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Gen Z Generation's Difficulties in Proving Trigonometric Identities with The Help of Gpt Chat

Putih Fitri[1], Yusuf Hartono[2], Meryansumayeka[3]

[1] Sriwijaya University, Indonesia; Putihfitri28@gmail.com
[2] Sriwijaya University, Indonesia; yhartono@unsri.ac.id
[3] Sriwijaya University, Indonesia; meryansumayeka@fkip.unsri.ac.id

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ABSTRACT

Artificial Intelligence (AI) and machine learning technologies, which play an important role among emerging technologies, have developed rapidly and have begun to be used in various fields in recent years, especially in education. Many factors cause low student learning ability in mathematics lessons. This study aimed to analyze Gen Z students' difficulties in completing trigonometric identity proofs by utilizing ChatGPT Trigonometry-assisted learning. The type of research used was qualitative research. Research data were collected through observation of student activities, direct interviews, and related literature studies. This research was conducted in SMA N 1 Indralaya Selatan. The instruments used were test question sheets and interview guidelines. The results of this study indicate that Generation Z struggles with basic trigonometry concepts, early solution strategies, and proper algebraic manipulation. In addition, reliance on ChatGPT often reduces students' conceptual understanding of the material. This article recommends learning strategies integrating technology and direct teacher assistance to improve learning effectiveness.

Corresponding Author:
Yusuf Hartono
Sriwijaya University, Indonesia; yhartono@unsri.ac.id

1. INTRODUCTION

Education is one aspect of life that plays an important role(Putro & Setyadi, 2022). A country can achieve progress if the education in the country is of good quality. The high and low quality of education in a country is influenced by many factors, such as students, teachers, infrastructure, and environmental factors.(Diva & Purwaningrum, 2022). One of the subjects in school that can encourage students to hone their abilities is mathematics. The function of mathematics is as a tool, mindset, and science or knowledge ((Suherman E, 2003);(Rachma et al., 2020). These three mathematical functions should be used as a reference in school mathematics learning.

Learning mathematics for students also involves the formation of a mindset in understanding a concept or reasoning about a relationship between those concepts. The achievement of mathematics

education can be seen in students completing learning tasks, applying the objectives of mathematics education in everyday life, and making mathematics an important part of students' lives. However, at this time, students' mathematics learning achievement is still very low; this is indicated by the National Final Examination (UAN) score, school report results, semester test scores, and daily test scores at school. Even according to the Trend in Mathematics and Science Study (TIMSS) in 2011(Sugiarti & Basuki, 2014), Indonesian students' mathematics mastery in grade eleven ranked 38th out of 42 participating countries. Meanwhile, in the 2018 PISA report, Indonesia ranked 70th out of 78 participating countries. This shows that the achievement of students in mathematics learning in Indonesia is still very low.

The low learning outcomes of mathematics are not only caused by difficulty in mathematics. However, they are caused by several factors, including the students themselves, teachers, learning approaches, and interconnected learning environments. The factor of the students themselves is the lack of understanding of their concepts of the material being taught. According to(SARDIMAN AM, 2001), factors causing difficulties for students in learning mathematics are the characteristics of mathematics itself, namely that the concepts are generally abstract. Another factor is the habit of only applying the lecture method in implementing learning and the lack of teacher ability to present the right learning approach to motivate students and involve them in the learning process. Student success in the learning process can be measured by the student's ability to solve problems or questions on the subject matter presented by the teacher.(Yanti & Novitasari, 2021). Many factors cause low student learning ability in mathematics lessons. One is the low understanding and mastery of the subject matter delivered by the teacher, but the teaching factor can also influence it.(Izzatin et al., 2022)States that numeracy is a person's skill in formulating, identifying, and implementing basic mathematics in various contexts that a person needs in everyday life.

Factors that can affect the smoothness of student learning include the teacher who teaches, methods, students, and tools. Two factors affect student learning: internal factors (from within the student) and external factors (from outside the student). Student learning difficulties will impact student learning achievement because good achievement can be obtained from learning treatment at or outside school and on the provisions and efforts of students in learning.(Sholihah & Afriansyah, 2018). This also happens in learning mathematics. Therefore, understanding students' learning difficulties in mathematics lessons is important for teachers to use as input to improve the teaching and learning process in the classroom. The National Joint Committee for Learning Disabilities(Adamopoulou & Moussiades, 2020)put forward the definition of learning difficulties as learning difficulties refers to a group of difficulties manifested in the form of real difficulties in the proficiency and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. The disorder is intrinsic and is thought to be caused by dysfunction in the central nervous system. However, a learning difficulty may occur together with other disturbing conditions (e.g., sensory disorders, mental retardation, social and emotional obstacles) or various environmental influences such as cultural differences, inappropriate learning, and psychogenic factors(Akrim, 2018). These obstacles are not direct causes or influences.

Trigonometric equations are material studied in mathematics subjects. These trigonometric equations can be useful in everyday life.(Alruthaya et al., 2021). With the trigonometry application, we can measure the distance of a star in the sky without having to measure it using a real measuring instrument.(Taufiq & Agustito, 2021). With trigonometry, the height of a cliff can also be measured without climbing it(Setiawan, 2020). Trigonometry is the relation or relationship of sine, cosine, tangent, cotangent, secant, and cosecant that has fulfilled certain prerequisites. (Rusgianto MS, 2012);(Widyatama & Pratama, 2022).

As a branch of mathematics, trigonometry has many benefits. Trigonometry can be used in basic science to determine the direction of the Qibla. In addition, trigonometry is also used in geography and astronomy.(Mauluddin & Supriadi, 2020). Therefore,(Rahayu & Irawan, 2020), trigonometry has many benefits. The benefits of trigonometry in life, of course, have identities. Trigonometric identities are

important concepts in mathematics that require high thinking skills, problem-solving skills, and strong evidence. According to(Galili et al., 2023), Mastery of trigonometry requires many deep cognitive skills. The opinion reinforces this (Nurmeidina et al., 2021). The concepts studied in trigonometry are trigonometric ratio formulas and how to determine trigonometric identity rules. Students are expected to be able to recognize and understand the basic forms of trigonometric identities. In this trigonometric identity, there is an important element, namely the angle.

Technological advances have significantly impacted various aspects of daily life, including education.(Rahmatika et al., 2022). The development of technology and education creates a reciprocal relationship in which each aspect influences and shapes each other.(Firaina & Sulisworo, 2023). Technological advances in education continue to offer new ways to enhance the learning experience.(Anggraeni et al., 2023).(Nasution et al., 2024)Explains that tools such as technology and the internet offer quick access to various information and services, helping people gain knowledge more easily. In addition,(Isnaini et al., 2024) explain that technological advances have influenced individuals' daily activities, especially for Generation Z.

In the digital transformation era, artificial intelligence-based technology increasingly influences various aspects of human life. One of the leading innovations in this field is ChatGPT, a generative language model developed by OpenAI. ChatGPT leverages the Transformer architecture and transfer learning approach to provide advanced natural language processing capabilities. With its ability to generate contextual and responsive text, ChatGPT represents a significant milestone in the evolution of artificial intelligence and leads a paradigm shift in human-machine interaction. As a member of the Generative Pre-trained Transformer (GPT) model family, ChatGPT is known for its capacity to understand context and generate natural text. Its learning process involves processing large amounts of data and unsupervised processing, which makes it capable of providing contextual answers to user questions and requests. These skills make it a relevant tool in various contexts, from virtual assistants who help with everyday tasks to solution providers in education and research. However, along with its impressive capabilities, the application of ChatGPT also raises certain questions and challenges. Ethical issues, such as data security and potential bias in the results it generates, are of serious concern. Therefore, understanding how ChatGPT works and its applications in various fields is essential to address the challenges and maximize its potential. In this context, this article will explore the theoretical basis of ChatGPT, its potential impacts on various aspects of life, and the challenges that need to be overcome to ensure its ethical use and benefit society.

Gen-Z children generally have unique characteristics, namely being strong in the community, tolerant of cultural differences, and exposed to various types of information that make them digital because of the difficulty distinguishing between the real world and the virtual world (Rakhmah, 2020). In addition, one of the characteristics of Gen Z is that their daily lives are only filled with social media, and they will stop if they want to take a break. (Li & Wu, 2023). In addition, Gen Z also has a fairly inclusive nature, always wanting to be involved in the community by utilizing sophisticated technology. This challenges educators to understand Gen-Z's learning needs and how to develop effective learning methods for them. If Gen Z has such traits and characteristics, how can learning be as good as possible according to Gen Z's characteristics? To understand this, it is necessary first to understand what kind of learning is effective or not to be applied to Gen-Z. Research states that traditional learning methods are not always effective to apply because, in terms of understanding, they are less than contemporary learning, such as problem-based learning methods(Anggraeni et al., 2023). Furthermore, other studies state that Gen-Z also likes learning symbols and images and optimizing the use of technology. In addition to the problem of using the method, it is also necessary to pay attention to the reality in schools, showing that participants' critical thinking skills are still relatively low.(BAİDOO-ANU & OWUSU ANSAH, 2023). This shows the need for appropriate learning and assessment methods to understand more personal and contextual in Generation Z. The phenomenon of the extraordinary application of ChatGPT technology has attracted attention and become the focus of various discussions or research from various academic circles, which have influenced various fields of life, including education.

So, based on the background above, researchers are interested in knowing more about the difficulties of the GenZ Generation in proving trigonometric identities by utilizing ChatGPT-assisted learning.

2. METHOD

This type of research is descriptive qualitative research. (Arikunto, 2010)Descriptive qualitative research is a study that aims to determine the conditions and circumstances of the results, which are explained in the form of a research report so that it can determine the location of student errors in solving trigonometric equation problems. At the same time, interviews are used to strengthen the data from the results of the description of student learning difficulty tests. This research was conducted on students at SMA N 1 Indralaya Selatan. The research subjects were four high school students. Data collection techniques include observation, written tests, interviews, and documentation. Observation: Observe how students use ChatGPT when trying to solve trigonometric identity-proof problems. Observations are focused on the process and errors that often occur(Sugiyono, 2017). Interviews: In-depth interviews were conducted to explore students' experiences and perceptions regarding using ChatGPT as a learning tool.(Nurfitriyah & _, 2022)

3. FINDINGS AND DISCUSSION

The results of observations and interviews obtained by researchers in the field related to learning difficulties experienced by students when learning mathematics include a lack of knowledge about the basic concepts of students in schools about mathematics. For example, some children in grade XI still lack knowledge of multiplication and division. So, for their next lessons, they have difficulties. This study found several major difficulties faced by Generation Z in completing trigonometric identity proofs with ChatGPT, namely:

3.1. Difficulty in Understanding Basic Concepts

In the first activity, students are given an initial ability test to prove trigonometric identities. Many students have difficulty understanding the basic identities of trigonometric functions, such as the relationship between the sine, cosine, and tangent functions with the Pythagorean identity. This misunderstanding often becomes an obstacle in completing the proof. (Suwarna A, 2019). Students who do not have this basic understanding tend to rely on instant solutions from ChatGPT.

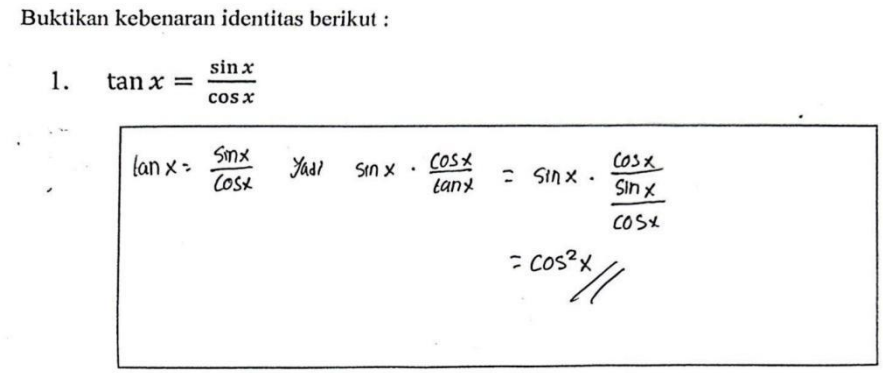


Figure 3.1. Not understanding the basic concept

In Figure 1, it can be seen from the students' answers that they do not understand the relationship between the sine, cosine, and tangent functions with the Pythagorean identity. This can be seen from the students' answers that do not use the Pythagorean identity in their proofs, even though this is still a simple proof.

3.2. Lack of Initial Strategy Appropriate

One significant difficulty is determining the initial step in the proof. Students are often confused about whether to start simplifying from the left or right side of the identity.

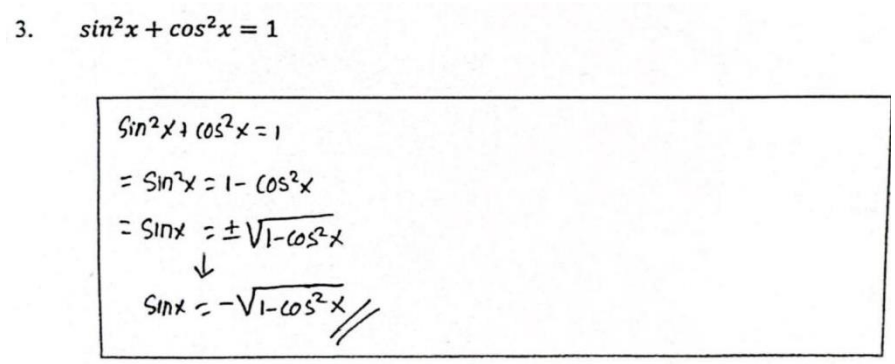


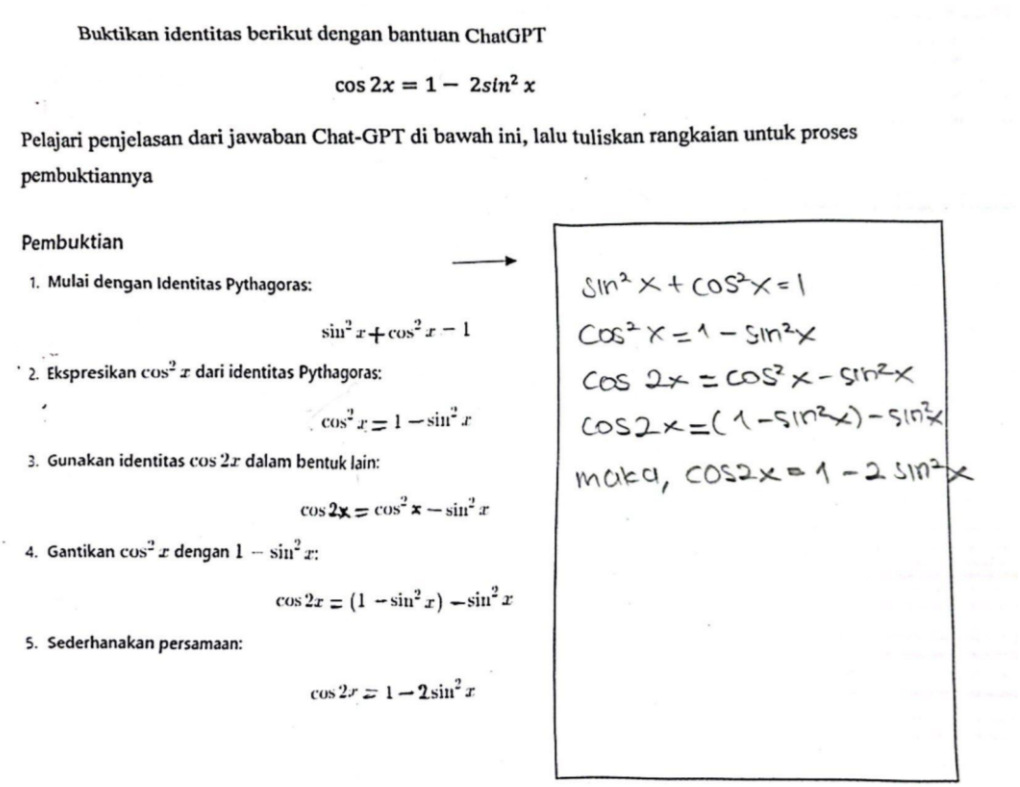
Figure 3.2. Inappropriate initial strategy

In Figure 2, it can be seen that the student made a mistake in using his strategy to solve the proof of trigonometric identity. This step can be seen as an attempt to simplify the problem, but it causes further confusion. Algebraically, it is true that from the identity sin2x+cos2x=1, it is changed to sin2 x= 1 – cos2x and then the right side is changed to the root. However, this should not be done when providing proof of identity. This kind of change introduces new variables without proper reason and confuses the flow of the proof, which is simple. This shows a lack of understanding of the strategic principles in mathematical proof (Hendriana & Sumarmo, 2017).

3.3. Dependence on Technology.

In the second activity, students are given questions with answers that Chat GPT has given. They study the solutions given and explain them again. The appropriate use of technology can have a better impact on learning activities. (Pagau & Mytra, 2023).

However, students rely on ChatGPT to provide quick solutions without understanding the suggested steps.



Buktikan identitas berikut dengan bantuan ChatGPT

$$\cos 2x = 1 - 2sin^2 x$$

Pelajari penjelasan dari jawaban Chat-GPT di bawah ini, lalu tuliskan rangkaian untuk proses pembuktiannya

Pembuktian

1. Mulai dengan Identitas Pythagoras:

$$\sin^2 x + \cos^2 x = 1$$

2. Ekspresikan $\cos^2 x$ dari identitas Pythagoras:

$$\cos^2 x = 1 - \sin^2 x$$

3. Gunakan identitas $\cos 2x$ dalam bentuk lain:

$$\cos 2x = \cos^2 x - \sin^2 x$$

4. Gantikan $\cos^2 x$ dengan $1 - \sin^2 x$:

$$\cos 2x = (1 - \sin^2 x) - \sin^2 x$$

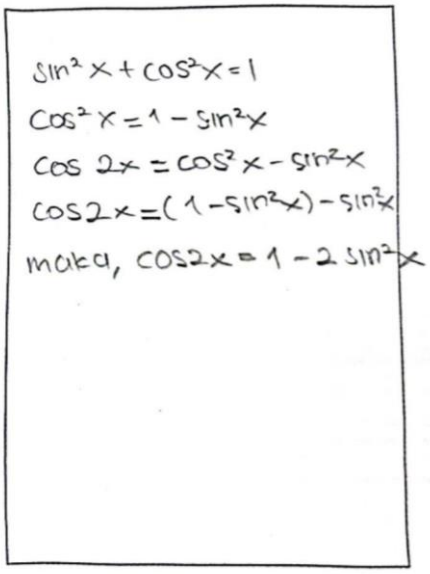
5. Sederhanakan persamaan:

$$\cos 2x = 1 - 2\sin^2 x$$

$\sin^2 x + \cos^2 x = 1$
$\cos^2 x = 1 - \sin^2 x$
$\cos 2x = \cos^2 x - \sin^2 x$
$\cos 2x = (1 - \sin^2 x) - \sin^2 x$
maka, $\cos 2x = 1 - 2\sin^2 x$

Figure 3.3 GPT Chat Dependency

From Figure 3, it can be seen that students immediately wrote the same thing as what was produced by Chat GPT. When interviewed, students said they only rewrote what Chat GPT had written.



$\sin^2 x + \cos^2 x = 1$
$\cos^2 x = 1 - \sin^2 x$
$\cos 2x = \cos^2 x - \sin^2 x$
$\cos 2x = (1 - \sin^2 x) - \sin^2 x$
maka, $\cos 2x = 1 - 2\sin^2 x$

Figure 3.4. Student answers

In Figure 4, students do not know why the final result is 1-2 si 2 x. Students say they do not know why there is suddenly a number two. This is the importance of the role of teachers as student guides. Asare in 2023 said that reliance on artificial intelligence should complement, not replace, traditional learning modalities. As a result, if left alone when faced with similar problems without the help of technology, they have difficulty solving them independently (Ningrum et al., 2024). Dependence on

technology, although it provides convenience and faster access to obtain answers or explanations, can cause students to be unable to think critically, solve problems independently, and build the social skills needed in learning. Technology such as ChatGPT, although it can accelerate learning by providing direct explanations and solutions, should not be a substitute for active student involvement in processing and understanding the material.

3.4. Errors in Algebraic Manipulation.

Proving trigonometric identities often involves algebraic manipulations, such as simplifying fractions or transforming trigonometric forms. However, many students make technical errors, which render their proofs invalid. (Ardiyanto, 2019).

This study shows that Gen Z students face various challenges in proving trigonometric identities, including difficulty understanding basic concepts, lack of appropriate initial strategies, reliance on technology, and algebraic manipulation errors. While ChatGPT can be a helpful tool, its use needs to be accompanied by guidance and mentoring from teachers to ensure deep understanding.

Recommendations from this study include Integrating technology with a concept-based learning approach to improve student understanding in mathematics learning, providing intensive training on trigonometric identity proof-solving strategies, and using ChatGPT as a complementary tool, not a substitute.

The interview results showed that many factors, including the problem of intelligence level, caused the difficulty in learning mathematics. Some students could easily accept and understand the teacher's explanation regarding the mathematics topics taught, especially trigonometric equations. Other factors were caused by the students' diligence to want to study hard and persistently and the students' diligence to want to repeat the lessons learned at school, but for some students, this was not the case. Some students tended to be lazy in following mathematics subjects because they disliked mathematics. Their motivation to learn mathematics was lacking, so some students had difficulty following mathematics lessons, especially trigonometric equations. The next factor was family background, and the tendency was that parents of students sometimes did not care about their children's learning progress at school or the difficulties they found in learning. The difficulties in learning mathematics for students on trigonometric equations were that they did not correctly understand how to determine basic equations, special angles, root equations, multiplication, and division. Students also had difficulty solving problems related to story problems. Some students also had difficulty distinguishing intervals with the special angles used. When students have difficulty working, they use the Chat GPT shortcut, resulting in a lack of basic understanding of mathematics lessons.

Generation Z has unique and different learning needs from previous generations. Generation Z's learning needs, which are accustomed to communication technology, cause Generation Z, especially students, to like interactive learning. Csobanca, in his article related to Generation Z(Kustyarini et al., 2020), mentioned that Generation Z always tends to use the internet or social media for primary communication or likes to learn while playing. Because Generation Z is dependent on the internet or digital, it is necessary to prepare learning related to digital, which is in line with the opinion of Similler and Grace (Li & Wu, 2023)that four effective learning for Generation Z, one of which is video-based. So from here, we understand that most Generation Z prefers more digital learning because of the era factor. In addition to interactive learning, Generation Z is familiar with technology and wants to use technology in learning (Limna et al., 2023). Generation Z is also very familiar with social media. The results of Palley's 2012 research in Turner 2015(Lin et al., 2023) show that 60% of Generation Z respondents start their social life online, 50% of Generation Z prefer to communicate online rather than talk directly in real life, even 70% of Generation Z are more comfortable communicating with their friends online. They want to learn to use technology to complete assignments and learn independently. This shows the learning needs that need to be prepared by teachers, namely technology learning and the use of social media as learning materials.

This follows the theory of this finding in line with several previous studies that highlight the potential negative impacts of using artificial intelligence-based technology on cognitive and academic abilities. For example, (Loeng, 2020)found that negative perceptions of AI can hinder employees' learning behavior and actual performance. Similarly, it shows that general concerns about AI can negatively affect users, especially in the context of developing analytical skills. However, research also highlights the benefits of using AI in education. (Löhr, 2023)found that AI can strengthen the interaction between instructors and students in online learning. Emphasized that this technology can support learning evaluation and impact analysis.

In addition, it is argued that experiential learning can improve students' positive attitudes towards AI. In addition, the use of AI in education has great potential to improve the overall quality of learning. AI can help develop various educational tools and platforms tailored to each student's needs. For example, adaptive learning systems that use AI can adjust the content, and the material's difficulty level is automatically based on each student's abilities and learning preferences. This can result in a more engaging and effective learning experience for them.

Generation Z also likes to learn things that are relevant to their lives and that they can apply in real life. They want to learn theory and how to apply the theory in practice (Learning by doing)(Lubis et al., 2022).

While the positive potential cannot be ignored, the results of this study underscore the importance of wise management in using AI, including Chat GPT, in academic environments. Excessive or undirected use of AI can hinder critical thinking and analytical skills essential for intellectual development. Therefore, clear policies and practical guidelines are needed to ensure that the use of AI in education provides optimal benefits while minimizing potential negative impacts.

4. CONCLUSION

This study shows that Gen Z faces various challenges in proving trigonometric identities. These include difficulty understanding basic concepts, lack of appropriate initial strategies, dependence on technology, algebraic manipulation errors, and minimal reflection on the learning process. Although ChatGPT can be a helpful tool, its use needs to be accompanied by guidance and guidance from teachers to ensure deep understanding. It is important to teach students how to use ChatGPT wisely—for example, avoiding cheating and ensuring ethical use. Utilizing technology such as ChatGPT can make learning more efficient and interactive. However, it should be remembered that technology is only a tool, and the role of teachers remains central in creating meaningful learning experiences for students. For further research, it is necessary to explore the use of Chat GPT to make learning more interesting and as teaching materials so that students can more easily understand a material.

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