THE USE OF AI IN TEACHING MATHEMATICS IN TEACHER TRAINING COLLEGES WITH BILINGUAL STUDENTS

Nader Hilf, & Leonid Kugel
Kaye Academic College of Education (Israel)

Abstract

With the development of the Internet and the ability to obtain information quickly, including professional and educational information, students have developed the skill of fast reading. Along with the advantages of such skills in learning mathematics, we would like to point out some disadvantages. With the skill of fast reading, it is easy to lose small details when parsing data in the proposed tasks. Such problems arise not only when reading about the problems themselves, but also when solving the problems offered in seminars. We want to look at some ways to fill these gaps in students' knowledge with the help of students' access to artificial intelligence chat rooms. There is no need to fear the fact that the student can get additional help in the subject, it is necessary to take control of this possibility. We will consider the issue of analyzing the initial data and the results obtained on the example of a subject (a subject of our choice, for example: Geometry), but if desired, this methodology can be extended to other subjects. The possibilities of AI are very broad, from finding answers to general questions to finding solutions to specific problems. For the instructor, the main difficulty in using AI is that today's systems do not use friendly forms of recording mathematical formulas but accept them in LaTeX format. Colleges typically do not take the time to learn the scientific language of formulas and thus must find additional applications to translate the familiar "math language" into a scientific format. However, ChatGPT can now recognize mathematical handwritten text, although it requires additional verification of the correctness of the translation (the correctness of reading the handwritten text). We use this feature for additional explanation of the material to Arabic-speaking students. After explaining the new material after the first examples, we suggest that students write a request to ChatGPT in their native language and get a second explanation, but in their native language. One of the disadvantages of the ChatGPT is the inability to draw geometric shapes, which will cause difficulties for students in understanding the proposed solution.

Keywords: ChatGPT, geometry, AI, prompts.

1. Introduction

In recent years, technology has developed rapidly and being used increasingly in learning and teaching. In the broad field of technology, artificial intelligence has recently gained special importance and attention because it helps to get information immediately. The capabilities of artificial intelligence today are very wide, from finding answers to general questions to finding solutions to specific problems. In addition, it is language-based. Considering these features of artificial intelligence, students have developed and still developing the ability to read quickly. It is important to note that an immediate barrier to this type of reading is a lack of attention to minute detail (NCTM, 2014). This means that the ability to process and analyze data as required from the user is limited. Therefore, it is very important to understand this technology and use it wisely, both in teaching and learning, by considering its weaknesses and limitations (Tashtoush et al., 2023), not only global but also adapted to the discipline.

2. Review

In the light of progress, the introduction of new technologies, including artificial intelligence, is also of great importance in the teaching of mathematics. Combining the teaching of a profession with artificial intelligence can increase its appeal by providing immediate feedback, helping to increase motivation, reduce anxiety and providing experiential learning processes (NCTM, 2014). Nevertheless, one major difficulty arises when using artificial intelligence in teaching mathematics, is that today's systems do not use known mathematical formulas because they are language-based, as mentioned above. They obtained

in LaTeX format. This is why teacher-training colleges are usually reticent to teach math using artificial intelligence, because math is a scientific language of formulation.

The conversation model developed using artificial intelligence calls ChatGPT. Currently, this model is beginning to show a potential as a methodology for teaching and learning mathematics (Baidoo-Anu & Ansah, 2023) as it can recognize mathematical text from a manuscript. However, it is worth noting that this ability, even today, requires additional verification of the correctness of the AI translation. However, we did not limit the students to only using ChatGPT; they also used Google (Gemini) and Microsoft (Copilot) environments. The results are the same. Each has advantages, such as the ability to write from right to left, combined with math formulas, and disadvantages, such as not everyone can read handwriting and then first need to translate it into printed text.

In this paper, we focus on the ability to use artificial intelligence in teaching mathematics in complex groups in terms of students' native language and proficiency levels. We thought that the use of artificial intelligence chat could help with two problems specific to learning mathematics in such groups: first, the comprehension of material in a second language (not the native language), and second, the different proficiency levels of the students. With the first difficulty, the material subjected to double processing at the student level: first, performed the translation of the learning material into the native language; Second, the process of mastering the theoretical material or solving the tasks begins. We realize that artificial intelligence can help by explaining the material studied in the native language. This is not a technical translation of a lecture or direct problem solving in class, but a result based on learning from many sources. Regarding the second difficulty, when solving problems, artificial intelligence can use for understand the steps of the solution as well as to further verify the correctness of the solution. Checking the correctness of the solution and detecting errors, if necessary, develops students' skills of self-quality control and analyzing solutions. It is worth noting that most chat rooms based on artificial intelligence who knows as a potential of many errors.

3. Research

To investigate the contribution of artificial intelligence in teaching math in touchy-feely classrooms, we use it to explain new material to Arabic-speaking students in a college for teachers from southern countries. During the study, students received explanations of new material in the Hebrew classroom, knowing that students from the Bedouin sector in the study group were discussing Hebrew with language difficulties. They then received their first sample solutions to the exercises. At the end of the tutorial, students invited to write a request to ChatGPT in their native language for further clarification. Prior to this, we invited an Arabic team member to go to the chat room and get the solutions in Arabic. We did the same with Russian-speaking students, offering them a Russian query. To see if this step is enough to understand the material and the solution paths in relation to it, we want to offer a solution to the exercise we showed.

Many students find it difficult to find a solution to a problem and do not know where to start. Here too, a chatbot based on artificial intelligence can help by showing different solution options without immediately revealing the solution.

-- To solve the given problem about the trapezoid ABCD, let us outline multiple possible approaches:

As a result, we got four ideas for solving our problem.

Figure 1.

-- 1. Using Proportionality in Similar Figures

Since $FE \parallel CD$ and lies between two parallel lines in the trapezoid, it forms a smaller, similar trapezoid within $ABCD$. This similarity can be used to determine segment ratios:

We use the midsegment theorem for directly compute EF in relation with AB.

The same similarity applies to the segment relationships between M, C and F.

-- 2. Using Coordinate Geometry

Assign coordinates to the vertices:

Let $A(0, h), B(a, h), C(2a, 0), D(0, 0)$.

Use the midpoint formula to locate points like E, F, ME.

Compute segment lengths using the distance formula and verify the required ratios.

-- 3. Using Vector Algebra

Assign vectors to points based on known ratios.

Express $\vec{E}, \vec{F}$, and $\vec{M}$ in terms of known points.

Use vector properties to prove given segment relationships.

-- 4. Using Mass Points

Assign mass values proportional to segment divisions (e.g., if $BC = 3 \cdot BE$, assign mass 3 at C and 1 at B).

Use the mass balance method to find the exact location of E, F, M.

Compute the required segment ratios.

We also decided to conduct the solution in two stages: the teacher's solution in the classroom and then analyzing and/or understanding the solution in the students' native language using artificial intelligence. After discussing and building possible models of our problem, we asked students to ask ChatGPT to suggest its solution.

At this stage, we considered additional tasks, as understanding the solution in their native language and analyzing the correctness of the solution. When teaching mathematics in schools, it is important to develop in future teachers the habit of analyzing not only their own solutions, but also the solutions of future students.

Figure 2.

-- Solve the problem step by step:

Step 1: Find $\frac{EF}{AB}$

Since $FE \parallel CD$ and lies between the parallel lines, it acts as a segment proportional to the bases of the trapezoid.

Using the trapezoidal midsegment theorem, the ratio between corresponding parallel segments follows the same ratio as that of the bases:

$$\frac{EF}{AB} = \frac{CD}{AB}$$

Given that $CD = 2AB$, we get:

$\frac{EF}{AB} = \frac{1}{2} \Rightarrow \frac{E}{F} = \frac{1}{2}CD$

Thus, the required ratio is:

$$\frac{EF}{AB} = \frac{1}{2}$$

Step 2: Prove $MC = 3FM$:

From the given data, $BC = 3BE$. This suggests that point E divides segment BC in the ratio:

$$BE: EC = 1: 2$$

Since M is the midpoint of DE, it follows that segment M divides line DE in a 1:31:31:3 ratio, meaning:

$$\mathbf{MC = 3FM}$$

Thus, the statement has been proved.

Step 3: Find $\dfrac{\mathbf{AM}}{\mathbf{MC}}$

From the previous step, we established:

$$\mathbf{MC = 3FM}$$

Since $\mathbf{AM = FM}$, we conclude:

$$\frac{\textbf{\textit{AM}}}{\textbf{\textit{MC}}} = \frac{\mathbf{1}}{\mathbf{3}}$$

Final Answers:

A. $\dfrac{\textbf{\textit{EF}}}{\textbf{\textit{AB}}} = \dfrac{\mathbf{1}}{\mathbf{2}}$

B. $\textbf{\textit{MC}} = \mathbf{3FM}$

C. $\dfrac{\textbf{\textit{AM}}}{\textbf{\textit{MC}}} = \dfrac{\mathbf{1}}{\mathbf{3}}$

We found that artificial intelligence helps and promotes data analysis by students who learn a language that is not their native language and understanding of the methods of solving the set tasks, but there are disadvantages in its use. In the process of research, we have identified that the first is the language problem, the problem of reading and understanding; the second is that students do not always conduct a complete data analysis (immediately start building a model: calculate, find, prove, etc.); the third is the verification of the correctness of the solution. We instill in students the skills that in each solution the student needs to perform four stages of the solution: data analysis, search for a solution, actually solving the problem and checking the correctness of the solution. In practice, we find that students, who often fail to find a solution, stop working, and in most cases, using artificial intelligence, and after receiving the results do not check them.

The study concludes that using artificial intelligence in groups with different proficiency levels to teach math requires instructors to ensure that students are accustomed to a safe environment of use in which the process of visualizing the material ingrained at every stage of learning the material and in practice. In addition, the use of artificial intelligence does not happen overnight. After using artificial intelligence to understand, the material and exercises are must until the material will learned at the native language level.

References

Baidoo-Anu, D., & Ansah, L. O. (2023). *Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning.* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4337484

National Council of Teachers of Mathematics (NCTM). (2014). *Principles to Actions: Ensuring Mathematics Success for All. National Council of Teachers of Mathematics*.

Tashtoush, M., Wardat, Y., & Elsayed, A. (2023). Mathematics distance learning and learning loss during COVID-19 pandemic: Teachers' perspectives. *Journal of Higher Education Theory and Practice, 23*(5), 162-174.