



# Enhancing mathematics education for students with special educational needs through generative AI: A case study in Greece

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## ABSTRACT

The rapid development of generative artificial intelligence (AI) is expected to have a profound impact on various aspects of human society, including mathematics education. Nevertheless, there is a noticeable lack of research, particularly in Greece, that focuses on the development and assessment of lesson plans and math worksheets tailored for students with special educational needs. To address this research gap, we designed and conducted a nine-hour teaching intervention in a general mathematics classroom in Greece, involving two 8<sup>th</sup> grade students with special educational needs as the subjects of the study. The intervention utilized worksheets generated by the ChatGPT 3.5 application, which were customized based on the current curriculum, as well as the special educational needs and interests of the two participating students. The data were collected through interviews, tasks, and e-questionnaires, and analyzed using a new theoretical framework based on the concept of mathematical familiarity. The results indicated that students were actively engaged in the educational process, felt safe and confident, satisfactorily met the learning objectives, and developed positive attitudes towards the mathematics course. The paper concludes with a list of good practices, teaching suggestions and restrictions that could be useful to teachers and education policy makers. The target audience for the current study is, mainly, mathematics teachers who serve at all levels of education and have students with special educational needs in their classrooms. Furthermore, the article may also prove of interest to students, parents and teachers who are interested in the interaction between mathematics education and generative AI.

**Keywords:** special educational needs, mathematical familiarity, math worksheets, ChatGPT, qualitative research

## INTRODUCTION

Recent research has highlighted the importance of effectively distinguishing between artificial intelligence (AI)-generated and human-written text, a critical issue across various fields, including education. Theocharopoulos et al. (2024) investigated the detection of AI-generated scientific abstracts using large language models (LLMs), revealing both significant challenges and advancements in the text classification accuracy. Additionally, the study by Theocharopoulos et al. (2023) on identifying AI-generated book reviews underscores the need for robust methodologies to preserve the integrity of educational content, achieving

an impressive accuracy rate of 96.86% in differentiated between human and AI-generated text. These findings emphasize both the potential and limitations of LLMs in educational settings, aligning with our objective of integrating AI to enhance learning experiences for students with special educational needs.

AI refers to the intelligence demonstrated by machines, particularly computer systems, and is regarded by professionals as closely related to algorithms and tools for building computer programs (see Ding et al., 2024). Leibniz's *Scientia Generalis* could be considered as a precursor of AI, in the context of which all scientific and philosophical problems were supposed to be answered, with the "software" calculus that Leibniz invented (Grabiner, 1995; Rizos & Gkrekas, 2023). However, Alan Turing is widely recognized as the father of AI, primarily for his pioneering work and, most notably, the introduction of the "Turing test", which determines when a computer program might be considered intelligent (Luger, 2021).

AI is a major challenge for 21<sup>st</sup> century societies. A great number of people are unaware of how to use AI interfaces – a situation which may be compared to the ignorance of reading and writing that prevailed in the past centuries. It is anticipated that AI will be utilized in numerous facets of the lives of citizens, including education. According to *Global Risks Report 2024*, all countries should incorporate AI teachers in their public education system. In this context, AI applications can be used by the educator to create lesson plans, for note-taking and as a teacher's assistant. But also in special education, AI tools could be used to adapt lesson plans to the specific needs and skills of each individual child.

On the other hand, inclusive education refers to the right of all children to equal and unimpeded participation in the learning process (Foykas, 2024b; Kenny et al., 2023; McQuillan & Mayo, 2024; Yaroshenko et al., 2024). The use of good practice in mathematics for children with special educational needs based on the idea of inclusive education, such as information and communications technology (ICT) and manipulative material, has produced positive learning outcomes (Drolia et al., 2022; Foykas, 2024a; Rizos & Foykas, 2023a, 2023b). In the context of differentiated teaching, children participate in the course with lesson plans which are pre-designed and created by the teacher according to their individual characteristics (Anteneh & Anshu, 2024; Hutchison et al., 2023; Kokkinos & Gakis, 2021). The aim of differentiated teaching is the active participation of all children in learning and the achievement of learning goals (Lindner & Schwab, 2020; Scarparolo & MacKinnon, 2022; Sharp et al., 2020). Moreover, social pedagogy is highly critical of the teacher-centered educational system and the authority of the teacher and promotes the equal participation of children in education (Luoma & Kosunen, 2024; Nam et al., 2023). The students participate in the decisions concerning themselves during the course that is being implemented and together with the teacher they shape the course (Dindler et al., 2020; Griffiths et al., 2022; Moorhouse & Tiet, 2021).

ChatGPT (Generative Pre-trained Transformer) is an AI application (chatbot and virtual assistant), that has gained significant attention from the academic community over the past two years. In each stage of the conversation between the user and ChatGPT, the user's prompts and responses are considered as part of the context. However, despite its considerable potential for integration into educational settings, many teachers across various levels remain unclear on how to incorporate ChatGPT into their daily school or university practices. This research seeks to address the gap in understanding how ChatGPT can be used to create math worksheets tailored for students with special educational needs. The goal (and the same time the contribution to the academic community) is to provide teachers with practical guidelines for developing math worksheets that align with the individual needs and preferences of each student. With this in mind, we aimed to explore the spontaneous reactions and the impact of using appropriately adapted worksheets, generated via ChatGPT, on the teaching of basic mathematical concepts to two high school students with special educational needs in a general classroom of 25 students. The mathematical concepts examined in this study include the square root of a positive number and irrational numbers, two key topics in high school mathematics. The worksheets created using ChatGPT were tailored to the interests, preferences, and special educational needs of the participating students.

The present study is distinctive from previous studies in that it concentrates on the design, creation, utilization in the classroom and assessment of personalized lesson plans for students with special educational needs, using the ChatGPT application. This represents a novel approach, particularly in the context of Greece. Consequently, the paper makes a valuable contribution to the existing body of literature on the creation of lesson plans and worksheets for students with special educational needs using an innovative AI application.

As a tool for analyzing the research results, we introduce the concept of “mathematical familiarity”, which is defined as *a measure of the degree of comfort that students with special educational needs feel with the math worksheets provided by the classroom teacher*. High mathematical familiarity means that students feel familiar, i.e., the worksheet reflects the particular needs as well as the interests they have. This innovative term is visible through the analysis of the survey data and appears to be a key element of inclusive mathematics education to engage *all* students in the educational process, without exclusion or discrimination.

We implemented a nine-hour teaching intervention with the participation of two high school Greek students diagnosed with dyslexia and autism spectrum disorder (ASD), respectively. Our intervention aimed at teaching the square root of a positive number, as well as irrational numbers, and used AI-generated worksheets, specifically for the needs of these students. Thus, in light of the aforementioned considerations, we pose the following research questions:

1. Can ChatGPT effectively take into account the special educational needs of students in order to create individualized lesson plans and worksheets in mathematics?
2. Can ChatGPT substantially take into account students’ interests in order to create personalized lesson plans and worksheets in the mathematics course?

The results of the research showed that the participating students understood to a satisfactory degree the square root of a positive number and irrational numbers with the worksheets created by ChatGPT. The students were pleased with the worksheets because they reflected their interests and preferences and were able to deal with the tasks they were given. In addition, they satisfactorily completed the exercises of the test administered to all students in the class, without the help of the teacher, indicating that they largely mastered the new mathematical concepts.

## THEORETICAL FRAMEWORK

### About Dyslexia and Autism Spectrum Disorder

Dyslexia is a specific learning disability that refers to a child’s difficulties in understanding written language and mathematics, without being caused by any cognitive difficulties or other external factors (Duff et al., 2023). More specifically, children with dyslexia often struggle to comprehend written language, fail to recognize the data in the problems and exercises they are asked to solve, and find it challenging to perform mathematical operations (Price et al., 2022). In mathematics, these children face difficulties with the content of the exercises and often fail to comprehend the instructions accompanying them (Morrow, 2023). More specifically, children with dyslexia want to feel trust and stability in the classroom (Tomlinson, 2012). The percentage of children with dyslexia worldwide is around 10%, depending on the language of each country (Mather et al., 2020).

ASD is a neurobiological developmental disorder that accompanies the child throughout his/her life (Astle & Fletcher-Watson, 2020). According to the American Psychiatric Association (2013), ASD includes autistic disorder, Asperger syndrome, Rett syndrome, childhood disruptive disorder and accidental autism (cf. O’Connor et al., 2019). Some key features of ASD include social difficulties, communication deficits, stereotypical behaviors and low school performance (Rosello et al., 2022). In particular, children with ASD have a need for safety, avoiding indiscriminate glances and do not want to attract attention (Malberg, 2021). In terms of mathematics skills, children with ASD find it difficult to understand verbal learning problems because they have a poor vocabulary (Patterson & Hicks, 2020). The percentage of children with ASD internationally is about 1.85% (van’t Hof et al., 2021).

### About Differentiated Teaching and Social Pedagogy

In the 21<sup>st</sup> century the concept of differentiated instruction begins to be gradually applied in schools. This innovative teaching practice is beneficial for children with special educational needs, as it gives them the opportunity to participate in the learning process (Knight & Crick, 2022). The term “differentiated instruction” refers to instruction that addresses the specific learning and behavioral characteristics of each child, so that they are not excluded from the learning process (Gheysens et al., 2022; Puzio et al., 2020; Tomlinson et al.,

2003). More specifically, the teacher of each class prepares material accordingly to each child's needs, with the aim of equal participation in the learning process (Alsolami, 2022; Rowan et al., 2021; Ruppap et al., 2023).

Many studies have shown the positive importance of differentiated instruction in the teaching of mathematics. Initially, a survey of secondary school children in Nigeria by Awofala and Lawani (2020) showed that the children had better learning outcomes in mathematics compared to traditional teaching. Furthermore, a study by Hackenberg et al. (2021) showed that the use of differentiated instruction in mathematics expands the critical thinking and knowledge of children in the classroom. Another study by Pozas et al. (2020) showed that children with differentiated instruction by teachers demonstrate higher performance in mathematics and higher levels of engagement in class. Furthermore, a study by Lai et al. (2020) showed that differentiated teaching environments are beneficial to the teaching of mathematics and increase the degree of children's involvement in classroom activities.

Differentiated teaching as a practice was influenced by social pedagogy, a theory founded by Carl Rogers (Servant-Miklos & Noordegraaf-Eelens, 2021). According to social learning theory, learning should be based on the individual characteristics of each child (Ke et al., 2022; Lian et al., 2022). Furthermore, Rogers criticized the person-centered educational system, where the teacher is an authority and children blindly follow instructions, and proposed a more emancipatory education system, where children have a voice in their education (Feigenbaum, 2024; Renger & Macaskill, 2021).

### The Use of ChatGPT in Teaching

The use of generative AI, particularly ChatGPT, in teaching and learning has been implemented since November 2022. At this point, it should be noted that since the analysis and commentary of the research were completed, during the writing of this paper, a new version of Chat GPT-4 was released, which we believe has increased capabilities compared to the previous ones and will equally lead to positive learning outcomes. Therefore, the number of studies that have been carried out is limited. First, a study by Hasanah and Nurcholis (2024) showed that the use of ChatGPT in writing articles in English for 7<sup>th</sup> semester children had positive results. A further study by Lavidas et al. (2024) demonstrated that the anticipated benefits and enjoyment derived from AI tools are the primary motivators for educators in their utilization of such applications. A research by Wardat et al. (2023) showed that ChatGPT could be utilized by mathematics teachers to solve difficult mathematical problems in the future. Sánchez-Ruiz et al. (2023) implemented a study in which 110 children participated in the teaching of mathematics using ChatGPT. The results showed that the use of this application fosters children's critical thinking and problem solving skills. A research by Siegle (2023) has shown that ChatGPT can be used in teaching to create individual lesson plans and in the creation of composite assessment questions. Another research by Castro et al. (2024) showed that students used the ChatGPT to copy in their assignments, affecting the quality of education.

A research by Sharma and Yadav (2023) has shown that the use of ChatGPT appears to be beneficial to teaching and learning, but teachers and students need to learn how to use it correctly. In addition, a research by Onal and Kulavuz-Onal (2024) has shown that the use of ChatGPT can create very well structured assessment questions in courses and can be effectively used by teachers. However, its correct use by teachers is required. A research by Singer et al. (2023) indicated that the use of ChatGPT by children should be done in an ethical way and its use by teachers should be used with care in the educational process. Furthermore, a research by Strzelecki (2023) showed that the use of ChatGPT in tertiary education appears to have positive learning effects on students' learning, as long as it is used wisely. A study by Bounou et al. (2023) showed that children's good performance in STEM lessons is related to their computational thinking.

### "Mathematical Familiarity": A New Framework of Analysis

In differentiated teaching, lesson plans are created with the aim of each student's involvement in the educational process and avoiding their marginalization (Ginja & Chen, 2023). In social pedagogy, learning and lesson plans are required to involve all students in the learning process and not to exclude any of them (Florian & Beaton, 2018). Taking the above into account, our intention of involving *all* students in the educational process, as well as our interest in providing support to the teachers, led us to introduce the term "mathematical familiarity". *Mathematical familiarity is a measure of the degree of comfort that students with special educational needs feel with the math worksheets provided by the classroom teacher.* In our research, we

look exclusively at two parameters that can influence mathematical familiarity. In particular, we seek to ascertain whether the mathematics worksheets generated by ChatGPT 3.5 consider

- (a) the specific educational requirements of each student and
- (b) their individual interests and preferences.

However, it is our contention that mathematical familiarity is a necessary but not a sufficient condition for learning.

It is evident that educators cannot create individualized worksheet for each student in the class on a daily basis, given that it is a time consuming task. Consequently, we conducted a study to ascertain whether the ChatGPT application could be employed to address this obstacle. Furthermore, we considered that math worksheets, when they have a high degree of mathematical familiarity, can facilitate the achievement of the learning objectives set by the teacher. This hypothesis was largely corroborated by the collected data. Indeed, one of the participating students stated: "What helped me to understand [square] roots and irrational numbers is that I saw the role they have in my [everyday] life. I felt familiar [...]".

## DESCRIPTION OF THE TEACHING INTERVENTION

### The Students' Profile

The children who participated in our research were Georgia and Orestis. These are pseudonyms in order to preserve the anonymity of the participants. In this subsection we report some of the key elements of their personalities:

*Georgia* is a fourteen-year-old 8<sup>th</sup> grade student who has been diagnosed with dyslexia, according to the diagnosis made by the official (public) Center for Interdisciplinary Assessment, Counseling and Support (C.I.A.C.S.). Georgia likes drawing, swimming, and playing volleyball with her classmates. Moreover, she has cultivated some social skills, having developed a close friendship with two classmates of hers. In terms of academic skills, Georgia has low grades and shows no interest in the course. In mathematics, her performance is low since her test scores in the previous semester were below grade level.

*Orestis* is a fourteen-year-old 8<sup>th</sup> grade student who has been diagnosed with ASD according to the certified diagnosis by the C.I.A.C.S. He likes football and often goes walking with his parents. Also, he has developed his social skills to a certain extent by hanging out with a peer of his. As for his academic skills, he has low grades in most of his classes. In terms of math, Orestis is struggling to learn new math concepts and his test score was marginally above grade level.

### Overview of the Project

In the spring semester of the academic year 2023-2024 we implemented a nine-hour teaching intervention with two participants with dyslexia and ASD, attending a general classroom of 25 students in Greece. We focused on the teaching of two basic mathematical concepts; the square root of a positive number and irrational numbers. We chose these concepts since they are considered fundamental to algebra. These concepts, in particular the transition from rational to irrational numbers, are challenging for students all over the world (Rizos & Adam, 2022).

Initially, we visited the school in order to meet the school director and the educator who teaches mathematics in the class attended by the children who would participate in our intervention. At the same time we spoke in a very friendly atmosphere with the families of the two children to inform them about the purpose of our teaching intervention and to obtain their permission. The parents were particularly enthusiastic about the participation of their children in this process and were happy to give us verbal permission.

It should be mentioned that both the director and the teacher of the class fully informed us about the academic skills of the children and about key aspects of their character. We were committed to the fact that any information which would come to our attention would remain confidential and the anonymity of the children and the school they attend would be preserved as well. So, we did not have to get any additional permission.

Furthermore, we also got to know the children. This created a climate of trust with the school teachers, the children's families and the children themselves.

*In the first hour* of our nine-hour intervention, we visited Georgia and Orestis' classroom to find out in practice what the math teacher and the parents told us. Indeed, after the end of the first hour, we realized that the two children were not involved in the lesson. It is important to mention that throughout the project, our role was simply to observe the educational process, without intervening in any part of the lesson. In the afternoon, using ChatGPT 3.5, we created lesson plans and corresponding worksheets for Georgia and Orestis, taking into account the current curriculum (see [Appendix A](#)). Note that we replaced the units of measurement with those used in Greece (e.g., yards → meters).

*In the second hour*, the teacher revised the lesson "power of a number" so as to introduce the concept of the square root of a natural number. Then, the teacher gave out worksheets to the 23 students in the class while the 2 students with special educational needs were given the worksheets we provided and created by ChatGPT. In addition, he distributed a calculator and a square root table to the students. The teacher, following the lesson plan (see [Appendix B](#)), talked to the students about the concept of the square root and wrote several examples on the whiteboard. The first two worksheet exercises of all the students' worksheets were computational tasks (e.g., find out the square root of 9) and were completed without significant difficulty.

*In the third hour*, the students took out the worksheets that the teacher had given them the previous hour in order to solve the remaining two exercises, which were two problems. For the two students with special educational needs, the last problem was a problem based on their interests and preferences, which excited them.

More specifically, for Georgia there was a problem related to swimming pools, which she really liked: "Imagine you are designing a swimming pool with a square shape. If the area of the pool is 100 square meters, what is the length of each side of the pool? Use the square root to find the answer" (see [Appendix C](#)). Georgia said: "Hmm, nice! It's talking about swimming. I love swimming".

For Orestis, there was a problem with a park, which excited him: "Picture yourself going on a walk with your parents. If the area of the park you're walking in is 81 square meters, what is the length of each side of the park? Use the square root to find the answer" (see [Appendix C](#)). Orestis said: "I like this problem. It refers to a walk in the park. I often go there".

Both students interpreted these problems correctly. In fact, without any prompt, they drew a diving board in the pool and trees in the park correspondingly to the shapes they were asked to sketch.

*In the fourth hour* of our intervention, the teacher gave the students worksheets with three more difficult exercises about the square root of a positive number. Georgia and Orestis were given worksheets created by ChatGPT 3.5. In these worksheets there were two computational exercises and one exercise related to the interests and preferences of the students.

More specifically, for Georgia there was a problem related to a volleyball court, which excited her again: "Imagine the dimensions of a volleyball court are given by a square with an area of 900 square meters. What is the length of one side of the volleyball court? Draw a volleyball court to represent your answer" (see [Appendix C](#)). Georgia said: "I would like all the exercises to be like this problem".

The problem for Orestis was a problem about a football field, which excited him quite a bit: "Imagine a football field with a length of 48m and a width of 36m. Calculate the diagonal length of the football field using the Pythagorean theorem" (see [Appendix C](#)). In particular, Orestis said: "Hmm... I like this worksheet". The two students completed the worksheet exercises correctly, which impressed the class teacher.

*In the fifth hour*, the instructor administered a standardized test to all 25 students in the class, prior to commencing the unit on square roots. The test, which lasted twenty minutes, consisted of two exercises (see [Figure 1](#)).

Both Georgia and Orestis demonstrated proficiency in responding to the two exercises presented in the test. The teacher informed us that the two students almost never scored well in math tests, and the current results were a notable change from this trend.

*In the sixth hour* of the intervention, the concept of the square root was briefly revised and the lesson moved on to the concept of irrational numbers. In this context, the teacher distributed the same worksheet

**Square roots**  
**Test (20')**

Name: \_\_\_\_\_

1. Find the numerical value of the expression

$$A = \sqrt{\frac{\sqrt{4}}{2} + \sqrt{9}}$$

2. In the following figure find  $a$  and  $b$ .

**Figure 1.** The test on square roots (Source: Authors)

to the 23 students, while the two students with special educational needs were given two different worksheets created by ChatGPT 3.5. Once again, all students in the class were provided with a calculator and a square root table. All worksheets included 4 exercises. The teacher, following the lesson plan (see [Appendix B](#)), explained the concept of an irrational number on the whiteboard, gave some examples, and then asked the students to solve the first two exercises. He also encouraged them to ask for help if need be.

*In the seventh hour of our intervention*, the students completed the remaining two exercises on their worksheet. The students with special educational needs completed correctly the last two problems, which were related to their interests and preferences. Georgia said: "I'd like all the courses to have such exercises", while Orestis said: "I want the math class to be like this".

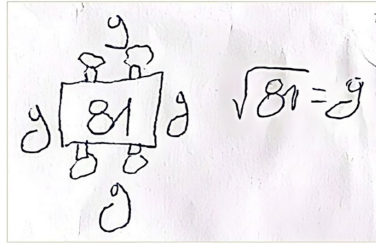
*In the eighth hour*, the teacher gave the students worksheets which consisted of three, more difficult exercises. Georgia and Orestis were given worksheets with three exercises, which were provided by the ChatGPT 3.5. The exercises related to the interests of both children, were almost correctly answered.

*In the last hour*, the teacher gave all the students in the class a test with exercises on irrational numbers. And this test lasted twenty minutes. Georgia and Orestis solved the exercises in a short period of time, which surprised the class teacher again.

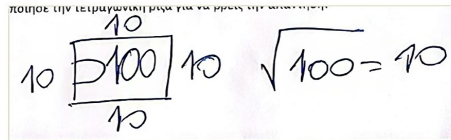
## METHODOLOGY

The strategy we followed was Denzin's (2009) multiple triangulation, according to which different methods of data collection are used in different time periods and the participation of researchers with different roles and expertise is promoted. More specifically, in terms of evaluation, there were the students, the teacher and the researchers, in terms of the time of the intervention, there was the study of the students' files implemented before the intervention, the students' reactions during the intervention and the use of an e-questionnaire through the Wordwall effect. Furthermore, as regards students' perceptions of mathematics, we have relevant information from the teacher and the parents of the participants, the support of students during the teaching with lesson plans and the use of e-questionnaires through the Wordwall effect. The reliability and validity of the data within this framework can be adequately substantiated.

To be able to get the lesson plans from ChatGPT 3.5 we used appropriate prompts in English (see [Appendix A](#)). For example, we started with the prompt:



**Figure 2.** Orestis drew trees on the worksheet (Source: Authors)



**Figure 3.** Georgia drew the diving board (Source: Authors)

I want you to act as a high school math teacher. I will provide you with the curriculum for high school mathematics, as well as the elements of the two units you will teach, and your job is to prepare a lesson plan.

In addition, there was a prompt that referred to the special needs, interests and hobbies of the students, in order to take a worksheet that accurately reflects the students (see [Appendix C](#)). For instance, one of the prompts we gave was the following:

Based on the above, I want you to create 2 worksheets: one for the square root section, and one for the irrational numbers section. But be careful: These worksheets are for a student with dyslexia but with developed social skills who likes to draw, swim, and play volleyball with her friends. I want you to take the student's specificities and interests into account and adapt the two worksheets accordingly.

The students were very enthusiastic about the worksheets and the problems they contained expressed exactly their interests. In particular, there was a problem in the worksheet that referred to a walk in the park and Orestis when solved it drew trees on the worksheet (see [Figure 2](#)). In addition, in the worksheet where there was a problem involving a swimming pool, Georgia drew the diving board, which shows the "mathematical familiarity" that she feels with the problem she is trying to figure out (see [Figure 3](#)).

Then, we asked ChatGPT to create two more worksheets with more difficult exercises for the students. The prompt we gave was the following:

I want you to create 2 more worksheets for the same student: one for the square root section, and one for the irrational numbers section. But be careful: I want this time the worksheets to include tasks that involve the Pythagorean theorem, as well as advanced numerical expressions involving square roots.

The worksheets were again given to the students who were once again excited, as the problems they contained again expressed their preferences and interests. Actually, Orestis was asked to draw a square logo on a T-shirt, he painted it red, which was the color of his favorite football team (see [Figure 4](#)). Moreover, when he was asked to draw a football field on a rectangular grid, he also drew the large area around the two goal posts.

Furthermore, when Georgia was requested to create a scenario utilizing the concept of irrational numbers with the objective to enhance her volleyball experience, she drew a square with a side length of one, and then drew the diagonal of the field (see [Figure 5](#)) and wrote: "I can identify the diagonal  $d$ , which is an irrational number, and determine the trajectory of the ball". Georgia is an enthusiastic volleyball player who is aware that an opposite hitter (or right-side hitter) must possess strong diagonal hitting abilities and technical skills.



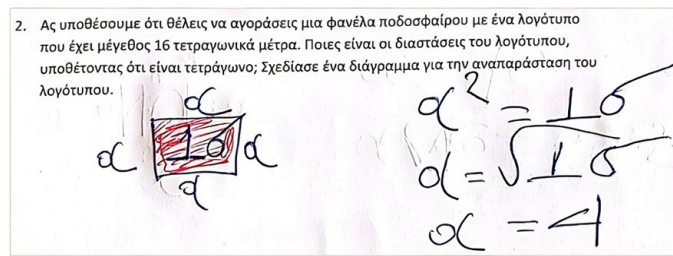


Figure 4. Orestis drew a logo on the T-shirt, and he painted it red (Source: Authors)

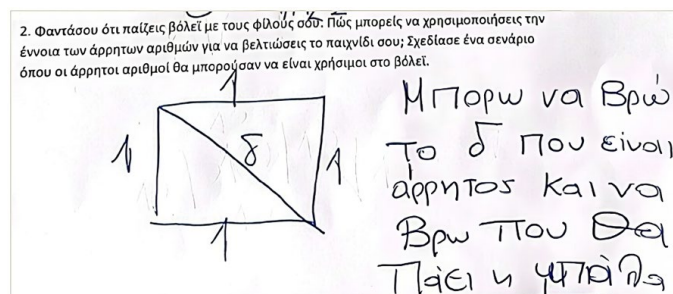


Figure 5. Georgia drew the diagonal of the court (Source: Authors)

We believe that the student's response (and) to this exercise reflects her increased involvement in the educational process.

The test that we gave to all students in the class contained two exercises in square roots and irrational numbers, similar to those in the Greek high school textbook, which is unique for all Greek students. More specifically, the textbook contains elements of algebra (e.g., first-order equations and inequalities) and geometry (e.g., areas and the Pythagorean theorem).

The data of the research were collected through three open-ended questions, which were simply structured due to the specific learning difficulties that the students faced in the content of written language. These three questions were incorporated into a semi-structured interview, which gives the researcher the opportunity to change the topics in case of need (Knott et al., 2022).

The interviews were separate for each student and took place during school hours. In particular, after consultation with the music teacher and the English teacher, we met the children and carried out the interviews. The questions we asked Georgia and Orestis are the following:

- Q1. What was it that you liked and were impressed by in the worksheets in the square root of a positive number and in the irrational numbers?
- Q2. Did these worksheets help you understand the concepts of square root and irrational numbers and write well in the test?
- Q3. Do these worksheets make the mathematics course more attractive to you?

Student's answers were relatively short and simple due to the difficulties they face with speech. The method we chose to analyze the data was contingency analysis (Abreu et al., 2022). More specifically, an initial coding of the data obtained from the interviews of the two students was implemented (Table 1, Table 2, and Table 3). Table 4 shows subjects areas.

It should be mentioned that we also asked the class teacher about students' attitudes towards the worksheets we created from the ChatGPT. The teacher confirmed that he noticed the students been engaged in the lesson, something he had not observed this year or last year. He also reported that the students showed particular interest in mathematics and understood the mathematical terms they were asked to learn, a fact confirmed by the test where they completed all the exercises almost correctly.

From the analysis of the data obtained from the interviews we conducted, both students had difficulties in mathematics probably because the exercises and problems taught had no relation to their everyday life and their interests, which did not happen with the ChatGPT worksheets. In particular, Georgia reported: "I didn't like mathematics at all because it was a subject I didn't understand [...]. With these worksheets I saw

**Table 1.** Q1. What was it that you liked and were impressed by in the worksheets in the square root of a positive number and in the irrational numbers?

Interview extract	Codes
<i>Georgia:</i> What impressed me was that there were exercises with familiar topics. For example, the volleyball court and the swimming pool made me try to find the solution.	B & A
<i>Orestis:</i> What I liked about the worksheets was that my teacher made them just for me. There were exercises that referred to my interests, such as football and walking activities [...] Yes, I felt comfortable.	B & A

**Table 2.** Q2. Did these worksheets help you understand the concepts of square root and irrational numbers and write well on the test?

Interview extract	Codes
<i>Georgia:</i> Yes, I saw the role they [square roots and irrational numbers] have in my everyday life. I felt familiar [...]. Well, maths is, in general, a boring subject for me. But I think I did very well in the tests.	B, A, & C
<i>Orestis:</i> The worksheets came from activities I do in the afternoon. So I wanted to find the solutions. They would help me to do better [...]. This helped me understand [the concepts of irrational numbers and square roots] and write well in the tests. Generally, I don't write well in tests.	B, A, & C

**Table 3.** Q3. Do these worksheets make the mathematics course more attractive to you?

Interview extract	Codes
<i>Georgia:</i> Yes, of course! I didn't like mathematics at all because it was a subject I didn't understand [...] With these worksheets I saw that maths is useful and I can use it in my hobbies.	B, A, & C
<i>Orestis:</i> Definitely yes! I would like from now on [maths] to be like that. I see [how it applies] in my life, I feel familiar, and I understand it!	B, A, & C

**Table 4.** Subjects areas

Codes	Symbols
Positive impact of worksheets on students with special educational needs.	A
The emergence of mathematical familiarity.	B
Understanding of mathematical terms through worksheets.	C

that math is useful and I can use it in my hobbies". Orestis reported: "The worksheets have to do with activities I do in the afternoon. So I wanted to find the solutions. They would help me to do better".

In addition, the term "mathematical familiarity" mentioned in the theoretical framework is evident in all students' responses to all the questions they received. The students responded in the interviews that the worksheets were relevant to their interests, preferences and hobbies, which helped them to engage with the problems and exercises given by the worksheets and to understand the mathematical concepts taught. Georgia's response is typical: "I saw the role they [square roots and irrational numbers] have in my [everyday] life. I felt familiar".

In view of all this, the use of the ChatGPT worksheets for learning mathematical concepts seems to have positive learning outcomes for children with special educational needs. Initially, the students had difficulties in mathematics and their test scores were poor. However, with the use of these worksheets, they understood, at least to some extent, the mathematical concepts of square root of positive number and irrational numbers, and were able to score high marks on the tests set by the teacher.

The worksheets were constructed based on the preferences, interests and hobbies of students with special educational needs, so as to engage them as much as possible in the lesson. In particular, as it can be seen from their responses to the interviews, the students were enthusiastic and at the same time understood the mathematical concepts they were asked to learn, as evidenced by their results in the tests which were common for all students in the class.

Finally, we created an e-questionnaire with three questions about the worksheets that Georgia and Orestis would answer on a Likert scale of 1-5. More precisely, 1 corresponds to "strongly disagree", 2 corresponds to "disagree", 3 corresponds to "neutral", 4 corresponds to "agree" and 5 corresponds to "fully agree". The questions were as follows:

1. Do the problems on the worksheet match my interests and preferences?
2. Were the worksheets interesting?

### 3. Would I prefer math lessons to be done with similar worksheets?

Georgia and Orestis answered the three questions by marking the number 5. Therefore, the term “mathematical familiarity” appears to exist in the worksheets, since both students were in complete agreement.

The online questionnaire, created on Wordwall, comprises three questions with a straightforward structure, as children with ASD and dyslexia often have difficulty comprehending the content of written sentences. The method employed for the analysis of the survey data is content analysis, a technique suited to the examination of data derived from interviews and the extraction of detailed information (Abreu et al., 2022). This method serves to enhance the reliability and validity of the data (Bartholomew & Lockard, 2018).

## DISCUSSION, SUGGESTIONS, AND LIMITATIONS

Generative AI and in particular ChatGPT, will be a challenge for educational policy in the coming decades. In this research we implemented a teaching intervention to include all children with special educational needs in the educational process in the current inclusive school. Furthermore, we combined basic principles of differentiated instruction and social pedagogy in order to include two specific participants in the math class through differentiated worksheets, which we created with ChatGPT 3.5.

Our intervention was implemented with the aim of creating worksheets for the teaching of mathematics from the application of ChatGPT to two 8<sup>th</sup> grade students with dyslexia and ASD in the context of the general classroom. Through this process, the participants were involved in problems the topics of which were influenced by their interests, hobbies and preferences, with the intension of enhancing the students’ interest in mathematics – a lesson which is usually difficult for them.

The use of ChatGPT to create differentiated worksheets for mathematics seems to have positive learning outcomes, a fact that is confirmed by the literature (Awofala & Lawani, 2020; Hackenberg et al., 2021; Lai et al., 2020; Pozas et al., 2020). In addition, the use of ChatGPT during the lesson in the classroom seems to have a positive impact, which is in line with the literature (Hasanah & Nurcholis, 2024; Sánchez-Ruiz et al., 2023; Siegle, 2023; Wardat et al., 2023). Furthermore, by differentiating the teaching due to the worksheets of mathematical terms, it seems that the participation of all children in the learning process was achieved, something which is expected from the literature (Alsolami, 2022; Gheysens et al., 2022; Puzio et al., 2020; Rowan et al., 2021; Tomlinson et al., 2003). Furthermore, the degree of mathematical familiarity that appears on the differentiated worksheets gives a sense of safety, enjoyment and not being distracted by other classmates during the lesson for both students with dyslexia and ASD, thus meeting their special educational needs (Malberg, 2021; Tomlinson, 2012).

Some of the benefits that emerged from our research are the following:

1. Understanding the concept of the square root of a positive number and of irrational numbers.
2. Increasing students’ engagement by using differentiated worksheets from ChatGPT.
3. The mathematics course is made more attractive by using worksheets with exercises that match students’ preferences.
4. Students understand that the newly acquired knowledge can be applied in both the context of solving exercises and in real-life scenarios.
5. Teachers are able to prepare individualized worksheets for each student in the class, within a reasonable time frame.

However, there were some limitations:

1. The number of participating students. We estimate that if the number of students with special educational needs in the classroom was higher, it would be difficult to implement our intervention.
2. The two students with special educational needs had increased social skills (as reported by the classroom teacher) and had the same behavior in the classroom despite our presence. If the students had reduced social skills, then they may have been affected by our involvement.

3. The way each teacher interacts with generative AI applications plays a crucial role in the creation of worksheets. In particular, the way in which the teacher gives prompts in ChatGPT is important in the creation of worksheets.

Thus, the research questions posed have positive answer. More specifically, regarding the first research question, ChatGPT took into account the special educational needs of students when creating lesson plans and worksheets, with clear and concise language. Regarding the second research question, it is evident that ChatGPT took into account students' interests in order to create the appropriate lesson plans and worksheets. This is confirmed by the students' views.

Based on all of the above, we propose the following suggestions:

1. We already had the lesson plans ready and gave them to the teacher to implement the lesson of the two math units. However, we believe that it will have better results if the teacher makes the lesson plans during the lesson.
2. Training of educators in the use of ChatGPT. All educators should be trained in the use of ChatGPT with special seminars so that they know how to use it.
3. Free access to the new version of ChatGPT-4 by all schools and all teachers in the future. More specifically, all schools should have the new version of ChatGPT-4 available and teachers should have access to it.
4. Simultaneous use of ChatGPT and the critical ability of each teacher during its use. In particular, the teacher should evaluate each worksheet based on his knowledge and teaching experience, and then give it to the students. Thus, the role of the teacher in the successful outcome of teaching is highlighted.

What has been mentioned above are some of the results of using an application of generative AI in the teaching of mathematics in the modern school, without restrictions and discriminations. ChatGPT can be used as a tool to engage all children and their understanding of mathematical concepts and terms. Differentiated worksheets that address the specific educational needs, preferences and interests of each student in the class with the simultaneous use of ICT is a teaching practice for teaching algebra and geometry.

The pedagogical benefit of the intervention was that the students had an active role in the course, developed a positive attitude towards mathematics and the learning objectives set at the beginning of the course were successfully implemented. In addition, the class teacher also benefited as we provided ideas and good practice to use in the creation of appropriate worksheets for the mathematics lesson.

The term "mathematical familiarity", if we take into account the special needs of the participating students, the curriculum and their interests and preferences, is a parameter that we give to the worksheets. It seems that the worksheets we created from ChatGPT inspire a high degree of mathematical familiarity in students, as they match their preferences and interests as well as the needs of each student.

For children with dyslexia and ASD, teacher's effective use of ChatGPT can help them to deepen their knowledge in mathematics, as opposed to traditional teaching, where the educator teaches mathematical concepts and terms in a formalistic way, ignoring the specific needs of each child in the class, providing notes on the board that all children must copy in a mechanical way. By using this resource in a rigorous and critical way, students learn and master new knowledge through examples of their daily life and interests, thus increasing their active participation in learning.

## CONCLUSION

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The objective of this research was to ascertain whether the ChatGPT application is capable of effectively addressing the specific educational needs and interests of students in order to create personalized lesson plans and worksheets for them in mathematics. The qualitative research conducted in our nine-hour teaching intervention with two children with ASD and dyslexia in a general class of twenty-five students yielded positive learning results. The differentiated math worksheets created using ChatGPT 3.5 in the math units of square root of a positive number and irrational numbers, two important math units, were found to be highly familiar with math and made the two participants feel secure and confident while actively engaging them in the learning process. The contribution of this study is significant in that it enables teachers to develop

individualized mathematics lesson plans for students with special educational needs in a relatively short period of time. The teaching staff is now in a position to utilize the ChatGPT application to devise lesson plans of their own choosing, provided that they interact in an appropriate manner with the AI and provide clear prompts. It can be concluded that the ChatGPT application can be effectively used in the education of children with (or without) special educational needs, provided that teachers are adequately trained in its use. As the subject of this research is still relatively new, a future study could investigate the potential of teaching different mathematical modules based on other similar AI applications, with a greater number of participants.

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**Data availability:** Data generated or analyzed during this study are available from the authors on request.

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## APPENDIX A

The prompts we gave ChatGPT to create lesson plans.

I want you to act as a high school math teacher. I will provide you with the curriculum for high school mathematics, as well as the elements of the two units you will teach, and your job is to prepare a lesson plan. Do you agree?



Absolutely! I'd be happy to help you prepare a lesson plan based on the provided curriculum and units. Please go ahead and provide me with the details for the two units you'd like to focus on, along with any specific topics or concepts within those units. Once I have that information, I'll get started on crafting the lesson plan for you.

The Curriculum and the elements of the two units are: "The purpose of teaching the Mathematics course is part of the general aims of Education and concerns the contribution to the completion of the student's personality and his successful social integration, since Mathematics exercises the student in methodical thinking, in analysis, abstraction, generalization, application, criticism and logical processes and they teach him to formulate his thoughts with order, clarity, simplicity and precision. Mathematics develops observation, attention, the power of self-concentration, perseverance, initiative, creative imagination, free thinking, cultivates a sense of harmony, order and beauty and stimulates the critical spirit. They are essential in everyday life and especially in the workplace but also for the development and evolution of other sciences and especially Technology, Economics and Social Sciences. In particular, the unity of the square root of a positive number can be taught with reference to the area of a square. After 3 hours of instruction, students should be able to: a) know the meaning of the square root symbol, b) calculate square roots of positive numbers by trial, with the help of tables and with the calculator. Also, the irrational numbers unit, which will be taught for 3 hours immediately after the square root unit, aims for students to recognize that there are numbers that cannot be written as fractions in whole terms. The concept of irrationality makes it difficult for students. For example, they often assume that "the square root of 2 does not exist." Such misconceptions need to be identified and discussed as it is important that students are supported to develop the concept of real number correctly. In this direction, it is proposed to discuss in the class topics related to basic properties of continuity of real numbers and the number line, with simple questions such as: "What is the smallest positive real number?", "What is the 'next' real number of 1?", "Can we always find a rational/irrational between two others?"



Thank you for providing the curriculum and the elements of the two units. Based on this information, here's a lesson plan for the square roots and irrational numbers units:

## APPENDIX B: THE LESSON PLANS CREATED BY CHATGPT

### Unit 1: Square Roots

**Objective:** After 3 hours of instruction, students should be able to:

- (a) understand the meaning of the square root symbol and
- (b) calculate square roots of positive numbers by trial, with the help of tables, and with a calculator.

#### *Lesson 1: Introduction to square roots (60 minutes)*

**1. Engagement (10 minutes):**

- Begin with a brief discussion on the importance of square roots in everyday life and applications in various fields such as science, technology, and economics.
- Pose questions to prompt critical thinking: "Why do we need to understand square roots?" "What are some real-life examples where square roots are used?"

**2. Conceptual understanding (20 minutes):**

- Define square roots and introduce the square root symbol ( $\sqrt{\quad}$ ).
- Discuss the relationship between squares and square roots using visual aids such as diagrams or geometric shapes.
- Provide examples of calculating square roots manually.

**3. Practice (20 minutes):**

- Distribute worksheets or provide problems on the board for students to solve individually or in pairs.
- Encourage students to use trial and error, tables, or calculators to find square roots.

**4. Reflection (10 minutes):**

- Review solutions to practice problems and address any questions or misconceptions.
- Summarize key concepts learned in the lesson.

#### *Lesson 2: Exploring square roots further (60 minutes)*

**1. Review (10 minutes):**

- Briefly recap the previous lesson's key concepts and discuss any questions or issues that arose during practice.

**2. Application of square roots (20 minutes):**

- Introduce real-life scenarios where square roots are applicable, such as calculating areas of squares and solving problems involving measurements.
- Guide students through practical examples and encourage them to apply square root calculations.

**3. Technology integration (20 minutes):**

- Demonstrate how to use calculators or online tools to efficiently calculate square roots.
- Provide opportunities for students to practice using technology to find square roots.

**4. Collaborative activity (10 minutes):**

- Divide students into small groups and assign them a problem-solving task that requires the application of square roots.
- Encourage collaboration and discussion among group members.

### Unit 2: Irrational Numbers

**Objective:** Help students recognize that there are numbers that cannot be written as fractions in whole terms and develop a correct understanding of real numbers.

#### *Lesson 3: Introduction to irrational numbers (60 minutes)*

**1. Engagement (10 minutes):**

- Start with a thought-provoking question: "Can you write the square root of 2 as a fraction?" Encourage students to think critically about the question.

**2. Conceptual understanding (20 minutes):**

- Define irrational numbers and explain that they cannot be expressed as fractions.

- Discuss common misconceptions about irrational numbers, such as assuming they do not exist.

**3. Exploration (20 minutes):**

- Engage students in activities that demonstrate the existence of irrational numbers, such as geometric constructions or numerical examples.
- Use visual aids and interactive demonstrations to enhance understanding.

**4. Reflection (10 minutes):**

- Facilitate a class discussion on the challenges and misconceptions related to irrational numbers.
- Encourage students to reflect on their learning and share any new insights gained.

**Lesson 4: Properties of real numbers (60 minutes)**

**1. Review (10 minutes):**

- Recap the previous lesson's key concepts and address any lingering questions or concerns.

**2. Number line and continuity (20 minutes):**

- Introduce the concept of the number line and discuss its role in representing real numbers.
- Explore the idea of continuity and the infinite nature of the real number line.

**3. Exploration of rationality (20 minutes):**

- Pose questions such as "What is the smallest positive real number?" and "Can we always find a rational/irrational number between two others?" to provoke critical thinking.
- Engage students in discussions and activities that explore the density of rational and irrational numbers on the number line.

**4. Application (10 minutes):**

- Provide real-world examples that illustrate the relevance of understanding real numbers and their properties.
- Encourage students to apply their knowledge of irrational numbers in solving practical problems.

**Conclusion**

By the end of these lessons, students should have a solid understanding of square roots, irrational numbers, and their applications in real-life contexts. Continuous assessment and reinforcement of key concepts will be essential to ensure student mastery and address any misconceptions that may arise.

## APPENDIX C

The prompts we gave ChatGPT to create worksheets, and the worksheets created by ChatGPT.

Based on the above, I want you to create 2 worksheets: one for the square root section, and one for the irrational numbers section. But be careful: These worksheets are for a student with dyslexia but with developed social skills who likes to draw, swim, and play volleyball with her friends in the local volleyball team. I want you to take the student's specificities and interests into account and adapt the two worksheets accordingly.



### Worksheet 1: Square Roots

Name: \_\_\_\_\_

#### Instructions:

- Read each question carefully.
- Use your understanding of square roots to solve the problems.
- Feel free to draw diagrams or use visual aids to help you.

#### 1. Square root introduction:

- Draw a square and label its side length as 4 units. Calculate the square root of the area of the square.
- Imagine you have a garden shaped like a square with an area of 25 square meters. What is the length of one side of the garden?

#### 2. Calculating square roots:

- Find the square root of each of the following numbers:
  - 9
  - 16
  - 25
- Draw a picture representing each square root and its corresponding square.

#### 3. Real-life application:

Imagine you are designing a swimming pool with a square shape. If the area of the pool is 100 square meters, what is the length of each side of the pool? Use the square root to find the answer.

#### 4. Square roots and volleyball:

Imagine the dimensions of a volleyball court are given by a square with an area of 900 square meters. What is the length of one side of the volleyball court? Draw a volleyball court to represent your answer.

### Worksheet 2: Irrational Numbers

Name: \_\_\_\_\_

#### Instructions:

- Read each question carefully.
- Use your understanding of irrational numbers to answer the questions.
- Feel free to draw diagrams or use visual aids to help you.

#### 1. Exploring irrational numbers:

Imagine a rectangle with side lengths of 2 meters and 3 meters. Calculate the area of the rectangle. Is the area a rational or irrational number? Draw a rectangle to represent your answer.

#### 2. Identifying irrational numbers:

For each of the following numbers, state whether they are rational or irrational:

- $\sqrt{9}$
- $\sqrt{10}$
- $\sqrt{25}$

**3. Real-life application:**

Imagine you are playing volleyball with your friends. How can you use the concept of irrational numbers to improve your game? Draw a scenario where irrational numbers might be useful in volleyball.

**4. Irrational numbers and drawing:**

Can you always find a rational or irrational number between two other numbers? Explain your reasoning and draw examples to support your answer.

**Bonus question:**

Can you think of a real-life situation where knowing about irrational numbers might be useful when playing volleyball, swimming, or drawing? Describe the situation and how understanding irrational numbers could help.

I want you to create 2 more worksheets for the same student: one for the square root section, and one for the irrational numbers section. But be careful: I want this time the worksheets to include tasks that involve the Pythagorean Theorem, as well as advanced numerical expressions involving square roots.

**Worksheet 3: Square Roots and Pythagorean Theorem**

**Name:** \_\_\_\_\_

**Instructions:**

- Read each question carefully.
- Use your understanding of square roots and the Pythagorean theorem to solve the problems.
- Feel free to draw diagrams or use visual aids to help you.

**1. Pythagorean theorem practice:**

- Imagine a right triangle with legs of lengths 3 units and 4 units. Calculate the length of the hypotenuse using the Pythagorean theorem.
- Draw a diagram representing the right triangle and label the sides.

**2. Advanced square root expressions:**

Evaluate each of the following expressions:

- $\sqrt{16 + 9}$
- $\sqrt{25 - 16}$
- $\sqrt{(3 \times 2)^2 + 5^2}$

**3. Real-life application:**

How can understanding irrational numbers help you better enjoy watching football matches? Think about the dimensions of the football field, player movements, and strategies. Describe your thoughts.

**4. Square roots and volleyball:**

Consider a volleyball court with dimensions of 18 meters by 12 meters. What is the length of the diagonal of the volleyball court? Use the Pythagorean theorem to find the answer. Draw a volleyball court to represent your answer.

**Worksheet 4: Irrational Numbers and Advanced Expressions**

**Name:** \_\_\_\_\_

**Instructions:**

- Read each question carefully.
- Use your understanding of irrational numbers and advanced expressions to answer the questions.
- Feel free to draw diagrams or use visual aids to help you.

**1. Advanced square root expressions:**

Evaluate each of the following expressions:

- $\sqrt{24}$
- $\sqrt{50}$
- $\sqrt{108}$

**2. Identifying irrational numbers:**

Determine whether each of the following numbers is rational or irrational:

- a.  $\sqrt{16}$
- b.  $\sqrt{27}$
- c.  $\sqrt{64}$

**3. Real-life application:**

Imagine you are designing a swimming pool with a length of  $\sqrt{40}$  meters and a width of  $\sqrt{45}$  meters. What is the area of the swimming pool? Use irrational numbers in your calculation. Draw a diagram to represent the swimming pool.

**4. Irrational numbers and drawing:**

Draw a picture of a volleyball match in progress. Label the dimensions of the volleyball court using both rational and irrational numbers (e.g., lengths of  $\sqrt{100}$  meters and  $\sqrt{225}$  meters).

**Bonus question:**

Can you think of a real-life situation where knowing about advanced numerical expressions involving square roots might be useful when playing volleyball, swimming, or drawing? Describe the situation and how understanding these expressions could help.

I want you to create 2 more worksheets: one for the square root section, and one for the irrational numbers section. But be careful: These worksheets are for a student with autism spectrum disorder who is not very social. The student likes playing and watching football, as well as going on walks with his parents. I want you to take the student's specialties and interests seriously, and adapt the two worksheets appropriately.

**Worksheet 5: Square Roots for Football Fans**

**Name:** \_\_\_\_\_

**Instructions:**

- Read each question carefully.
- Use your understanding of square roots to solve the problems.
- Feel free to use football-related scenarios to help you understand the questions.

**1. Football field dimensions:**

Imagine a football field with a length of 100 yards and a width of 53.3 yards. Calculate the diagonal length of the football field using the Pythagorean theorem.

- Hint: The diagonal forms a right triangle with the length and width of the field.

**2. Square root expressions:**

Evaluate each of the following expressions:

- a.  $\sqrt{144}$
- b.  $\sqrt{225 - 64}$
- c.  $\sqrt{(7 \times 3)^2 + 4^2}$

**3. Real-life application:**

Suppose you want to buy a football jersey with a logo that measures 16 square inches. What are the dimensions of the logo, assuming it is a square? Draw a diagram to represent the logo.

**4. Football match dimensions:**

Consider a football pitch with dimensions of 105 meters by 68 meters. What is the length of the diagonal of the football pitch? Use the Pythagorean theorem to find the answer.

## Worksheet 6: Irrational Numbers for Nature Walks

Name: \_\_\_\_\_

### Instructions:

- Read each question carefully.
- Use your understanding of irrational numbers to answer the questions.
- Feel free to relate the questions to your experiences on nature walks with your parents.

### 1. Nature walk distances:

During a nature walk, you walk 3 kilometers north and then 4 kilometers east. How far are you from your starting point? Use the Pythagorean theorem to find the distance.

- Hint: Imagine you're walking along the sides of a right triangle.

### 2. Identifying irrational numbers:

Determine whether each of the following numbers is rational or irrational:

- a.  $\sqrt{25}$
- b.  $\sqrt{40}$
- c.  $\sqrt{81}$

### 3. Real-life application:

Picture yourself going on a walk with your parents. If the area of the park you're walking in is 81 square meters, what is the length of each side of the park? Use the square root to find the answer.

### 4. Nature walk distances:

Suppose you go on a walk with your parents in a forest. If you walk 2 kilometers north and then 5 kilometers east, what is the shortest distance back to your starting point? Use the Pythagorean theorem to find the answer.

### 5. Irrational numbers and football:

Draw a picture of your favorite football field. Label the dimensions using both rational and irrational numbers (e.g., lengths of 5 meters and  $\sqrt{10}$  meters).

