2024) which highlights the students' positive attitudes toward artificial intelligence and acceptance of ChatGPT. Similarly, students expressed favorable attitudes toward utilizing ChatGPT in academic settings (Ajlouni et al., 2023; Sánchez-Reina et al., 2024). According to Sallam et al. (2023), attitude toward technology encompasses both the perception and readiness to adopt technological innovations, which, in turn, influences attitudes toward tools like ChatGPT. Granić and Marangunić (2019) emphasized that positive attitudes are frequently identified as a significant factor in the readiness to adopt and use technology, further explaining the increased acceptance of ChatGPT in this study.

Additionally, a study by Yu et al. (2024) revealed that male students exhibited more positive attitudes than female students toward artificial intelligence tools such as ChatGPT. As with other technologies, positive attitudes play a critical role in facilitating the adoption of ChatGPT.

The behavioral intention dimension toward using ChatGPT increased from a mean score of 3.07 to 3.27 both remained at moderately high level. This aligns with Hsiao and Tang's (2014) and Li et al. (2024) assertion that behavioral intention is influenced by perceived usefulness, ease of use, and attitude. While students' positive attitudes toward ChatGPT increased, as noted by Thuy and Mai-Thi (2024), and perceived usefulness is a predictor of behavioral intention (Rahman et al., 2023), the study found that the overall impact on behavioral intention was insignificant. The results also show that at the 5% significance level, the p-value does not indicate a statistically significant difference in mean score in the behavioral intention toward using ChatGPT dimension. Additionally, Yilmaz et al. (2023) suggest that participants have shown an average interest in using Chat GPT in the future.

With regard to credibility, it obtained a moderately high result from a mean score at 3.06 to 3.25 both interpreted as moderately high. This indicates a stable trust in the information provided by ChatGPT. Further analysis showed that there is no significant difference in the credibility in using ChatGPT on students' perception. Based on the statistical findings which is similar to the study of Joshi et al. (2023), moderate credibility, individuals tend to verify the information provided by ChatGPT which requires cross checking with a peer or available resources, such as Google Search. Clearly, Huschens et al. (2023) noted that while AI-generated content is seen as clearer and engaging, trustworthiness remains comparable to human-generated content. According to Caulfield (2023), one should utilize ChatGPT only as a source of inspiration or feedback but not as a source of information.

The social influence dimension remained relatively stable from a mean score of 3.30 to 3.36 both interpreted as moderately high. It shows that peer perceptions have a limited but consistent role in shaping students' views on ChatGPT. The computed p-value of 0.62 which is greater than 0.05 validates that there is no significant difference in the students' perception on ChatGPT's social influence. Thus, the hypothesis is rejected at 0.05 level of significance. In fact, Albayati (2024) found that social circles do not significantly drive students' intentions to use ChatGPT, supporting the stable scores from the data. However, the influence of social factors was another factor that contributed to the use of ChatGPT. Students who received recommendations from peers were more likely to adopt. Positive feedback from the peers influenced the decision to adopt the tool (Jowarder, 2023).

Privacy and security showed a slight increase from a mean score of 3.04 to 3.14 both interpreted as moderately high. It suggests that concerns remain despite some minor improvements in perception. Based on the results, the computed p-value is greater than 0.05 which results in the rejection of the hypothesis. Hence, the null hypothesis, stating that there is no significant difference on the level of perception of students on the utilization of ChatGPT before and after, specifically regarding privacy and security, is rejected at a 0.05 significance level. Albayati (2024) further emphasized that perceived usefulness, ease of use, privacy, security, and social influence collectively shape technology acceptance and use patterns. Finally, to ensure the safety of users and to prove its seriousness about data privacy, ChatGPT has an overall privacy policy and has implemented strong measures to safeguard user data (Drozdov, 2023).

Generally, the data shows that the most significant changes that the students indicated were in the dimensions of ease of use and attitude towards using ChatGPT. Students found it easier to use and had a more positive

perception after the intervention. Similar to the study of Habiba and Partho (2024) states that having a positive perception encourages the students to use ChatGPT as a helpful resource in academic, professional or individual purposes. However, dimensions of credibility, social influence, and privacy and security remained no change in terms of perception, thereby requiring attention to achieve better acceptance.

**Difference in the Level of Motivation of Students Before and After**

**Using ChatGPT on Learning Kinematics Graphs**

Table 2 presents a comparative analysis of students' motivation levels before and after using ChatGPT on learning kinematics graphs. The table examines various categories of motivation, including intrinsic motivation, self-determination, self-efficacy, extrinsic motivation related to career goals, and extrinsic motivation related to grades. The mean scores and descriptive equivalent for each category are presented, long with t-tests to assess the statistical significance of differences in motivation levels before and after the intervention. P-values less than 0.05 indicate statistically significant differences.

Table 2. Comparison on the level of motivation of students before and after using ChatGPT on learning kinematics graphs

| CATEGORIES | BEFORE | | AFTER | | t-value | p-value |
|---|---|---|---|---|---|---|
| | MEAN | DE | MEAN | DE | | |
| Intrinsic | 3.61 | H | 3.52 | H | 0.74 | 0.46$^{ns}$ |
| Self-Determination | 3.51 | H | 3.35 | MH | 1.48 | 0.14 $^{ns}$ |
| Self-Efficacy | 3.39 | MH | 3.29 | MH | 0.87 | 0.39 $^{ns}$ |
| Extrinsic (Career) | 3.32 | MH | 3.26 | MH | 0.41 | 0.68 $^{ns}$ |
| Extrinsic (Grade) | 3.35 | MH | 3.15 | MH | 1.18 | 0.24 $^{ns}$ |

Legend: MH = moderately high, H = high, ** - highly significant, * - significant, ns - not significant

In the aspect of intrinsic motivation, although there was a decrease in the mean score of 3.61 to 3.52, it remained in the high level category. This indicates that students' interest and enjoyment in kinematics graphs were not significantly impacted by the use of ChatGPT. The p-value which is greater than 0.05 indicates that the hypothesis there is a significant difference in the level of motivation of students before and after using ChatGPT on learning kinematics graphs is rejected. This agrees to the findings of Reeve and Shin's (2019) that intrinsic motivation is best sustained when learning tools support autonomy and self-direction. ChatGPT allows students to ask questions and explore topics at the students own pace, it can promote autonomous learning without undermining intrinsic motivation. Furthermore, the study of Abas et al. (2023) demonstrated that ChatGPT supports personalized learning, this is because it provides immediate feedback capabilities, adapts to the needs of students, and creates participatory and engaging learning experiences. The result negates the study of Vansteenkiste et al. (2017) noting that intrinsic motivation is consistently maintained in digital learning environments when students perceive the tool as providing meaningful learning experiences.

In terms of self-determination, the data showed a minor decrease in the mean scores from 3.51 interpreted as high to 3.35 interpreted as moderately high level. Based on the p-value which is greater than 0.05, there is no significant difference in the level of students' self-determination after using ChatGPT in terms of self-determination. This suggests that students might have experienced a **reduction in their perceived autonomy, or control over their learning process** when using ChatGPT. However, Reeve and Shin's (2019) findings that autonomy and self-direction are supported by learning tools that is sustained with intrinsic motivation. Because ChatGPT allows students to ask questions and explore topics at the students own pace, it can promote autonomous learning without undermining intrinsic motivation. Thus, the stable high levels observed suggest that ChatGPT has no effect in supporting autonomy.

The Self-Determination Theory of Ryan and Deci (2017) states that intrinsic motivation and self-determination are sustained when students' needs for autonomy, competence, and relatedness are met. Tools like ChatGPT can support autonomy if used correctly but do not inherently diminish or enhance intrinsic motivation, which explains the stable levels observed in the data.

The self-efficacy category remained at a moderately high level with a mean score from 3.39 to 3.29 before and after using ChatGPT in learning kinematics graphs. The results also show that at the 5% significance level, the p-values do not indicate a statistically significant difference in the level of students' motivation in terms of self-efficacy. It also suggests that ChatGPT did not substantially enhance the confidence level and own abilities of learners. While the tool provides support in terms of information and task completion, it does not necessarily contribute to boosting students' belief in their competence. This aligns with the findings from DiBenedetto (2016), who emphasized that building self-efficacy requires goal-setting, feedback, and self-reflection - elements that may not be fully supported by ChatGPT alone. As a result, while ChatGPT offers informational support, it may not directly strengthen students' self-efficacy unless complemented by these additional strategies.

Consequently, Zimmerman and Schunk (2011) further highlight that using digital tools for learning can sometimes reduce students' perceived self-efficacy for being overly reliant on the tool for answers. Therefore, while ChatGPT can be a useful tool, it should be used in conjunction with other teaching strategies that encourage self-reflection and independent problem-solving.

Career-related motivation's mean scores maintained a moderately high level before and after using ChatGPT. The p-value is greater than the 0.05, ChatGPT did not significantly impact students' career-related motivation to improve their prospects for a future career. The marginal decline in motivation implies that students' external drive to learn remained constant, while the use of ChatGPT had little impact on their career-related goals.

In the grade-related motivation there was a noticeable decrease in the mean score from 3.35 to 3.15 interpreted as moderately high. Based on the result, the calculated p-value is greater than 0.05, which leads to the rejection of the hypothesis that there is no significant difference in the grade-related motivation towards learning kinematics graphs. This indicates that ChatGPT did not significantly impact students' grade-related motivation, such as their desire to get excellent grades. On the contrary, Hulleman et al. (2017) conducted a meta-analysis on grade-related motivations, finding that the motivation to achieve grades is primarily influenced by long-term goals and reinforcement rather than by specific learning tools. Similarly, Leaper et al. (2012) examined how external factors, such as career aspirations, influence motivation, noting that these factors are generally stable and less affected by short-term tools. Furthermore, a higher grade has a link to higher levels of satisfaction and engagement, motivation, and lower feelings of isolation, procrastination, and stress (Sage et al., 2021).

Generally, data shows that there were no significant changes in any of the motivational factors, suggesting that ChatGPT did not substantially impact students' intrinsic drives, self-beliefs, or extrinsic motivations. The motivation categories of intrinsic motivation remain at high level before and after using ChatGPT, with a slight decrease in the mean for each. For the self-determination aspect, it shifts from high to moderate level. In terms of self-efficacy and extrinsic motivations (career and grade), students maintained a moderately high levels of motivation before and after using ChatGPT, with a slight decrease in the mean.

**Difference in the Level of Engagement Before and After**

**Using ChatGPT on Learning Kinematics Graphs**

Table 3 presents a comparison of students' engagement levels before and after using ChatGPT for learning kinematics graphs. The table includes four indicators of engagement: cognitive, behavioral, emotional, and social. For each indicator, the mean scores and descriptive equivalent (DE) are provided for both the before and after the intervention, along with t-values and p-values to indicate statistical significance.

Table 3. Comparison of the level of engagement of students before and after using ChatGPT on learning kinematics graphs

| INDICATORS | BEFORE | | AFTER | | t-value | p-value |
|---|---|---|---|---|---|---|
| | MEAN | DE | MEAN | DE | | |
| Cognitive | 3.41 | H | 3.42 | H | -0.18 | $0.86^{ns}$ |
| Behavioral | 3.15 | MH | 3.55 | H | -5.99 | $0.00^{**}$ |
| Emotional | 2.76 | MH | 2.87 | MH | -1.73 | $0.09^{ns}$ |
| Social | 2.81 | MH | 3.00 | MH | -3.23 | $0.00^{**}$ |

Legend: MH = moderately high, H = high, ** - highly significant, * - significant, ns - not significant

The cognitive engagement results show minimal change in the mean scores from 3.41 to 3.42 before and after using ChatGPT for learning kinematics graphs, reflecting a consistently high level (H) and a non-significant p-value (0.86). Hence, the hypothesis in the level of engagement before and after using ChatGPT in this domain is rejected. The stability in the mean scores suggests that students' mental investment, focus, and willingness to apply cognitive effort remained steady regardless of ChatGPT use. It also indicates that students were already cognitively engaged in learning kinematics, while ChatGPT provided support, it did not significantly alter their cognitive engagement. This may imply that ChatGPT is a complementary tool that reinforces existing cognitive involvement rather than transforming it.

However, according to Liang et al. (2023), the rich explanations produced by ChatGPT could capture attention and interest while provoking curiosity in the minds of students as they enhance their cognitive engagement towards learning. Also, to obtain an accurate answer, questions must be asked in multiple rounds with the constant change in wording (Patac and Patac Jr., 2024), and this process may help increase cognitive engagement for students. Furthermore, results from the study of Suciati et al. (2024) indicate that the motivation and engagement among students receiving the treatment through ChatGPT were significantly higher than that of the control group. The levels of cognitive, behavioral, and emotional engagement improved in the experimental group. Thus, these results indicate that AI chatbots, such as ChatGPT, could revolutionize educational practices by making learning more engaging, interactive, and customized.

In addition, Wu et al., (2024) discovered that self-efficacy and self-regulation were enhanced by ChatGPT-supported learning. Given that self-regulation is an essential element of successful learning, this is critical for cognitive engagement. As supported by Swargiary (2024), shows that using ChatGPT appears to enhance cognitive engagement, which could potentially lead to deeper learning and increased motivation in the long term. Students were able to learn via ChatGPT, which improved their comprehension and performance from a cognitive standpoint (Lo et al., 2022). In a similar study of Alneyadi and Wardat (2024), they discovered that the experimental group using ChatGPT performed better on post-tests than the control group, proving that the tool is useful for improving learning outcomes. However, based on the study of Bastani et al. (2024), students who used ChatGPT for their studies showed improvements, although their performance on the final exam ended up worse.

The behavioral engagement indicator increased from a mean score of 3.15 interpreted as moderately high to 3.55 interpreted as high after exposure to ChatGPT towards learning kinematics graphs. The computed p-value is 0.00 which results in the acceptance of the hypothesis that there is a significant difference in the level of students' behavioral engagement after using ChatGPT towards learning kinematics graphs. This implies that the students' persistence, effort, attention, participation, and involvement in the class were improved. In addition, more students were actively participating in their classes using ChatGPT. This is aligned to the study conducted by Lo et al. (2022) on the active involvement of students in working with ChatGPT and using ChatGPT could raise the likelihood of students completing their learning tasks. Same through to the study of Ng et al. (2024) that learning performance, motivation, and long-term learning habits were all boosted by the ChatGPT-enhanced instructional design, which also decreased learning anxiety. Furthermore, results from the study of Suciati et al. (2024) indicate that the levels of behavioral engagement improved in the experimental

group. Thus, these results imply that AI chatbots, like ChatGPT, have the potential to transform educational practices by making learning more engaging, interactive, and customized.

The students' level of emotional engagement with ChatGPT before and after its use is the same with a mean score of 2.76 to 2.87. The results indicate a non-significant difference in students' emotional engagement after using ChatGPT to learn kinematics graphs. This is supported by a computed p-value of 0.09, which is statistically not significant. This consistency shows that students' emotional factor to the topic is strong and that ChatGPT did not significantly increase or decrease their engagement levels. Bond and Bedenlier (2019) and Lo and Hew (2021) found that some indicators of emotional engagement are enjoyment, satisfaction, interest/fun, positive social interaction, excitement and reduced anxiety. Notably, such positives social interactions have the role of making information sharing within the students' circle and learning cooperative and participative (Duong et al., 2023). In addition, engagement may be due to the interactive and dynamic nature of AI-assisted learning, which can promote active thinking and participation. Furthermore, according to the study of Suciati et al. (2024), the level of emotional engagement improved in the experimental group. Hence, it points out that AI-based chatbots like ChatGPT can bring revolution in the educational practices by making learning more interactive and customized, yet interesting.

In terms of social indicator, there is an increase in the mean scores from 2.81 to 3.00 both interpreted as moderately high. This means that social engagement is significantly changed when using ChatGPT. This is based on the calculated p-value of 0.00 that validates there is a significant difference in the level of engagement in using ChatGPT in the aspect of social engagement. Hence, the hypothesis is accepted at 0.05 level of significance. Current study proves that social interaction and involvement have played a critical role in ensuring that students interact effectively and perform well academically (Ezeanya et al., 2024). This implies that ChatGPT has helped in upholding the students' socialized active performances during learning kinematics graphs.

Overall, ChatGPT in learning kinematics graphs has a varied engagement effects on the various indicators. Levels of students' behavioral and social engagements were highly significant, as this moved from moderately high into high levels with highly associated p-value is obtained from the data. However, cognitive and emotional engagement showed slight change, the cognitive stayed high while the emotional remained moderately high, with no significant p-values.

**Difference Between the Pre-Test and Post-Test Scores of Students in**

**Learning Kinematics Graphs**

Table 4 presents a comparison of students' pre-test and post-test scores in kinematics graphs. The table includes mean scores, standard deviations, t-values, and p-values for the pre- and post-test scores, allowing for a statistical comparison of the impact of ChatGPT on students' academic performance.

Table 4. Comparison of students' pre-test and post-test scores in kinematics graphs

| BEFORE | | AFTER | | t-value | p-value |
|---|---|---|---|---|---|
| MEAN | SD | MEAN | SD | | |
| 1.29 | 1.22 | 3.85 | 1.72 | -12.28 | 0.00** |

Legend: ** - highly significant

Data shows a computed p-value of 0.00 which validates that there is a highly significant difference in the students' understanding of graphs in kinematics in using ChatGPT. The alternative hypothesis which states that there is a significant difference in the understanding of students in Kinematics concepts is accepted. This outcome demonstrates a minor increase of the mean score after the intervention, and there it serves as evidence that ChatGPT positively impacts knowledge about kinematics graphs by students. However, there is evidence that applying ChatGPT in learning contributes to improvement in academic performance, even if there is a small increment from the result.

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Based on the data, ChatGPT appears to be a helpful resource for students to more effectively grasp kinematics graphs. These results suggest that ChatGPT is a tool in improving the conceptual understanding of kinematic concepts (conceptual terms, graphing and interpreting Kinematics graphs) for students. However, the students had difficulty with graphing kinematics. Further studies are required to better understand its potential and limitations, explore the long-term effect of ChatGPT on student learning and the best ways to apply it in practice within educational settings.

Evidently, the experimental group improved with achievement test scores and level of motivation (Yildiz et al., 2021). ChatGPT has the potential to revolutionize academic learning by offering students customized explanations and interactive guidance to overcome difficult concepts (Kalla et al., 2023). Additionally, it is proven that the inclusion of ChatGPT into learning activities will bring about marked improvement in student learning outcomes according to the study of Hakiki et al. (2023). Similar to the study of Tlili et al. (2023) that the results revealed that the application of ChatGPT greatly improved the learning outcomes of students while learning. Also, based on the study of Chugai et al., (2024) reveals a general agreement that the tool (ChatGPT) indeed improves student learning while being ideal for peer recommendation. All these findings highlight the advantages that AI technologies, including Chat GPT, hold in making interactive, user-specific learning experiences that result in the active involvement of a learner in the process.

**Relationship Between Post-Test Scores of Students in Kinematics Graphs and Students' Perception Across Different Dimensions, Motivation, and Engagement with ChatGPT**

Table 5a displays the relationship between various dimensions related to students' perceptions of ChatGPT and their post-test scores in kinematics graphs. The six dimensions that were considered include perceived ease, perceived usefulness, attitude toward using ChatGPT, behavioral intention to use ChatGPT, credibility, social influence, security and privacy. For each dimension, the table gives the correlation coefficient (r), descriptive equivalent (DE) and the value of p to indicate statistically significant for observed relationships.

Table 5a shows that each of the dimensions under perception does not have a relationship to the students' understanding of kinematics graphs. All of the dimensions have a very weak (VW) correlation, therefore, having minimal influence on understanding graphs representing kinematics.

Table 5a. Relationship between post-test scores of students in kinematics graphs and students' perception of ChatGPT across different dimensions

| DIMENSIONS | r | DE | p-value |
|---|---|---|---|
| Usefulness | -0.050 | VW | $0.622^{ns}$ |
| Ease of use | -0.017 | VW | $0.870^{ns}$ |
| Attitude towards using ChatGPT | -0.103 | VW | $0.312^{ns}$ |
| Behavioral Intention to use ChatGPT | 0.006 | VW | $0.957^{ns}$ |
| Credibility | 0.055 | VW | $0.590^{ns}$ |
| Social Influence | 0.005 | VW | $0.965^{ns}$ |
| Privacy and Security | 0.039 | VW | $0.699^{ns}$ |

Legend: VW = very weak correlation, ns - not significant

However, this finding contrasts other prior researches. Jones and Carter (2019) explained that students' positive perceptions regarding the learning experience enhance one's engagement and motivation in learning, the result is positive academic outcome. Conversely, negative perceptions regarding the learning experience may result in disengagement and reduced motivation and failure to attain desired academic success. Moreover, the perceptions of the students are so relevant to education because these perceptions can greatly influence how motivated, engaged, or unengaged the academic performance of the students is (Muenks et al., 2020).

Interestingly, tools like ChatGPT have been found to positively impact student learning outcomes and performances (ElSayary, 2024). Although the present study indicates that the perception factor has minimal

direct influence on kinematics graphs, use of tools like ChatGPT may bridge the gap by making learning more enjoyable and motivational.

Table 5b shows Pearson product-moment correlation coefficients and p-values for the linkage of student motivation in each of five dimensions: intrinsic, self-determination, self-efficacy, extrinsic (career), and extrinsic (grade) to their post-test scores in kinematics graphs. The table shows particular motivational factors that would be leading to better learning outcomes.

Table 5b. Relationship between post-test scores of students in kinematics graphs and students' motivation when using ChatGPT

| INDICATORS | r | DE | p - value |
|---|---|---|---|
| Intrinsic | 0.323 | W | $0.001^{**}$ |
| Self-Determination | 0.279 | VW | $0.005^{**}$ |
| Self-Efficacy | 0.179 | VW | $0.076^{ns}$ |
| Extrinsic (Career) | 0.144 | VW | $0.154^{ns}$ |
| Extrinsic (Grade) | 0.261 | VW | $0.009^{**}$ |

Legend: VW = very weak correlation, W = weak correlation, ** - highly significant, ns - not significant

Data shows that intrinsic motivation has a weak but statistically important correlation with students' understanding of kinematics graphs. This implies that students who find learning kinematics graphs as interesting or enjoyable in itself have a higher probable understanding of the subject. According to the study of Ito and Umemoto (2022), students who had high levels of intrinsic motivation showed higher levels of cognitive engagement, which improved their academic performance. This shows that students are more likely to deeply connect with the content and achieve higher levels of learning and understanding when one is motivated by real interest and delight.

Students exhibiting higher levels of intrinsic motivation also showed stronger cognitive learning outcomes, similar to the study of Lo et al., (2022) examining self-learning outcomes. In particular, students' involvement and learning experiences acted as a mediating factor in this relationship. This suggests that intrinsic drive might greatly improve students' capacity to apply and retain knowledge. The results of this study support the idea that students who are intrinsically driven may benefit more from using ChatGPT because of their increased interest and engagement in difficult subjects like kinematics. Furthermore, Hawthorne (2024) explained that one benefit of motivation in learning may improve performance and learning outcomes.

Intrinsic motivation is a powerful force that motivates students to seek learning experiences and take initiative in their learning process. Specifically, when the student is intrinsically motivated, he or she enjoys the process of learning, is curious, and desires to explore and understand new concepts (Suman, 2023). In addition, extrinsic motivations positively affect the learning effectiveness of students. However, intrinsic motivations more powerfully affected students' learning effectiveness than extrinsic motivations (Kum, 2022). According to (Trevino & DeFreitas, 2014) intrinsic motivation that is developed by curiosity and the enjoyment of the process of learning has direct association with higher engagement and outcomes in the long-run. Thus, intrinsic motivation makes a student more conscious and active in the learning process but also enhances critical thinking skills and creativity.

The data revealed a weak positive correlation between self-determination and students' post-test scores in kinematics graphs. This suggests that while greater autonomy can positively influence students' knowledge and motivation in learning (Hu & Zhang, 2017), the impact may be limited in this specific context.

However, the observed weak correlation in this study may be due to various factors, such as the specific design of the intervention, individual differences among students, or the complexity of the subject matter. Further research is needed to explore the nuances of this relationship and to identify optimal strategies for fostering autonomy in the context of AI-assisted learning.

On the aspect of self-efficacy motivation, the link is weak and not statistically significant, demonstrating that confidence in one's own capacity to understand content has minimal impact on their knowledge while using ChatGPT. Self-efficacy and learning outcomes while utilizing ChatGPT and other generative AI techniques have a complicated relationship. According to a study by Liang et al. (2023), self-efficacy plays a minor but statistically significant mediating role in the positive relationship between learning achievement and student interaction with AI, indicating that while it plays a role in learning success, it is not as significant as other factors such as cognitive engagement. However, a different study by Wu et al. (2024) revealed that, depending on the setting, self-efficacy can considerably alter learning behavior and outcomes. It demonstrated that self-efficacy plays a more major role in improving students' motivation and autonomous learning in AI-driven environments.

No significant link is seen in terms of career-related extrinsic motivation, suggesting that students who use ChatGPT primarily for career-related reasons do not demonstrate an enhanced comprehension of kinematics. This is similar to the Study of Bargmann et al. (2022) indicates that while career decision-making can affect students' academic determination it is not always correlated with improved understanding or performance, particularly when students are unmotivated. However, the study of Liu et al (2024) indicates that extrinsic motivators—such as career goals—can enhance academic performance and engagement, but only if it is consistent with intrinsic interests and self-efficacy. This implies that it depends on supportive factors that may influence the aspect of career-related extrinsic motivation.

Students driven by grades, an extrinsic motivation, have a somewhat higher knowledge, according to a modest but statistically significant positive connection. This suggests that students who are grade-focused may make greater use of ChatGPT. Grades and other external sources of motivation can act as motivators for students to use ChatGPT and other tools successfully, which can improve comprehension (Meng and Hu, 2022). Similarly, extrinsic motives, such as a grade-focused perspective, have been shown in the study of Liu et al. (2024) on motivational elements in blended learning environments to positively impact overall academic attainment and engagement. Findings that support that there is a considerable positive relationship between academic performance and motivation to use technology in the language classroom (Solak and Cakir, 2015; Munoz et al., 2023). But learning with ChatGPT slightly affects the motivation to learn according to the study of Siregar et al. (2023).

Students' motivation along intrinsic, self-determination, and extrinsic motivation (grade) categories resulted to have high significant association to their understanding of kinematics when using ChatGPT. Intrinsic motivation and knowledge of kinematics using ChatGPT are highly positively correlated. This implies that students who use ChatGPT tend to learn the material better when the students are personally involved in it and find it enjoyable.

Table 5c presents the correlation coefficients and p-values for the relationship between students' engagement in each of the four categories (cognitive, behavioral, emotional, and social) and their post-test scores in kinematics graphs. It also includes the descriptive equivalent (DE) classified as very weak (VW).

Table 5c. Relationship between post-test scores of students in kinematics graphs and students' engagement with ChatGPT

| CATEGORIES | r | DE | p - value |
|---|---|---|---|
| Cognitive | -0.064 | VW | $0.531^{ns}$ |
| Behavioral | -0.058 | VW | $0.567^{ns}$ |
| Emotional | -0.049 | VW | $0.629^{ns}$ |
| Social | -0.118 | VW | $0.243^{ns}$ |

Legend: VW = very weak correlation, ns - not significant

Results show that all categories of engagement - cognitive, behavioral, social, and emotional - show very weak and non-significant correlations, suggesting that different aspects of engagement (how students think, behave,

feel, or interact socially) do not significantly influence students' understanding of kinematics graphs when using ChatGPT. Moreover, since engagement is useful in the learning process, it is not necessarily enough to ensure that learners acquire rich understanding. It suggests that other factors may be more influential or have a stronger impact on understanding. One factor may be during the intervention of ChatGPT in the learning process. This is similar to the study of Adarkwah (2023), if not channeled properly to allow teaching and learning, it is foreseen that ChatGPT will de-motivate classroom engagement in traditional classrooms where fewer technologies are utilized for the purpose of assessment and offering feedback.

The findings of Almulla (2024) show that factors such as perceived ease of use and perceived usefulness were the intermediary variables that influence between learning satisfaction and engagement with ChatGPT. This is congruent to the data of the study (see table 3), which shows that ease of use is significant to the students' learning process with the use of ChatGPT. In addition, learning motivation was enhanced through engagement with ChatGPT, indicating a potential to boost student engagement and interest in learning. Moreover, information quality significantly impacts the use of ChatGPT, and hence, it is important for the sake of collaborative learning for enhancing technology adoption and increasing user engagement.

## Students' Views and Experiences on Using ChatGPT

### Towards Learning Kinematics Graphs

Students' perception, motivation, and engagement levels in learning kinematics graphs with ChatGPT were consistent, according to the quantitative data. Subsequent analysis, however, indicated that although some indicators did not change, others were carried out, both before and after being exposed to ChatGPT. Based on the thematic analysis, students' experiences on perception, motivation, and engagement are consistent with quantitative findings which indicate a strong alignment between students' subjective experiences and measurable outcomes. There are four main themes generated for the views and experiences, which are in parallel with the quantitative data. These are perceptions, motivation, engagement, and cognition.

### Perception

**Easy to Use.** Because of ChatGPT's user-friendly interface and rapid response time, all the participants regarded it to be easy to use. Students valued how easily individuals could access information and how easily it was accessible. According to Mukred et al. (2023), the overall easy-to-use interface presented the learning platform as simple and intuitive to the students. Regarding whether usability equated to meaningful learning experiences, viewpoints varied.

*Participant 1: "It is very easy to use, the features that I like is that ChatGPT can make animations and graph-building from what I asked it to make."*

*Participant 2: "ChatGPT is so easy to use, because it doesn't have many features."*

*Participant 5: "ChatGPT is more easy than other AI tools. ChatGPT gives more accurate answers to any specific questions."*

*Participant 8: "It was very easy, the features that were really helpful for me is the instant answer."*

Similar to the study of Almulla (2024) states that students who found the interface of ChatGPT amiable and helpful for their research and learning activities reported greater satisfaction in their learning experience. However, participants' statements indicate that ChatGPT is easy to use because of its simplicity, but it also suggests that this simplicity limits the depth of interaction between students and ChatGPT. According to Javaid (2023), applying knowledge acquired from ChatGPT may make learners less critical in thinking and learn more dependently, making them reliant on AI.

**Attitude Towards Using ChatGPT.** The participants' statements depict an optimistic attitude towards the use of the tool. It is asserted that using ChatGPT would be of value because the tool modifies learning and problem-

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solving in an excellent way. Appreciation for a tool that fosters curiosity, efficiency, and reliable information is shared as the premise for critical thinking and creativity. It is viewed as an addition to their learning journey and makes the experience more engaging and productive.

*Participant 4: The answers make me want to explore the topic more."*

*Participant 5: "It allows me to learn more quickly, which helps with time management for other subjects."*

*Participant 6: "It gives valid answers that I use as a basis for generating my own."*

Participant 4's response finds ChatGPT's responses engaging enough to inspire further exploration and learning beyond the initial query. This implies that ChatGPT can drive deep learning. Similar to the study of Hashana et al. (2023), states that ChatGPT has benefited significantly from deep learning techniques. In terms of time management, participant 5 views ChatGPT as a time-saving tool that supports efficient learning, allowing for faster understanding and freeing up time to focus on other academic responsibilities. This would have positive effects on the overall academic productivity and time management of students, allowing ChatGPT to deliver rapid information instantly. According to Shi (2024), a primary indicator of ChatGPT's efficiency is its ability to save time which can free users up to focus on more complex tasks.

ChatGPT encourages critical thinking as implied by the response of participant 6. The participant views ChatGPT as an application for simple information and refers to it simply to build or confirm one's own knowledge. the students can develop critical thinking skills by comparing AI-provided answers with other resources. Similar to the study of Guo and Lee (2023), students who responded actually said that one had increased utilization of ChatGPT in efforts to make better use of critical thinking skills and would further recommend it.

**Trust and Reliability Issues.** Most of the comments from the participants expressed the unreliability ChatGPT for learning, especially on the visual representation of motion graphs in kinematics. Some prefer using Google because one think it is more trustworthy and helps them learn better. This lack of trust in ChatGPT makes it hard for students to use it effectively, which can lead them to stick with traditional methods instead. Overall, these insights suggest that improving how students view the reliability of AI tools in education is important for helping them accept and use these technologies effectively.

*Participant 2: "I rely more on Google because I trust Google and learn more from it."*

Participant 2's reliance on Google highlights a lack of confidence in ChatGPT's answers, suggesting that students prefer sources they perceive as more trustworthy. Students' trust in conventional sources like Google may result in underutilization of AI tools like ChatGPT, limiting the potential for innovation in learning. This may lead to an educational environment where AI tools are seen as supplementary rather than essential. Research by Chan et al. (2023) emphasizes the importance of trust in educational technology, suggesting that students are more likely to engage with tools that they perceive as reliable and effective.

*Participant 6: "I doubt to use ChatGPT because it is unreliable."*

The statement of participant 6 shows clear doubt about ChatGPT's reliability, suggesting that students do not trust in giving accurate information. The word "doubt" indicates a reluctance to fully use AI in their learning process. Such doubts can prevent students from using AI tools, limiting their chances to benefit from useful resources. If students believe they cannot rely on these tools, they may be less open to trying new ways of learning in the future. Henderson et al. (2017) discovered that how reliable students think a tool is directly affects their willingness to use educational technology. If they see a tool as unreliable, students are less likely to use it effectively.

*Participant 3: "Somehow, I don't understand the lessons, so I think it affects my knowledge."*

Furthermore, the statement of participant 3 reflects the consequential impact of this distrust on students' understanding and knowledge acquisition. This statement suggests that the participant feels that their

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understanding of the subject matter is compromised when using ChatGPT. It indicates a disconnect between the AI-generated answers and the student's learning process. If students perceive that AI tools hinder their understanding rather than enhance it, they may disengage from using these tools altogether. This disengagement could lead to a reliance on traditional methods that may not provide the same level of interactivity and personalized learning experiences. Haleem et al. (2022) suggest that the effectiveness of educational tools relies on their ability to facilitate understanding.

**Motivation**

**Intrinsic Motivation.** Intrinsic motivation often involves engaging in learning activities for personal satisfaction, enjoyment, or a desire to learn and explore new things. According to Chow and Yong (2013), intrinsic motivation is an internal drive that propels students to participate in academic exercise simply because one is interested in learning and enjoys the process of learning. Half of the participants were more motivated in learning kinematics graphs when using ChatGPT, especially in terms of intrinsic motivation.

*Participant 3: "For me, it becomes interesting, fun and exciting to learn"*

*Participant 5: "Learning with ChatGPT is interesting."*

*Participant 9: "Learning kinematics using ChatGPT is fun"*

The statements indicate that using ChatGPT is an interesting and refreshing experience for the participants. This emphasizes the importance of interactive learning experiences to keep the students' attention and interest. According to the study of Siregar et al. (2023) that the use of ChatGPT has a positive impact on students' learning motivation. Moreover, the findings of Reeve and Shin (2019) explains that intrinsic motivation is best sustained when learning tools support autonomy and self-direction. Because ChatGPT allows students to ask questions and explore topics at the students own pace, it can promote autonomous learning without undermining intrinsic motivation.

**Self-determination.** Self-determination is the ability and the need of a person to make choices and control one's own life. It is connected with autonomy and the experience of control over the actions performed. Findings shows a neutral group of participants suggest a change in self-determination motivation when using ChatGPT in learning kinematics graphs.

*Participant 4: "I find myself using ChatGPT less...It made me want to know more about the topic rather than rely on ChatGPT."*

*Participant 6: "I consult other resources to verify ChatGPT's responses."*

*Participant 9: "I realized the need to critically think and fact-check ChatGPT's answers."*

Based on the statement of participant 4, instead of relying on AI to have the answers, it can lead to curiosity and encourage the learners to explore the topic further. Thus, the participants may be prompted by ChatGPT to have deeper learning that encourages them to engage in self-guided exploration beyond the platform. For instance, the study of Abas et al. (2023) demonstrated that ChatGPT supports personalized learning, this is because it provides immediate feedback capabilities, adapts to the needs of students, and creates participatory and engaging learning experiences.

Statements of participant 6 and 9 show the reliance on other sources in cross-checking and validation of what ChatGPT provided, therefore probably holding multiple sources to get a well-rounded view of a subject. This implies that the participants would find value in using ChatGPT as a complement along with other sources of truth, rather than using ChatGPT alone.

**Engagement**

**Cognitive Engagement.** There is an equal division of opinion among the participants on the potential of ChatGPT to enhance learning by fostering cognitive engagement. Interaction, clarity, and accuracy of answers

from ChatGPT would certainly create interest and keep the engagement levels high. “The learning has been quite interesting" and "the follow-up questions are worthwhile" are quotable forms of participant experience, the tool can indeed motivate when it aligns with the student’s learning needs.

*Participant 1: "It helped me provide a good understanding of velocity and position-time graph.”*

*Participant 3: “For me, as a not fast learner, it helps me a lot to understand it."*

*Participant 7: "By doing follow-up questions, it helps determine if the answer is clear.*

Participant 1 mentioned the word "helped" which is interpreted in terms of making the information more understandable or clearer, therefore leading to deeper understanding. It probably increased motivation for further interaction since attainment of understanding sometimes becomes a salient motivator for further use. Since participant 3 mentioned that "he/she is not fast learner" it emphasizes that ChatGPT was particularly helpful in providing different learning paces. Participant 7 believes that through the follow-up questions, the clarification of concepts is set thus showing active involvement in the learning process. The ability to clarify makes a student want to learn more thus showing proactive learning.

**Behavioral Engagement.** Behavioral engagement includes actions that show effort, persistence, and active involvement in using ChatGPT. Most of the participants showed behavioral engagement, primarily through repeated use of ChatGPT, seeking clarifications and effort and persistence despite the challenges. Accordingly, it is about involvement, effort, and behavior (Fredricks et al., 2004). Findings show different experiences, with some students increasingly motivated in learning kinematics graphs when using ChatGPT, indicating varied impact of ChatGPT in educational experience.

*Participant 5: “I suggest that students must specify their questions, especially when it comes to kinematic graphs.”*

*Participant 7: "ChatGPT helps me by doing double-checking the answers given and it gives many answers which help me explore the concepts."*

*Participant 9: “Patience and understanding are the key; you need to think critically so you can understand the answers given.”*

Participant 5 states that the student must raise a question accurately to derive the best benefit from the ChatGPT for kinematics graphs. The more specific and precise the questions of the students to AI, the more will it be relevant and, hence, generate accurate responses. According to Mouhriz (2024), the use of prompt engineering helps in creating accurate answers from the AI tool used. Moreover, prompt engineering is the art of creating, testing and refining prompts to enhance the interaction of users with AI systems so that their outputs could be relevant and accurate.

The statement of participant 7 suggests that the participant used ChatGPT as verifying information to be able to understand the concept given. This implies that the potential of ChatGPT as for independent learning and allows students to be an active learner. Similar to the study of Opara (2023) states that ChatGPT supports self-paced and active learning. Also, AI-driven systems provide personalized information and feedback based on each user's unique learning style (Shah, 2023).

Statement of participant 9 suggeststhe concept that students should never blindly accept a response from AI but instead comprehend and analyze it. It implies that students should be encouraged to approach ChatGPT with a critical and skeptical attitude, looking for bias in the responses as well as material that can help reveal its limitations.

**Emotional Engagement.** Findings show that the participants have a neutral emotional engagement when using ChatGPT in learning motion graphs in kinematics, that includes positive and negative emotional engagement. According to Fredricks et al. (2004), student emotional engagement has been linked with affective responses such as interest, satisfaction, emotions, and anxiety toward learning.

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*Participant 4: "When I first heard about using ChatGPT for our kinematics lessons, I was excited and also shocked because I don't know if I will be able to learn about our lesson properly."*

*Participant 6: "Excited and wondered how to use ChatGPT."*

Statements of participants 4 and 6 show the feelings of excitement or interest in using ChatGPT. This shows that the participants are interested in knowing the features of ChatGPT and what may be achieved using this tool in learning graphs in kinematics. Similar to the study of Skjuve et al. (2024) states that the participants were also using and trying out ChatGPT, often as a learning tool to see what it could accomplish and then determine where it might serve one's needs currently or in the future.

*Participant 2: "It only confused me more, and I didn't learn anything."*

*Participant 7: "ChatGPT didn't make my learning in kinematics easier because it gives different answers to my questions, which makes me confused."*

Frustration and confusion due to inaccurate answers given by ChatGPT was shown in the statements of participants 2 and 7. The participants' experience with ChatGPT seemed to prove not helpful since the inconsistent responses generated made things only more confusing rather than for clarity.

**Cognition**

**Kinematics Learning.** Most of the participants agreed that learning with the help of the ChatGPT motivated them to look for more information, actual meanings, and examples. The finding indicates that the participants learned basic concepts in kinematics such as definitions of terms, examples of the kinematics graphs (position-time, velocity-time and acceleration-time graphs) and interpreting kinematics graphs using the slope indicated.

*Participant 1: "It helped me provide a good understanding of velocity and position-time graph."*

*Participant 4: "Using ChatGPT helped me to understand kinematics better by making me search the real meaning and examples of what kinematics is."*

*Participants 6: ChatGPT helps me learn better concepts and terms in kinematics."*

Participant 1 statement indicates that learning velocity and position-time graphs can be done using ChatGPT. Fourth participant's statement suggested that using ChatGPT allows the student to learn deeper in kinematics by seeking out additional information and examples. It also shows that they may have developed better problem-solving skills, since ChatGPT encouraged the participant to explore more in kinematics. According to Ayman (2023), since ChatGPT seems to be interactive and adaptive, it may aid in creating a more inclusive and dynamic learning environment while fostering critical thinking and problem-solving abilities.

**Graph Confusion.** On the other hand, half of the participants expressed frustration about the limits of the AI tool in terms of accuracy and clarity. This entails the limitations on generating visual representations by ChatGPT, particularly kinematics graphs.

*Participant 4: "ChatGPT doesn't give the accurate pictures of graphs."*

*Participant 6: "ChatGPT gives me confusing images."*

*Participant 7: "ChatGPT gives different answers and different graphs, which makes me confused."*

Statement of participant 4 suggests that generated graphs do not accurately present the correct one leading to mistrust on the output given by ChatGPT. This suggests that users may be less likely to rely on ChatGPT when the given output is inaccurate or confusing. It is difficult to understand the graph given by ChatGPT when the graph may be poorly designed or incomplete, which leads to confusion as expressed by participant 6. Participant 7 points out the inconsistent answers given by ChatGPT leading also to confusion.

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These feedbacks point out the proper guidance and instruction in using ChatGPT to be able to give the proper and needed answer. Similar to the study of Kim and Lu (2024) states that refinement of prompt and few-shot learning enhanced the ChatGPT's performance. This will help the students regarding the gap between the students' expectations and ChatGPT's capabilities. Furthermore, providing students with guidelines about how to critically evaluate and supplement the information received from ChatGPT might enhance the learning experience and avoid confusion.

**Convergence between Quantitative and Qualitative Results**

Table 8 provides a convergence between the quantitative and qualitative results of the study. It is actually a synthesis of some key understandings gathered from both research approaches, pointing at the complementarity of both approaches in understanding the influence of the use of ChatGPT on students' learning experiences in kinematics, specifically on the motion graphs. It indicates that some of these factors, including, ease of use, attitude towards using ChatGPT, and reliability also exhibit convergence in qualitative and quantitative perception. Ease of use and attitude towards the usage of ChatGPT emerged as significant influencers of the overall students' perception and is in line with the qualitative findings where almost all participants agreed to the user-friendliness of ChatGPT and were optimistic about the prospect of learning enhancement.

Table 8. Summary of Convergence between Qualitative and Quantitative Findings

| FINDINGS | QUANTITATIVE DATA | QUALITATIVE DATA |
|---|---|---|
| Ease of Use | Highly improved scores in ease of use. | All the participants found ChatGPT easy to use. |
| Attitude towards using ChatGPT | A significant positive attitude toward ChatGPT was demonstrated. | Most participants expressed optimism about ChatGPT's potential to enhance learning. |
| Concerns on Reliability & Effectiveness | Slight decline or no significant change in trust. | Participants questioned ChatGPT's accuracy and ability to handle visual representation in kinematics |
| Intrinsic Motivation | No significant change observed. | Neutral motivation toward learning with ChatGPT. |
| Self-Determination | No significant change observed. | Data shows neutral change in self-determination motivation |
| Cognitive Engagement | No measurable difference in cognitive engagement. | Opinions divided on ChatGPT's impact on learning engagement. |
| Behavioral Engagement | Significant increase was observed. | Majority of the participants showed active involvement and repeated use. |
| Emotional Engagement | No significant change in emotional engagement indices. | Emotional response during learning is neutral. |
| Kinematics Learning | Improved scores in motion graph learning | Participants agreed ChatGPT aids in learning kinematics graphs. |

In terms of motivation, there was no change in categories like intrinsic motivation and self-determination, which align with the qualitative findings, showing a neutral view among the participants pertaining to those motivations. In regard to whether learning could be enhanced by using ChatGPT for learning motion graphs in kinematics, it did not have much effect on students' motivation to use this tool for learning motion graphs in kinematics.

For the engagement aspect, the quantitative findings on cognitive, behavior, and emotional engagement had a congruence with the qualitative findings. In comparison, while cognitive and emotional engagement took a neutral view, behavioral engagement, though remarkable in terms of its power to influence students' engagement level, took the side of most participants' active engagement, exhibited through repeated use of ChatGPT.

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Improved mean scores were obtained in student's understanding of kinematics graphs, showing that learning concerning motion graphs in kinematics had occurred. Although this increase in scores is moderate, it is consistent with qualitative results where participants would comment that the tool offered by ChatGPT is indeed helpful when learning kinematics graphs. These findings indicate that ChatGPT provides a positive contribution to the participants' understanding of motion graphs, thereby supporting the participants' perceptions of its utility in enhancing their understanding of this part of physics.

Generally, quantitative data indicated that in the cases with ChatGPT, different factors in perception and motivation significantly affect students' learning in kinematics graphs while all of the categories in engagement of the students toward learning kinematics were stabilized. The qualitative findings offered some understanding of the slight changes, in the sense that students seemed to either accept or reject ChatGPT while relating one's experience. Some appreciated its utility for a better basic understanding, but some complained about the issues with reliability and clarity. It is then confusing and unreliable to learn it in complex subjects, specifically on the visual representation. This has problematic consequences including a decrease in motivation and engagement.

Findings further illustrates that the hesitation is based on a concern of the accuracy and applicability of ChatGPT in the actual learning experience, specifically on the visual representation, graphing kinematics. All of that data, whether qualitative or quantitative, suggest that ChatGPT was more of a supplemental tool and not a primary learning tool, and therefore it is yet to meet its potential of being an agent of deep learning and comprehensive engagement.

While AI tools can be useful for basic learning support, students often doubt their reliability and effectiveness, especially for more complex or detailed tasks. Research by Awad and Oueida (2024) shows that while AI can improve education, concerns exist about its reliability and usefulness, especially in important learning situations. Similar to the findings of this research, students expressed doubts about ChatGPT's ability to understand complex ideas, even though they saw its advantages for basic learning. Moreover, a systematic review by İpek et al. (2023) points out that although AI such as ChatGPT has the ability to create individualized learning experiences, if not properly incorporated into current teaching methodologies, there will have little to no effect on student motivation and engagement.

**Summary**

The following are the summary of the findings:

1. There is a significant difference in the level of perception of students before and after utilizing ChatGPT on ease of use and attitude towards using it. However, no significant difference was observed on usefulness, behavioral intent to use, social influence, credibility, and privacy and security.
2. There were no significant differences found in the motivation level of students before and after using ChatGPT across different categories.
3. There is a significant difference in the level of engagement of students before and after ChatGPT use, particularly in behavioral and social engagement. However, no significant differences were observed in cognitive and emotional engagement.
4. There is a significant difference between the pre-test and post-test scores of students in learning kinematics graphs.
5. There is no significant relationship between students' post-test scores in kinematics graphs and their perceptions of ChatGPT across various dimensions, including usefulness, ease of use, attitude toward ChatGPT, behavioral intention to use it, credibility, social influence, and privacy and security.
6. In terms of students' post-test scores in kinematics graphs and their motivation when using ChatGPT, intrinsic motivation, self-determination, and grade-related extrinsic motivation were found to be correlated. However, no significant differences were observed in self-efficacy and career-related extrinsic motivation.
7. Across different motivation categories, there was no significant relationship between students' post-test scores in kinematics graphs and their engagement before and after use utilizing ChatGPT.

8. There are several themes that emerged for the views and experiences of students after using the ChatGPT. For perception, ease of use, attitude towards using ChatGPT, and issues of trust and reliability have emerged. Under motivation, intrinsic motivation and self-determination were identified. For engagement, cognitive, behavioral, and emotional engagement were similarly developed. Finally, under cognition, the themes that are identified are kinematics learning and graph confusion.

# CONCLUSION AND RECOMMENDATIONS

## Conclusions

Based on the findings of the study, the following conclusions were drawn:

1. Students perceived that ChatGPT is fun, interesting, and easy to use as it provides different dynamics on how they interact with the AI. However, their perception on other issues remains unchanged after they have been exposed to it.
2. Students' interest and enjoyment in learning kinematics graphs remained constant after exposure to ChatGPT.
3. Students reported increased satisfaction and interaction with peers. Also showed more positive behaviors, resulting in better engagement and more effort during learning kinematics graphs while using ChatGPT. On the other hand, the affective responses and cognitive effort toward learning kinematics graphs were unchanged.
4. ChatGPT positively affected and enhanced students' conceptual understanding of kinematics graphs after exposure to ChatGPT.
5. The academic performance of students is not affected by how they view ChatGPT, despite its easy-to-use features, acceptance and support.
6. The students who are intrinsically motivated to learn, feel autonomous in their learning process, and are motivated by grades perform better on assessments. Self-efficacy and career-related extrinsic motivation, however, did not influence academic performance.
7. The engagement with ChatGPT may positively influence the learners in other aspects of learning, but it does not correlate with improved academic performance in kinematics graphs.
8. Students' perceptions, motivations, and engagement with ChatGPT helps capture one's views and experiences with the tool. The ease of use, positive attitude, and trust issues highlighted through the themes indicate the importance of user experience. Intrinsic motivation and self-determination highlight that these factors may indeed be used to enhance the learning outcome. Finally, the cognitive and affective components of engagement, as well as specific challenges for example, graph confusion may indicate additional support or guidance needed in certain areas.

## Recommendations

Based on the conclusion, the following recommendations are proposed:

1. Students may use the interactie and dynamic features of ChatGPT to their advantage or for better learning. However, teachers may need to look into how to integrate the tool for students to develop their critical skills, as engagement with the tool should supplement their learning.
2. Students may seek alternative materials and activities, including experiential learning, group activities, or role play, to sustain or increase interest in kinematics graphs, along with the use of ChatGPT.
3. Students may be encouraged to maintain the cooperation with peers that would be helpful in mastering kinematics graphs. Also, students need to be offered opportunities to reflect on their learning and to engage actively in building cognitive strategies in order to address difficult issues.
4. Students may use ChatGPT as an additional resource where one can clarify understanding and misconceptions in concepts of kinematics graphs. To perform much better, students should bring this together with regular practice or solving problems and consulting the teachers.
5. While ChatGPT is friendly and easily adopted, students should focus on the development of effective study habits and self-control. ChatGPT should be adopted as part of a comprehensive approach to learning rather than exclusively relying on it.

6. Students may explore more on the topics and set personal goals while using ChatGPT to learn deep understanding. Also, students should make the learning relevant by relating it to real-world applications or career goals, practicing regularly, and reflecting on feedback makes the process more meaningful and effective.
7. Students may do study groups to discuss kinematics graphs to provide new perspectives and enhance learning experience, and share work with teachers or classmates to receive constructive feedback and identify areas for improvement.
8. Students may spend time exploring the features of ChatGPT to better understand its capabilities and limitations. Likewise, students should practice using specific and well-structured prompts to elicit clear, relevant responses. Then, balance it with the use of traditional learning methods like textbooks, peer discussion and teacher guidance. Moreover, students reflect on how to use the tool in contributing to their academic growth and long-term aspirations.

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