

Leveraging ChatGPT to Develop Critical Thinking Through Mathematical Problem-Solving in ESP Classes

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Abstract—The article highlights the influence of artificial intelligence (AI), in particular ChatGPT, on the development of critical thinking during ESP (English for Specific Purposes) classes. The authors' main goal is to investigate the effectiveness of using ChatGPT to foster critical thinking skills of prospective mathematicians and engineers. Great attention is paid to the methodology of using ChatGPT to solve mathematical problems through the prism of problem-based learning by combining theoretical research and its practical implementation in the educational environment. The results of a survey, conducted among students, showed that 89% of respondents agree that ChatGPT is an effective tool for developing critical thinking skills. Participants noted an improvement in their ability to divide complex tasks into stages, analyse data and get valuable explanations of complex concepts. The article focuses on the possibilities of integrating AI to solve mathematical problems, analyse complex concepts, and develop reflection skills. It's also highlighted the benefits of using ChatGPT in education, mainly for increasing students' confidence, interactivity of the learning process, and expanding opportunities for the development of analytical thinking. At the same time, the authors emphasise on the necessity of critical analysis of AI results and the need to improve approaches to its integration into the educational process. As it can be seen ChatGPT has a positive impact on the formation of an individual approach to learning and the development of interdisciplinary skills. The results of research describe the significant potential of

AI in modernising the educational process and improving its quality.

Keywords—Artificial intelligence (AI), ChatGPT, critical thinking skills, ESP (English for Specific Purposes) classes, problem-based learning (PBL), prospective mathematicians and engineers.

I. INTRODUCTION

Artificial intelligence (AI) technologies are progressing so fast that human beings cannot catch up with them at times. They are slowly creeping into every corner of people lives and have transformed the way how they live and work. AI is not a threat to humans, but rather an assistant that can help succeed in work, make routine matters easier and have time for creativity. It's no longer a buzzword; it is a part of human life.

The impact of AI on humanity depends on how people use it. The importance of it is revealed in a number of new innovative technologies like machine and deep learning. It's possible to see its wider impact in a lot of other sectors like education, healthcare, manufacturing and hospitality, which strengthens its potential further.

AI is reshaping life as people know it, and the education system is no different. It has emerged as a powerful solution to face the challenges in education and speed up the progress toward the achievements of SDG 4

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(Sustainable Development Goal 4). AI allows technology to be able to collect and analyse data to inform teachers on students' engagement, learning progress, and well-being. Likewise, there are digital applications and tools whose features allow to interact with the teacher and monitor progress individually [1].

According to Harry and others [2], AI in education refers to the use of artificial intelligence technologies, namely machine learning and natural language processing, to improve the educational experience. It makes use of algorithms that analyse data, look for patterns and make predictions, which allows teachers to customise learning for the individual student. Nguyen [3] emphasises on the necessity to compare different approaches of AI usage which can improve education and create new AI applications in education that will include personalized recommendations for students.

AI has a great potential in the field of education. In his research Wu [4] investigates how AI transforms educational curriculum by shaping and responding to the educational demand within diverse contexts. First of all, it ensures personalized learning, especially for students with diverse needs, which can help them to improve their outcomes, progress at their own pace and in a manner that works with their preferred learning style [5] – [6]. It can be used for realisation of inclusive education that can increase students' accessibility, allowing more and more disabled students to participate in the classroom [7]. AI has a capacity in spreading eohumanism in educational settings, personalizing experiences, and enhancing ecological literacy while bridging interdisciplinary collaboration [8].

One of the directions of modernisation and innovative development of education is STEM-oriented approach aimed at enhancing the popularisation of engineering and technical professions which increases interest for choosing specialty, motivates for studying disciplines which form the basis of STEM education. It refers to the teaching of complex scientific disciplines combined into one: science, technology, engineering and mathematics. It focuses on educating, developing talents and professional skills, as well as scientific literacy, innovation awareness and ability [9].

The necessity to concentrate on integrated curriculum in the field of science, technology, engineering and math became evident by research studies conducted by Rumjaun, Barcelona, Belbase and others [10] – [12]. Their findings are connected with the implementation, priorities, prospects, processes and problems of STEM education. It is shown that by integrative approaches to teaching and learning is possible to improve students' interest and progress in STEM learning skills.

ChatGPT is considered nowadays as the main AI tool and is ranked confidently among the top global educational trends. With its rapid spread, teachers and researchers around the world are worried that it will prevent the development of analytical and critical thinking skills and affect students' academic integrity [13]. In turn,

students claim that ChatGPT increases their confidence to ask meaningful questions, analyse information and understand complex concepts, and encourages deep, reflective thinking and intellectual engagement [14].

The development of critical thinking skills is impossible without problem-based (PBL) learning, as it encourages students to analyse, research and find solutions to complex problems [15]. This method promotes critical thinking, logical reasoning and innovative decision making. Students become active participants in their learning process rather than absorbing facts and information passively, they examine alternative opinions and analyse real data to draw their conclusions [16]. Moreover, problem-based learning allows not only to deepen knowledge but also to develop flexibility of thinking and the ability to make informed decisions in a situation of uncertainty. That's why, it's very important to find effective strategies for facilitating the successful adoption of PBL in diverse educational contexts [17].

Using ChatGPT during ESP (English for Specific Purposes) classes for solving problem-based tasks creates new perspectives for critical thinking development. The interaction with AI allows to explore problems, discuss various ways of solving them and evaluate other opinions. ChatGPT serves as an assistant that provides real-time solutions, helps to clarify requests and create models for effective problem solving. Such method enhances not only the English language skills but also logic, the ability to set goals and assess the adequacy of selected solutions in the context of the learning situation.

This research *aims* to investigate how leveraging ChatGPT in ESP classrooms can foster critical thinking by guiding prospective mathematicians and engineers through mathematical problem-solving tasks relevant to their specific academic or professional spheres.

II. MATERIALS AND METHODS

This study applied a mixed-methods approach, using quantitative and qualitative methods to evaluate the effectiveness of using ChatGPT in developing critical thinking skills through mathematical problem-solving and analyse the results of students' activities in ESP classes.

There is a wide variety of tools and platforms that can be used to solve mathematical problems, such as: Wolfram Alpha – an online platform that uses AI to solve integrals, mathematical equations, differential equations, etc.; Microsoft Math Solver – a free tool that helps with math, including equations, graphs and other problems; Symbolab – popular tool for solving equations step by step; ChatGPT – a chatbot for arithmetic operations, proportions, fractions, calculation of percentages, linear equations and inequalities. After analysing functions of these resources, it was decided to use only ChatGPT for the research, because it covers the largest scope of usage: basic mathematics, algebra, geometry, trigonometry, higher mathematics and statistics.

Working on the study, the concept of using AI to solve mathematical problems was formed, which included 5 main stages “Fig. 1”. Following the proposed instruction, the students were able to test their critical thinking skills, which include the ability to compare, analyse and evaluate information from any source; to see problems and ask questions; to put forward hypotheses; to make a conscious choice and justify it.

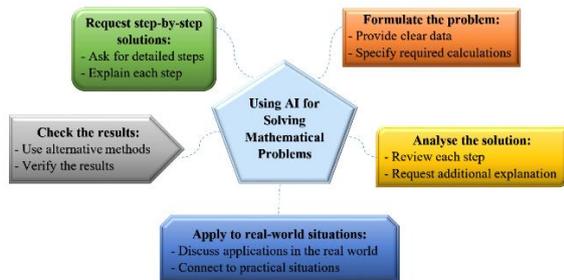


Fig. 1. Using AI for solving mathematical problems.

Solving a certain mathematical problem, students followed step-by-step instructions on how to formulate a request correctly for receiving the necessary information. After processing the request by ChatGPT, they had to analyse the received information if it met their requirements. They had to observe what critical thinking skills they applied at each stage of the work.

Example of using ChatGPT for solving mathematical problems:

Stage 1. Formulate the problem:

Objective: Analyse and understand the problem, break the problem into its component parts, recognise the main and secondary aspects of the task, determine the available information and its relevance, consider possible methods of solving the problem, identify hidden details and understand the context of the task, develop critical thinking skills.

Instructions: State all the information and parameters of the mathematical problem clearly; specify required calculations.

Result: Interaction between a student who learns how to form correctly a request and ChatGPT that responds to the student’s request “Fig. 2”.

The stage of problem formulation is the basis that determines the direction of further solution. An unclear or incorrect formulation of the problem can lead to a false result, even if the subsequent steps are performed correctly.

Stage 2. Request step-by-step solutions:

Objective: Ensure a logical sequence of calculations and operations, develop the ability to assess the correctness of each step, improve the accuracy of calculations by focusing on individual actions, identify and correct errors at the early stages, and strengthen basic knowledge and rules of mathematics.

In a right triangle, the legs are in the ratio of 3:4, and the hypotenuse is 25 cm. Find the area of this triangle.

To solve this problem, follow these steps:

1. Understand the problem
 The triangle is a right triangle, with the legs in the ratio 3:4 and the hypotenuse given as 25 cm.
 Let the lengths of the legs be $3x$ and $4x$, where x is a common multiplier.

2. Use the Pythagorean theorem
 The Pythagorean theorem states:
 $(leg)^2 + (leg)^2 = (hypotenuse)^2$
 Substitute the values:
 $(3x)^2 + (4x)^2 = 25^2$
 $9x^2 + 16x^2 = 625$
 $25x^2 = 625$

3. Solve for x
 $x^2 = 25$
 $x = 5$

4. Calculate the lengths of the legs
 First leg = $3x = 3 \cdot 5 = 15$ cm
 Second leg = $4x = 4 \cdot 5 = 20$ cm

5. Find the area of the triangle
 The area A of a right triangle can be given by:
 $A = \frac{1}{2} \cdot (\text{first leg}) \cdot (\text{second leg})$
 $A = \frac{1}{2} \cdot 15 \cdot 20 = \frac{1}{2} \cdot 300 = 150 \text{ cm}^2$

Final Answer:
 The area of the triangle is:
 150 cm²

Fig. 2. Sample of interaction between the student and ChatGPT at stage 1.

Instructions: Make a request that each step of the decision process was outlined; make sure that each step is accompanied by an explanation of clarity.

Write down each step in detail and explain what we are doing and why

Here is the detailed step-by-step explanation for solving the problem:

Step 1: Understand the problem
 We are given:
 1. The triangle is a right triangle.
 2. The two legs of the triangle are in the ratio 3 : 4.
 3. The hypotenuse is 25 cm.
 The area of a right triangle can be calculated using:
 $A = \frac{1}{2} \cdot (\text{leg 1}) \cdot (\text{leg 2})$

But first, we must find the lengths of the two legs.

Step 2: Represent the lengths of the legs
 Since the legs are in the ratio 3 : 4, let their lengths be $3x$ and $4x$, where x is a common multiplier. This allows us to represent the legs proportionally. Using a variable x ensures the ratio 3 : 4 is maintained, and we can use it to solve for the actual lengths of the legs.

Step 3: Apply the Pythagorean Theorem
 The Pythagorean theorem for a right triangle states:
 $(leg 1)^2 + (leg 2)^2 = (hypotenuse)^2$
 Substitute $3x$ and $4x$ for the legs, and 25 for the hypotenuse:
 $(3x)^2 + (4x)^2 = 25^2$
 Simplify:
 $9x^2 + 16x^2 = 625$
 $25x^2 = 625$

This equation lets us solve for x , the common multiplier, which will give us the actual lengths of the legs.

Step 4: Solve for x
 Divide both sides of the equation by 25:
 $x^2 = 25$
 Take the square root of both sides:
 $x = 5$

The value of x is now determined, and we can use it to calculate the actual lengths of the legs.

Step 5: Calculate the lengths of the legs
 Substitute $x = 5$ into $3x$ and $4x$:
 1. First leg:
 $3x = 3 \cdot 5 = 15$ cm
 2. Second leg:
 $4x = 4 \cdot 5 = 20$ cm
 Now we know the lengths of both legs, which are required to calculate the area.

Step 6: Find the area of the triangle
 The formula to calculate for the area of a right triangle is:
 $A = \frac{1}{2} \cdot (\text{leg 1}) \cdot (\text{leg 2})$
 Substitute the values of the legs (15 cm and 20 cm):
 $A = \frac{1}{2} \cdot 15 \cdot 20$
 $A = \frac{1}{2} \cdot 300 = 150 \text{ cm}^2$

This formula calculates the area by multiplying the base (15 cm) and the height (20 cm) and dividing by 2, as required for any triangle.

Final Answer:
 150 cm²

Fig. 3. Sample of interaction between the student and ChatGPT at stage 2.

Result: Interaction between a student who learns how to form correctly a request and ChatGPT that responds to the student's request "Fig. 3".

The request step-by-step solution stage is especially useful for beginners who are just mastering the method of solving problems. It provides analysis of complex problems that require a multi-step approach. Teachers are encouraged to teach students to think autonomously and understand mathematics, not just perform mechanically operations.

Stage 3. Analyse the solution:

Objective: Check the compliance of the solution with the conditions of the problem, identify possible errors in calculations or reasoning, verify whether the result meets the original objective of the task, understand the impact of individual steps on the final solution, identify more efficient methods of solving the problem.

Instructions: Go through the solution step by step to ensure accuracy; ask for further clarification if any part of the solution is unclear.

Result: Interaction between a student who learns how to form correctly a request and ChatGPT that responds to the student's request "Fig. 4".

Explain step 3 in more detail

🔗 **Step 3: Apply the Pythagorean Theorem**

The Pythagorean Theorem may be a crucial property of right triangles, which states:
 $(\text{leg } 1)^2 + (\text{leg } 2)^2 = (\text{hypotenuse})^2$

This means that the square of the lengths of the two legs of a right triangle adds up to the square of the hypotenuse. It applies only to right triangles and allows us to relate the three sides of the triangle.

We are given the hypotenuse (25 cm) and the ratio of the two legs (3 : 4). To find the actual lengths of the legs, we need to relate all three sides of the triangle. The Pythagorean theorem is the perfect tool for this.

Set up the equation
 The legs are represented as $3x$ and $4x$, where x is the common multiplier maintaining the ratio 3 : 4. Substituting these expressions for the legs into the theorem, we write:
 $(3x)^2 + (4x)^2 = 25^2$

By substituting, we ensure the lengths of the legs maintain the given ratio, while x scales them to their true size based on the hypotenuse.

Simplify the equation
 Expand the squares of the terms:
 $(3x)^2 = 9x^2$ and $(4x)^2 = 16x^2$

Add these together:

$$9x^2 + 16x^2 = 625$$

$$25x^2 = 625$$

This gives us a single equation in terms of x^2 , which we can solve to find x . Solving for x will let us calculate the actual lengths of the legs.

Solve for x
 To isolate x^2 , divide both sides by 25:

$$x^2 = \frac{625}{25} = 25$$

Take the square root of both sides to solve for x :

$$x = \sqrt{25} = 5$$

The value of x tells us how much the legs $3x$ and $4x$ are scaled. Using this value, we can calculate the actual lengths of the legs.

By applying the Pythagorean theorem and substituting the given information, we reduced the problem to a solvable equation. Solving this equation for x allowed us to determine the true dimensions of the triangle while preserving the 3 : 4 ratio.

Fig. 4. Sample of interaction between the student and ChatGPT at stage 3.

Analysing the solution helps not only to check the correctness of the answer, but also to develop self-control, critical thinking and reflection skills. This stage provides a deeper understanding of the solution process and helps to improve the quality of further solutions.

Stage 4. Check the results:

Objective: Use backward calculation or alternative methods to verify the result, analyse the result for compliance with the initial conditions, find possible inaccuracies or shortcomings in the solution process, use simulations or simplified versions of the problem to confirm the result, develop skills of critical analysis of own work.

Instructions: Solve the problem using different methods to confirm the results; cross-check the results to ensure correctness.

Result: Interaction between a student who learns how to form correctly a request and ChatGPT that responds to the student's request "Fig. 5".

Do another calculation with a different solution method

🔗 Let's solve the problem using trigonometry as an alternative method. Here's how:

Step 1: Understand the problem
 We know:
 1. It's a right triangle.
 2. The hypotenuse is 25 cm.
 3. The legs are in the ratio 3 : 4.
 We need the lengths of the legs to find the area.

Step 2: Use the ratio of the legs
 The ratio of the legs is 3 : 4. This means the triangle corresponds to a scaled version of the well-known 3-4-5 Pythagorean triple. The hypotenuse (25 cm) matches a scaled version of the "5" in the 3 : 4 : 5 ratio.
 Scale Factor:
 The scaling factor can be determined by dividing the hypotenuse by 5 (the hypotenuse in the basic 3 : 4 : 5 triangle):
 $\text{Scale factor} = \frac{\text{Hypotenuse } 25}{5} = \frac{25}{5} = 5$

Step 3: Calculate the lengths of the legs
 To find the actual lengths of the legs, multiply the 3 and 4 from the 3 : 4 : 5 ratio by the scale factor (5):
 1. First leg:
 $\text{Length of first leg} = 3 \cdot 5 = 15 \text{ cm}$
 2. Second leg:
 $\text{Length of second leg} = 4 \cdot 5 = 20 \text{ cm}$

Step 4: Calculate the area
 The formula for the area of a right triangle is:
 $A = \frac{1}{2} \cdot (\text{leg } 1) \cdot (\text{leg } 2)$
 Substitute the values:
 $A = \frac{1}{2} \cdot 15 \cdot 20$
 $A = \frac{1}{2} \cdot 300 = 150 \text{ cm}^2$

Final Answer
 The area of the triangle is: 150 cm²

Fig. 5. Sample of interaction between the student and ChatGPT at stage 4.

This stage is the final and crucial step in the problem-solving process, as it ensures that the result is correct, logical and applicable. It also contributes to the development of attentiveness, consistency and a responsible attitude to problem solving.

Stage 5. Apply to real-world situations:

Objective: Use the obtained solution to solve same or similar problems in real life, analyse how well the result meets the needs and conditions of the real situation, develop the ability to apply theoretical knowledge in practice and flexibility of thinking to adapt to different conditions, formulate proposals for optimising or improving the result, compare the expected and actual effect of the solution, recognize possible risks and consequences in a real-world context, form a positive attitude towards the use of the experience gained.

Instructions: Identify where the solution can be applied practically in the real world; relate the

mathematical problem to real-life contexts for better understanding.

Result: Interaction between a student who learns how to form correctly a request and ChatGPT that responds to the student's request "Fig. 6".

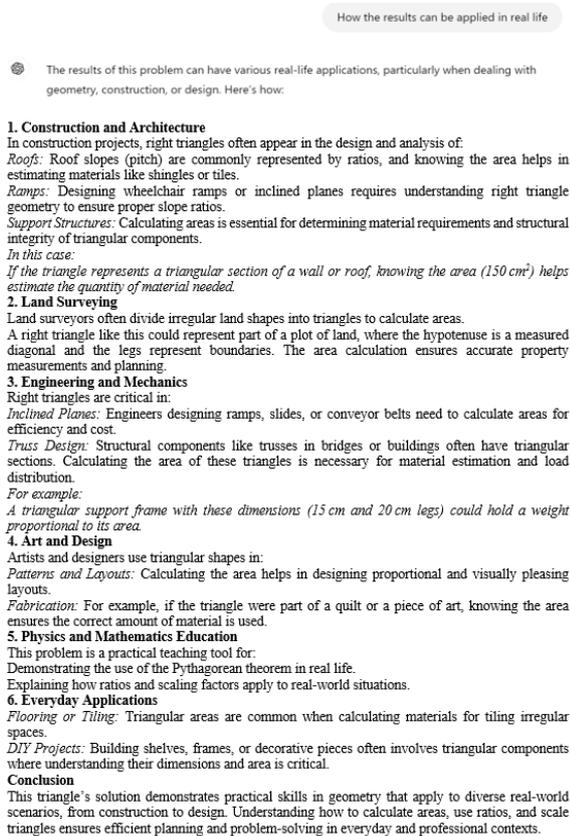


Fig. 6. Sample of interaction between the student and ChatGPT at stage 5.

This stage completes the problem-solving process, making knowledge more practical and valuable. It helps to consolidate the results, create new experience and increase competence in various fields of activity.

Participants:

The students of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University took part in this study. The participants were 36 second-year students from the Mathematics and Information Technology educational programme. The students had an obligatory ESP course (2 academic hours per week during the second term of 2023-2024 academic year) according to the university syllabus with the ratio of classwork and self-study 1 to 2. They worked in a self-study mode for four months. The ESP classes were held offline and lasted 80 minutes. Students were informed about the goals, tasks, and conditions of study and participated voluntarily.

Procedure:

From the very beginning, all students attended an initial session to familiarise them with the objectives and

expectations of the study. They were given a tutorial on how to sign in and use ChatGPT effectively and were provided with the set of mathematical problems tailored to ESP classes. Over a four-month period, during classes at the university they worked weekly on problem-solving exercises using traditional resources such as textbooks, lectures and teacher's explanations. At home they used ChatGPT to solve mathematical problems interactively, get explanations, and explore alternative solutions. A special collaborative platform was created where students and teachers discussed the advantages and disadvantages of using ChatGPT for improving critical thinking, understanding of mathematical problems and influencing their instructional strategies.

Data Collection:

Both teachers and students participated in the study. Quantitative data was collected and analysed from problem-solving tasks, critical thinking assessments, and post surveys. Qualitative data, which included transcripts of interviews, was subjected to thematic analysis to identify patterns and insights related to the benefits and challenges of using ChatGPT in the context of ESP. In addition, a questionnaire survey entitled "Benefits of Using ChatGPT to Develop Critical Thinking" was conducted among students. The study followed ethical research practices. The participants' anonymity and confidentiality was ensured throughout the research process.

III. RESULTS AND DISCUSSION

While participating in the study, first of all, students had the ability to develop their critical thinking skills. They learned to evaluate the correctness of AI answers, to improve the ability to ask clarifying questions to AI and to analyse mathematical problems and check solutions. Secondly, they examined the role of ChatGPT in education, which helped them to understand complex mathematical concepts easier and form skills of collaboration with AI as a tool. They also faced with challenges and limitations, such as: problems with the accuracy of ChatGPT answers in complex mathematical problems and the need for critical analysis of the results.

After conducting in-depth case studies of prospective mathematicians and engineers and analysing the results of the questionnaire, it was examined how ChatGPT impacts learning (table 1).

As it can be seen from the table of results of the questionnaire, using ChatGPT had a clear positive impact on the development of critical thinking. 89% of the respondents believe that ChatGPT is an effective tool for the development of critical thinking. For instance, 36% "strongly agree" and 55% "agree" that ChatGPT improves these skills. 74% of respondents said that ChatGPT allows them to divide complex problems into smaller steps – an important skill that develops critical thinking. Overall, 82% of participants reported that ChatGPT improves their analytical and evaluative ability in processing information critically. 83% of respondents

TABLE I BENEFITS OF USING CHATGPT TO DEVELOP CRITICAL THINKING SKILLS

No	Benefits of Using ChatGPT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
		(%)	(%)	(%)	(%)	(%)
1	ChatGPT helps break down complex problems into manageable steps	10	74	10	4	2
2	using ChatGPT can improve the ability to analyse and evaluate information critically	25	57	3	10	5
3	ChatGPT provides valuable explanations that enhance understanding of challenging concepts	48	35	7	6	4
4	the feedback from ChatGPT encourages to explore alternative solutions to problems	20	66	7	4	3
5	ChatGPT helps identify logical errors or gaps in reasoning	22	50	12	10	6
6	using ChatGPT encourages to ask more critical and thoughtful questions	43	45	6	4	2
7	ChatGPT provides examples that enhance problem-solving and critical thinking skills	19	71	5	3	2
8	the interactive nature of ChatGPT makes it easier to understand complex ideas	39	43	8	6	4
9	using ChatGPT has increased confidence in tackling unknown or challenging problems	16	68	4	6	6
10	ChatGPT is an effective tool for developing critical thinking skills	36	55	5	3	1

feel that ChatGPT offers valuable and clarifying explanations to help improve their understanding of complex ideas. 86% of respondents agree that feedback from ChatGPT motivates them to explore alternative solutions to problems. 88% of participants said that ChatGPT helps them to formulate critical and thoughtful questions. The majority of those surveyed (84%) reported feeling more confident solving unknown or difficult problems using ChatGPT.

The analysis of students' answers proved that ChatGPT is an effective tool for critical thinking development in the ESP classes. The study results cohered with Nguyen [3], Donnell and others [5] conclusions that ChatGPT assists in examining information, comprehending intricate ideas, building a holistic strategy for activities and improving users' trust in solving complex challenges in the educational process. Overall, the study results are compatible with Harry and others [2], Wu [13] evidences that respondents who use ChatGPT as a learning and reflection tool have relatively high satisfaction while using it.

Thus, ChatGPT or other AI tool can be used in multiple ways to support the teaching and learning process, particularly as an interactive tool for facilitating understanding, engagement and critical thinking in the ESP classes. Below are some specific ways by which it can enrich teaching and learning in general:

1. Analysis of ideas and arguments. Submit the ideas or arguments to ChatGPT and ask it to review their logic or recommend other ways to solve the problem or alternative perspectives on the problem. It is possible to identify thinking weaknesses and shortcomings, develop an evaluation of one's own ideas, and improve arguments.

2. Evaluation of information and sources. Paste the article or news text in and ask ChatGPT to check facts or assess its reliability and objectivity. Though ChatGPT can't fact-check in real time, it can help indicate common errors or stereotypes. It builds critical reading and source evaluation skills.

3. Question formulation. Ask ChatGPT generate questions that can help better understand what you have just read or come up with complicated problems to solve that requires analysis. Learning how to ask questions encourages deep thinking and analysis.

4. Analysis of complex concepts. Make ChatGPT summarise a challenging concept in plain language or suggest an analogy for a complex phenomenon. This makes it easier to understand complex concepts and gives access to more data for their further analysis.

5. Consideration of alternative points of view. Offer a discussion on a topic to see different views then ask ChatGPT to evaluate these arguments and find weaknesses. This helps to learn how to take into account different points of view and improve the arguments.

6. Analysis of problems and solutions. Make ChatGPT break the task into smaller steps and suggest

potential consequences of solution. This contributes to a structured approach to problem solving.

7. Assessment of risks and uncertainties. Ask ChatGPT for risks or solutions in case of uncertain data. It aids in the predicting of problems and planning of actions in the face of uncertainty.

8. Scripting and modelling. Ask to simulate a situation that will help assess reaction about methods to test theories. This activates the capacity for modelling repercussions and exploring potential scenarios.

9. Learning from mistakes. Send made mistakes so ChatGPT can help correct them and provide ways to prevent typical errors. The errors analysis develops self-control and accuracy in thinking.

10. Self-reflection. Send a text or argument for feedback and ask ChatGPT to find cognitive biases in thinking. Reflection lead to improvement in the process of thinking and do not allow to make the same mistakes again.

IV. CONCLUSION

In this age of rapid technological development, such tools as ChatGPT are transforming our approach to learning, problem-solving and critical thinking. From analysing ideas and arguments to evaluating information and sources or exploring alternative perspectives, ChatGPT provides an accessible platform for elaborating intellectual processes. By breaking down complex concepts, promoting introspection, and simulating problem-solving scenarios, it empowers users to enhance their logic, assess risks, and gain insights from errors. This tool not only plays a crucial role in building analytical skills, but also helps the user to explore and examine a wide variety of topics.

The usage of ChatGPT in ESP classes is a valuable innovation in modern education, particularly for enhancing mathematical problem-solving. It serves as a catalyst for developing critical thinking skills by providing real-time feedback, generating diverse problem scenarios, and encouraging analytical discussions. It's known as a versatile tool for improving the learning process, its ability to simulate collaborative learning as well as adapt to different students' needs.

However, the use of ChatGPT should be lined up strategically with pedagogical goals, paying attention to guided learning and critical evaluation of the AI outputs. Teachers play an important role in ensuring that ChatGPT supplements traditional teaching methods, rather than replaces them. The study proved if this modern technology is integrated effectively, it can empower students to solve mathematical problems with greater confidence, foster both their language proficiency and problem-solving abilities in a dynamic and engaging learning environment.

The further research should be addressed the practical issue of incorporating ChatGPT in the educational process

of prospective mathematicians and engineers in order to develop different aspects of English communicative professionally oriented competency.

REFERENCES

- [1] N. Dmitrenko, I. Budas and T. Fedyk, "Maximizing University Students' Spoken Interaction in English within the Distance Learning Framework in Wartime." *Analele Universitatii Ovidius Constanta, Seria Filologie*, vol. 35(1), pp. 227-245, 2024. Available:https://litere.univ-ovidius.ro/Anale/volume_2024_1.php. [Accessed: Dec. 17, 2024].
- [2] A. Harry and S. Sayudin, "Role of AI in Education." *Interdisciplinary Journal and Humanity (INJURITY)*, vol. 2(3), pp. 260-268, 2023, <https://doi.org/10.58631/injury.v2i3.52>
- [3] N. D. Nguyen, "Exploring the role of AI in education." *London Journal of Social Sciences*, vol. 6, pp. 84-95, 2023, <https://doi.org/10.31039/ljss.2023.6.108>
- [4] Y. Wu, "Revolutionizing Learning and Teaching: Crafting Personalized, Culturally Responsive Curriculum in the AI Era." *Creative Education*, vol. 15(8), pp. 1642-1651, 2024, <https://doi.org/10.4236/ce.2024.158098>
- [5] F. O Donnell, M. Porter and S. Fitzgerald, "The Role of Artificial Intelligence in Higher Education: Higher Education Students use of AI in Academic Assignments." *Irish Journal of Technology Enhanced Learning*, vol. 8(1), 2024, <https://doi.org/10.22554/szwjfy54>
- [6] N. Atul Mote, "Role of AI in Personalized Education." *International Journal of Advanced Research in Science Communication and Technology*, vol. 4(4), pp. 108-111, 2024, <https://doi.org/10.48175/IJAR SCT-15919>
- [7] S. Yang, "The Role of AI in Achieving Inclusive Education." *Communications in Humanities Research*, vol. 64(1), pp. 193-197, 2025, <https://doi.org/10.54254/2753-7064/2024.19654>
- [8] A. Kővári, I. Andras and M. Rajcsanyi-Molnar, "The Role of AI in Ecohumanistic Education." *Journal of Ecohumanism*, vol. 3(3), pp. 1361-1370, 2024, <https://doi.org/10.62754/joe.v3i3.3606>
- [9] W. Li, "Research on the application of STEM education concept in college education." *Region - Educational Research and Reviews*, vol. 6(11), pp.21-24, 2024, <https://doi.org/10.32629/rerr.v6i11.3118>
- [10] A. Rumjaun, M. C Shakeel Atchia, R. Bholah and L. Molefe, "Broadening Perspectives of STEM education: A new Conceptual Framework." *Journal of Research in STEM Education*, vol. 10(1-2), pp. 60-88, 2024, <https://doi.org/10.51355/j-stem.2024.170>
- [11] K. Barcelona, "21st century curriculum change initiative: A focus on STEM education as an integrated approach to teaching and learning." *American Journal of Educational Research*, vol. 2(10), pp. 862-875, 2014, <https://doi.org/10.12691/education-2-10-4>
- [12] S. Belbase, B.R. Mainali, W. Kasemsukpipat, H. Tairab, M. Gochoo and A. Jarrah, "At the dawn of science, technology, engineering, arts, and mathematics (STEAM) education: prospects, priorities, processes, and problems." *International Journal of Mathematical Education in Science and Technology*, vol. 53(11), pp. 2919-2955, 2022, <https://doi.org/10.1080/0020739X.2021.1922943>
- [13] Y. Wu, "Critical Thinking Pedagogics Design in an Era of ChatGPT and Other AI Tools – Shifting From Teaching "What" to Teaching "Why" and "How"." *Journal of Education and Development*, vol. 8(1), 2024, <https://doi.org/10.20849/jed.v8i1.1404>
- [14] Y. Guo and D. Lee, "Leveraging ChatGPT for Enhancing Critical Thinking Skills." *Journal of Chemical Education*, vol. 100(12), 2023, pp. 4876-4883, <https://doi.org/10.1021/acs.jchemed.3c00505>
- [15] N. Dmitrenko, I. Dolia, and S. Nikolaeva, "Soft Skills Development of Prospective Educators by Means of Problem-Based ESP Learning." *The New Educational Review*, vol. 6(2), pp. 124-135, 2020, <https://doi:10.15804/ner.2020.60.2.10>

- [16] N. Dmitrenko, "The Implementation of Problem-based Learning in Ukrainian Higher Educational Institutions." *Advanced Education*, vol. 5, pp. 28–34, 2016, <https://doi.org/10.20535/2410-8286.61834>
- [17] S. V. Devika, S. Arvind, K. Rashpinder and B. Anupama, "From Lecture-Based Learning to Problem-Based Learning: A Review on Navigating the Transformation in Engineering Education." *Journal of Engineering Education Transformations*, vol. 38, pp. 179-183, 2024, <https://doi.org/10.16920/jeet/2024/v38is1/24229>