



## The Contribution of the Smart Board to the Improvement of Learning Results in the Subject of Mathematics

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### ARTICLE INFO

*Keywords:* Smart Board, Student Outcomes, Mathematics, Technology in Education, Students

*Received :* 22, October

*Revised :* 21, November

*Accepted:* 30, December

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### ABSTRACT

This research aims to explore the contribution of the Smart Board in improving students' results in mathematics. The main goal of our research is to reveal and understand how the Smart Board contributes to the improvement of students' results in the subject of mathematics. With a special focus on upper secondary school students, this study uses qualitative methodology to understand the contribution of technology to the learning process and students' skills. Teachers and students were interviewed to highlight their perceptions and experiences regarding the use of the Smart Board. The results provide a clear look at the role and value of the Smart Board in mathematics classrooms, addressing potential issues and making recommendations for more successful use of this technology in education. This research contributes to the existing literature related to the use of technology in the field of education and brings a new perspective on the use of the Smart Board in the context of mathematics in the classroom. The results of this research confirm that the Smart Board has a positive impact on the mathematics learning process and student motivation. Detailed discussion of these points will provide a rich and concise summary of the findings and their implications for the field of education.

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## INTRODUCTION

Technology has made great strides in the field of education, bringing new opportunities and innovative methodologies for student learning. In this context, the Smart Board is a remarkable tool that has entered school classrooms, providing an interactive and dynamic platform for learning mathematics. This research paper aims to examine in depth the contribution of the Smart Board in improving learning outcomes in this core subject. Learning mathematics is a real challenge for many students, and technological interventions, such as the Smart Board, have brought about a significant change in the way this subject is conveyed and understood. The use of technology in mathematics education is not simply a change in the learning environment but is an investment in improving the teacher experience and student outcomes.

The Smart Board offers a combination of technology, visualization, and interactivity, creating a learning environment that can help uncover deep mathematical understanding. Through its capabilities for displaying dynamic images, manipulating figures, and using specialized applications, the Smart Board serves as a powerful tool to explain complex mathematical concepts more clearly and engagingly. This research will focus on the analysis of the benefits of using the Smart Board in teaching mathematics and its impact on improving student results. By examining case studies, teacher evaluations, and student perceptions, we aim to identify the concrete advantages that the Smart Board brings to the context of mathematics learning and provide a clear perspective on its role in improving students' knowledge and skills in these critical areas of knowledge.

### The Purpose of the Research

The main goal of our research is to reveal and understand how the Smart Board contributes to the improvement of students' results in the subject of mathematics. Through the analysis of teachers' and students' perceptions, as well as through the assessment of student's performance, we aim to identify the advantages and challenges of using this technology in this context.

### Research Objectives

The objectives of the research are formulated to define and help to achieve the main goal of the research, addressing the challenges and providing a stable basis for evaluating and interpreting the results. Here are the main objectives of the research:

- To identify teachers' perceptions on the use of Smart Board
- To explore the perceptions and experiences of students on the Smart Board
- To evaluate the impact of using the Smart Board on learning outcomes
- To identify the Smart Board layouts that are most effective in mathematics lessons
- Recommend Smart Board layouts and applications that are most effective in the context of mathematics learning.

- To provide recommendations for the use of the Smart Board in mathematics lessons

### **Research Questions**

1. How does the use of the Smart Board contribute to the improvement of students' results in mathematics?
2. How do teachers perceive the impact of using the Smart Board in the learning process in mathematics?
3. What experiences do students have with the use of the Smart Board and how do they evaluate this tool in mathematics lessons?
4. In which mathematical concepts have the use of the Smart Board influenced the subject of mathematics from the student's perspective?
5. What are the main challenges that teachers and students face in using the Smart Board in mathematics lessons?

### **LITERATURE REVIEW**

Mathematics teachers are challenged with the task of preparing who can use technology as an essential tool in developing a deep understanding of mathematics for themselves and their students. Recent teacher trends have emphasized the importance of learning with technology instead of learning about technology (Li, 2003). One of the new technological advances that are widely used in the classroom today is a Smart Board to increase a student's knowledge and motivation (Rakes, Flowers, Casey, & Santana, 2006; Siemens & Matheos, 2010; Knezek, Christensen, Bell, & Bell, 2006). The technological capabilities of the Smart Board and its accompanying software are very compelling to students, effectively engaging them in the learning content. Investing financial and human resources in smart board technology is seen as warranted in part because it promises to make learning more engaging for students, especially in technical subjects (eg math) in which teachers sometimes struggle in their efforts to help students to engage and achieve (Torff & Tirota, 2010).

An Interactive White Board (IWB), also known as an interactive whiteboard or smart board, is a large interactive display board in the form of a whiteboard. It can be either a stand-alone computer with a touch screen used independently to perform tasks and operations, or a connected device used as a touchpad to control computers from a projector. They are used in a variety of settings, including classrooms at all levels of education, corporate boardrooms and workgroups, training rooms for professional sports coaching, broadcast studios, and more. The user then calibrates the whiteboard image by matching the position of the projected image relative to the whiteboard using an indicator as needed. After that, the pointer or other device can be used to activate programs, buttons, and menus from the whiteboard itself, just as you would normally do with a mouse. If text input is required, the user can call up an on-screen keyboard or, if the whiteboard software provides it, use handwriting

recognition. This makes it unnecessary to go to the computer keyboard to enter text (Poulter, 2012).

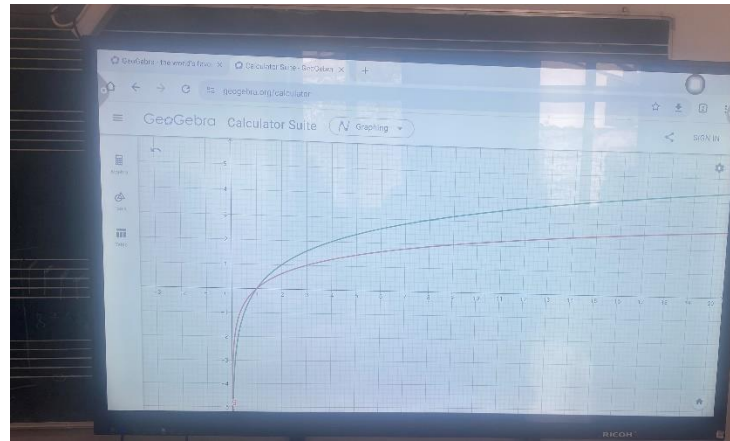


Figure 1. Smart Board

The results of the research by Akar (2020) are taken under the theme of positive aspects of using smart boards: "It ensures permanent learning", "supports visual and auditory learning", and "makes topics more concrete". The following results were obtained under the theme of negative aspects of using smart boards: "teachers' inability to use the smart board leads to wasted time and disrupts the lesson", "teachers can be blinded by the Smart Board", "the Smart Board makes students and teachers are lazy and they are taught that the Smart Board does everything". The following results were obtained under the topic of suggestions: "Teachers should be trained to use the Smart Board", "different functions should be used in addition to the presentation (video, sound, educational game, animation, etc.)", "Smart Board should not be used all the time, only when necessary" (Akar, 2020).

Research results by authors Tsayang, Batane, and Majuta (2020) show that the use of the Smart Board enabled a variety of learning experiences that promoted student engagement and interaction, as well as increased motivation levels and improved academic achievement. These findings show that Smart technologies have the potential to transform educational practices in Botswana as it strives to provide its children with a quality education that matches the best global standards, while at the same time reshaping itself into an innovative, efficient economy. and adaptive that can compete in the global world of the 21st century (Tsayang, Batane, & Majuta, 2020).

Also, the results of the research by Cabus, Haelermans, and Franken (2014) show that the differentiation of the level in the classroom, which was possible due to the efficient use of Smart Board, significantly increases the ability of mathematics by 0.25 points (Cabus, Haelermans, & Franken, 2014).

## **METHODOLOGY**

Before engaging in our research focused on the contribution of the Smart Board to improving student achievement in mathematics, it is important to develop a deep understanding of the available literature. The analysis of existing studies and previous research will provide a theoretical basis for our

research and will help us to identify still unexplored gaps in the existing literature.

An important part of this step is defining the context of the study. We have selected a secondary school with a particular focus on science and mathematics to provide a suitable basis for evaluating the use of the Smart Board in this specific area.

This study is qualitative research based on a significant degree of analysis of the experiences and perceptions of teachers and students regarding the use of Smart Board in teaching mathematics. Qualitative research conveyed several advantages, including in-depth knowledge, rich meanings, and broader social and educational context.

### **Research Population**

The population of the study consists of a mathematics teacher and 26 students of different classes in the music high school of "Lorenc Antoni" in Prizren, where the Smart Board has been used for a considerable period. The teacher is selected to represent a wide range of experience and teaching skills. Students were randomly selected from their classes to ensure a fair representation of the variety of Smart Board use.

### **Data Collection Procedures**

Data collection was conducted through interviews with the teacher and students to obtain their perspectives regarding the use of the Smart Board. The interviews were open-ended and structured to allow free expression of ideas and experiences.

### **Data Analysis**

The collected data were analyzed through a focus on content analysis and code breaking to identify key themes and patterns. After the data have been collected, their analysis is developed to understand the interactions and potential relationships between the use of the Smart Board and the student's performance in mathematics. Interviews were used to gain an in-depth understanding of the experiences and perceptions of the study subjects. Analysis of results was performed with MAXQDA Analytics qualitative data software.

### **Validity and Research Ethics**

To ensure the validity of the research, a wide range of sources was used and comparisons were made to the results with the existing literature. Validity was ensured using a combination of interview delivery techniques to ensure consistency of responses. This research respects all the ethical rules in scientific research, including informing and approving the subjects of the study, as well as guaranteeing the anonymity and confidentiality of the collected data. This methodology provides a contextual research approach, allowing students, teachers, and the school context to make a qualitative and summarized

contribution to the assessment of the Smart Board's contribution to improving student results in mathematics.

## RESULTS AND DISSCUSION

This chapter provides an overview of the results obtained, focusing on their motivation and teachers' perceptions about the use of the Smart Board in mathematics lessons. Through the in-depth analysis of interviews, the research aimed to identify the impact and potential of this technology in the context of mathematics education. In this research, a mathematics teacher and a group of 15 students were engaged as active participants. The teacher was part of this study to share his perceptions and experiences about the use of Smart Board in teaching mathematics, including the challenges and advantages he encountered during this period.

Participating students were randomly selected from a particular mathematics class, and they shared their perspectives, experiences, and evaluations regarding the use of the Smart Board in their lessons. This included their impressions about motivation, involvement, and the impact that this tool has had on their mathematics lessons. The participation of these key stakeholders has contributed to a complete and more diverse overview of the use of the Smart Board in the context of mathematics education. In the analysis and interpretation of the results, the aim is to reflect the experiences and opinions of both participant groups, providing a rich and detailed perspective on the results of this research.

### Interview with the Teacher

The interview with the teacher aimed to find out his perceptions, experiences and remarks about the use of the Smart Board in the mathematics lesson. This interview addresses issues such as the impact of the Smart Board on student engagement, the challenges teachers have faced, and how this tool has changed the dynamics of the math classroom.

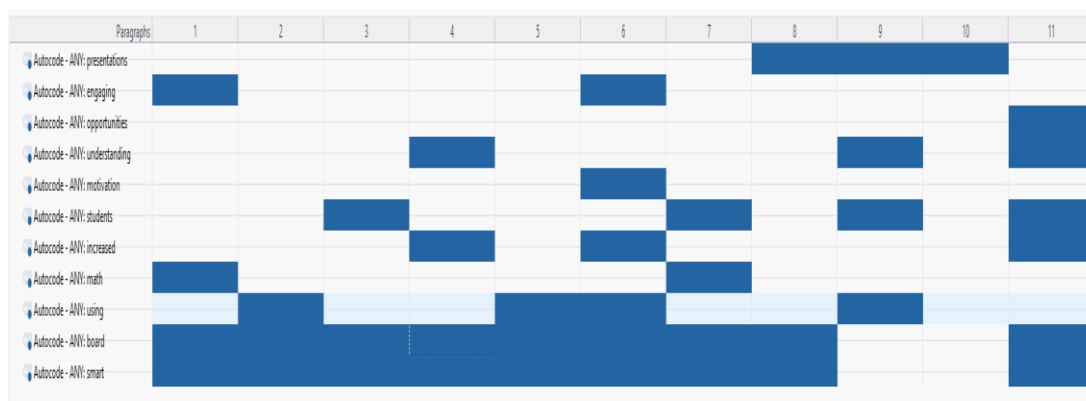


Figure 2. The Results of the Interview with the Teacher

The math teacher had experience 9 years in teaching and had started using the Smart Board this year. Initially, he was intrigued by the potential of this technology to make learning more engaging and improve student engagement. The school then invested in a Smart Board and began experimenting with

students in class. Student involvement and engagement had improved significantly. Students are more engaged in learning using this technology. Interactive presentations and the possibility to manipulate directly on the screen have made learning more interesting for them. Of course, some challenges have followed. The teacher reiterated the need for continuous training to explore all functions. Another challenge is that sometimes the technology does not work properly, and this has necessitated the technical assistance service. Students have enjoyed the presentations that use animations and practical examples. Apps that encourage collaboration and inclusion have served well. For example, using apps to solve exercises has helped to understand concepts better in their visual representation. Smart Board has significantly increased motivation. Students are more engaged in learning when using technology. They see math as more than just formulas on a spreadsheet. Being able to see and visually manipulate concepts has helped create a deeper connection with the subject matter. I recommend that teachers commit to continuous training and experimentation with Smart Board functions. Also, it is important to use their creativity and see technology as a tool to enhance learning, not just a technological update.

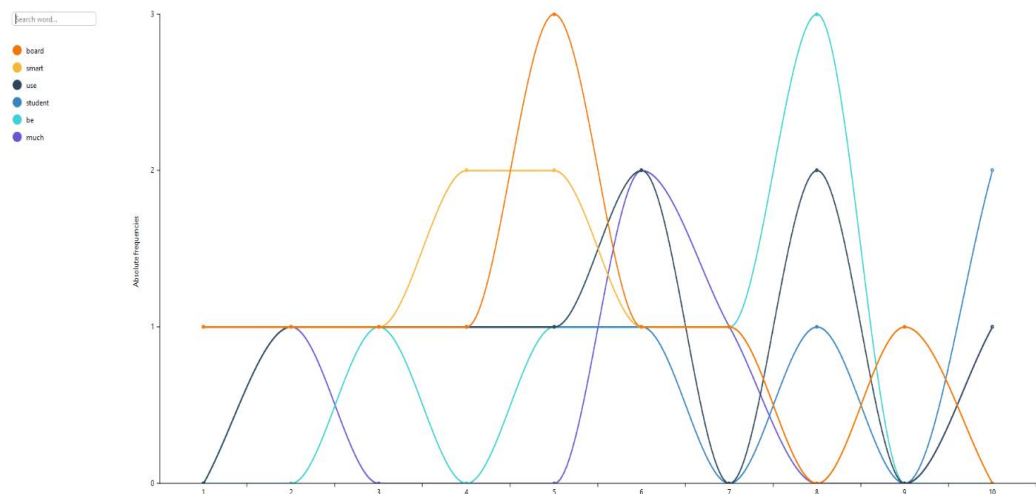


Figure 3. Results of the Interview with the Teacher from the Interview

Based on the teacher's evaluations and comments regarding the Smart Board, there seems to be a positive and influential correlation between the use of the Smart Board and the learning and motivation of students in the subject of mathematics. The teacher evaluates the contribution of the Smart Board as very positive in the lesson, describing it as a new dimension that has been added to the lesson. The use of multimedia materials has made learning more engaging and allowed for a clearer explanation of mathematical concepts. The teacher noticed a noticeable increase in the involvement and engagement of the students while using the Smart Board. Students appear more motivated and engaged in math class when this tool is used, showing a positive relationship between technology and their engagement in learning. The teacher finds a



significant improvement in the results of the students after using the Smart Board. This improvement is related to a better explanation of mathematical concepts and increased understanding. The Smart Board has had a positive effect on student motivation. The use of multimedia methods and engaging learning has increased students' interest in the subject of mathematics. Students appear more engaged and willing to participate in mathematics learning when the Smart Board is used. Interactive presentations and applications are highly valued, especially those that use animations and practical examples. This has also increased involvement and cooperation among students.

### Interview with Students

Based on the student's responses to the interview on the use of the Smart Board in learning mathematics, several key points are worth highlighting. Their answers express your thoughts and experiences regarding the use of the Smart Board in mathematics lessons. It has a positive perception and impact on the enjoyment and understanding of mathematics. We are analyzing these results below:

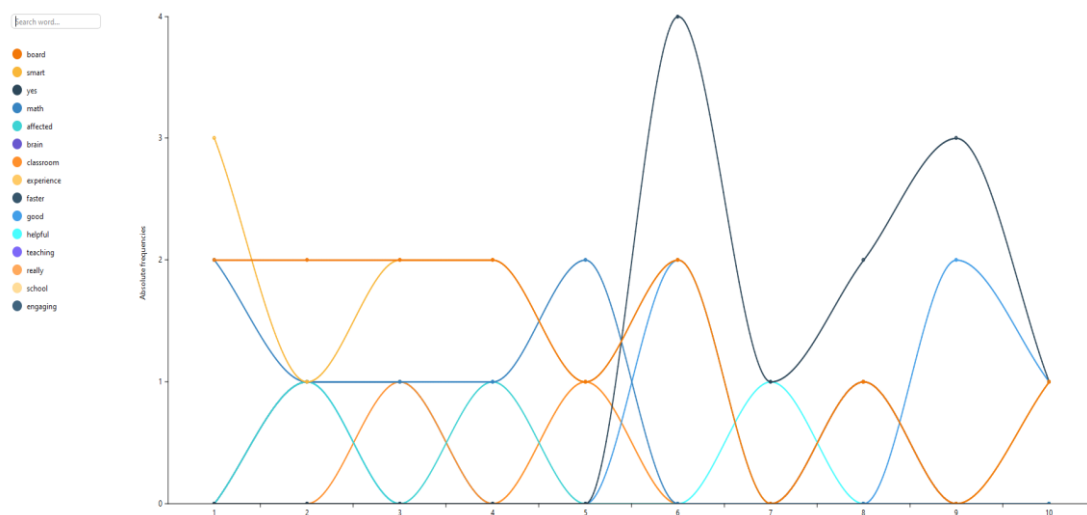


Figure 4. The Results of the Interview with the Students from the Interview

Most of the responses indicate that using the Smart Board is pleasant and easy. Positive language, such as "very good" and "pleasure," suggests a favorable experience. Some responses indicate an improvement in understanding of mathematical concepts after starting to use the Smart Board. This indicates a potential positive impact on the learning process. While one response mentions using their mind before the Smart Board, others state that they find these tools useful. Classification of specific tools or applications would provide a deeper understanding of which features are most effective. Most respondents believe that the Smart Board has positively influenced their motivation to learn mathematics. This alignment with motivation suggests that the interactive nature of Smart Board activities contributes to a more immersive learning experience. Answers vary regarding changes in mathematics



involvement. Some mention creating lessons, while others say their understanding has improved. Details on how inclusion has changed could provide valuable insights. Some responses express uncertainty or a lack of understanding about the challenges they encountered with the Smart Board. Collecting more detailed feedback on challenges would help address specific issues and improve the user experience. Some of the responses mention using the Smart Board to solve math problems or explain concepts. Understanding the impact on understanding and problem-solving could shed light on the effectiveness of this tool. Answers believe that the Smart Board can help students develop their math skills beyond the classroom. Further research into how this might occur could provide deeper insights for professors. A response expresses admiration for the professor and evaluates the experience positively. Gathering specific suggestions or ideas can help professors use the Smart Board to meet the needs of students. Reviews vary on a beautiful experience. Asking for more detailed feedback on what makes a positive experience could provide deeper understanding, students give a positive perception of using the Smart Board, and suggestions could improve the implementation of Smart Board technology in mathematics lessons.

Word	Word length	Freque...	%	Rank	Documents	Documents %
board	5	13	5.44	1	1	100.00
smart	5	13	5.44	1	1	100.00
yes	3	11	4.60	3	1	100.00
use	3	9	3.77	4	1	100.00
have	4	8	3.35	5	1	100.00
math	4	7	2.93	6	1	100.00
understand	10	7	2.93	6	1	100.00
how	3	6	2.51	8	1	100.00
much	4	6	2.51	8	1	100.00
good	4	5	2.09	10	1	100.00
your	4	5	2.09	10	1	100.00
easy	4	4	1.67	12	1	100.00
think	5	4	1.67	12	1	100.00
be	2	3	1.26	14	1	100.00
lesson	6	3	1.26	14	1	100.00
make	4	3	1.26	14	1	100.00
very	4	3	1.26	14	1	100.00

Figure 5. The Results of the Interview with the Students

According to the results of the interview, the students think that the Smart Board is very pleasant and makes the lesson more interesting. For them, it is a useful tool. When they use the Smart Board, they say that learning becomes more involved, and easier to understand certain concepts. However, one student states that he has not noticed any major changes. However, I think I understand some things more easily when using the Smart Board. Other students find that it is a little easier to understand some formulas or explanations when I see them on the screen with the help of the Smart Board. It's like an augmented visualization. They show that they have used it several times to explain a formula or show how to solve a problem. It is very easy to make demos. They also think it has made math more engaging. We can see the concepts visually and it's like a game, so it becomes more enjoyable and motivates them much more than traditional learning. It's different and makes the class more engaging. The students state that they have not encountered many challenges, but sometimes there are technical problems with the connection of the Smart Board. It would be nice to have a technician on hand to sort it out quickly. One challenge is that sometimes the screen may not react quickly when touched. Its sensitivity could be improved. On the other hand, they show that in addition to classroom learning, we can use the Smart Board to further explore topics at home. Maybe yes, because it becomes more interesting to learn. Even at home, we can use any application or watch instructional videos. As for suggestions, they pointed out that they could do more demonstrations and interactive exercises with the Smart Board. This would make learning more engaging. They think that the professor should make sure that all students use the Smart Board actively, asking questions and explaining things themselves. They rate the overall experience using the Smart Board in math 8 out of 10. It's a good experience, but there is still room for improvement. They say it helped them understand some concepts better and made learning more enjoyable.

In the discussion part of this research, we focus on the analysis and interpretation of the results to understand the essence of the Smart Board's contribution to mathematics lessons and student motivation. Based on the evaluations and comments of the teacher, and from the results of the studies Gregory (2010), Aytac (2013), Digregorio and Sobel-Lojeski (2010) we show that the use of Smart Board has a positive effect on student engagement and both students and teachers have generally positive attitudes towards the use of Smart Board in the teaching process and both are aware of the possible uses of this technology (Gregory, 2010; Aytac, 2013; Digregorio & Sobel-Lojeski, 2010). So, some key points follow from this, as the results show a very positive impact of the Smart Board on mathematics learning from our study. The teacher appreciates the key of this tool in adding a new dimension to the lesson, using multimedia materials to make the lesson more interesting and improve the explanation of the concepts. The teacher noticed a noticeable increase in the involvement and engagement of the students when using the Smart Board. This has revealed a positive relationship between the use of this technology and the involvement of students in the learning process. The results show a significant

improvement in the students' results, especially in the understanding of mathematical concepts. The impact of the Smart Board on student motivation has been positively assessed. Students have been rated as more involved and willing to participate in the lesson when the Smart Board is used. Interactive presentations and applications have been identified as effective tools to increase student involvement and engagement. Smart Board has opened new possibilities for the use of multimedia materials, increasing the interest and understanding of students. Improvements in results and motivation come from positive experiences of using the Smart Board in the classroom. In trying to achieve these positive results, the teacher has identified several challenges, including the security of the device and the time needed to prepare the presentations. This has led to continuous efforts in teacher training and the development of the necessary resources.

On the other hand, the results of our research are consistent with the research findings of Nejem and Muhanna (2014) where it is emphasized that students feel comfortable using a Smart Board and they list, listen, and engage during a lesson using a Smart Board, and using the smart board helps students to be more fun and motivated in learning mathematics. The visual presentation on the Smart Board helps students understand and remember mathematical information. Using the Smart Board in teaching mathematics helps students participate more in class discussions, enables them to stay on task better, helps them express their thoughts better, and enables them to be more creative (Nejem & Muhanna, 2014). According to the results from the interview with students from our study, we are noticing that it has helped them understand some concepts better and has made learning more enjoyable.

From the results of the research, we can also answer the first question of the research, how does the use of the Smart Board contribute to the improvement of students' results in the subject of mathematics? The use of the Smart Board had a positive impact on the improvement of students' results in the subject of mathematics through the possibility of an interactive and inclusive lesson. This technology allows visualization of mathematical concepts, provides opportunities for personalized learning, and encourages interaction between students. Smart Board also enables the use of online resources and educational applications, having a substantial impact on the expansion of students' knowledge. Dynamic descriptions and demonstrations, instant feedback, and real-time corrections help understand concepts and improve student performance effectively. Thus, the Smart Board serves as an effective tool to achieve learning goals in the subject of mathematics.

From the results of the research, we can also answer the second question of the research, how do teachers perceive the impact of using the Smart Board in the teaching process in the subject of mathematics? Teachers perceive the impact of using the Smart Board on the teaching process in the subject of mathematics as a positive and innovative intervention that increases the efficiency of teaching. The use of this technology provides an interactive and inclusive learning environment, enabling the visualization of mathematical concepts and the creation of dynamic content. Teachers say that the Smart

Board allows for clearer explanations and effective demonstrations, making learning more engaging for students. In addition, they appreciate the Smart Board's ability to provide feedback, helping to identify and correct student difficulties in real-time. This technology also encourages personalized learning and interaction between students, making it easier for teachers to adapt to individual student needs and promote a culture of collaboration in the classroom. In this way, the Smart Board serves as a powerful tool for improving the learning experience in mathematics.

From the results of the research, we can also answer the third question of the research, what experience do the students have with the use of the Smart Board and how do they evaluate this tool in mathematics lessons? Students had a positive and opportunity-rich experience using the Smart Board in their math lessons. They appreciate this tool for its ability to display mathematical concepts visually and interactively. Students say that the Smart Board helps in understanding the lesson by using animations, graphics, and practical examples that make the lesson more interesting and engaging. Their experience also includes their active engagement, using the touch screen to solve exercises and explain their solutions. Students also appreciate feedback and the opportunity to express their opinions through this technological tool. Overall, they rate the Smart Board as an effective and innovative tool that helps improve their learning experience in mathematics.

From the results of the research, we can also answer the fourth question of the research, in which mathematical concepts has the use of the Smart Board influenced the subject of mathematics from the students' perspective? The use of the Smart Board has positively influenced the understanding and discovery of some mathematical concepts from the student's perspective. Students report that the Smart Board has helped explain complex topics such as geometry, mathematical functions, and solving advanced math problems. For example, the use of visual demonstrations through the Smart Board has made it easier for students to understand and use complex formulas and theorems. Animations and interactive applications have provided an innovative way to explain and explore concepts such as trigonometry and functional graphs. This positive influence has fostered a deeper understanding and a more active involvement in the subject of mathematics, making learning more engaging and successful for students.

From the results of the research, we can also answer the fourth question of the research, what are the main challenges that teachers and students encounter in using the Smart Board in mathematics lessons? Teachers and students encounter several major challenges in using the Smart Board in mathematics classes. A challenge is ensuring device consistency and unwanted touchscreen interaction, which can affect the continuity of learning. In addition, the time required to prepare suitable presentations on the Smart Board is an aspect that often takes extra time from teacher preparation. Students, on the other hand, may face challenges in adapting to the use of technology and ensuring active involvement via the touch screen. Some of them may need further orientation and training to use the Smart Board efficiently. To address these challenges, it is

important to develop training resources and create clear guidelines for the successful use of the Smart Board in mathematics classrooms.

## CONCLUSIONS AND RECOMMENDATIONS

The research on the contribution of the Smart Board in improving the results of students in the subject of mathematics has evidenced a positive impact on the learning experience. The use of this technology has resulted in more interactive and involved learning, improving understanding of mathematical concepts and encouraging active participation on the part of students. Smart Board has diffused the challenges, providing a rich environment with opportunities for visualization, demonstrations, and instant feedback. Students have particularly appreciated the opportunity to explore and practice interactively, while teachers have identified the need for appropriate training and care in lesson preparation. In summary, the Smart Board represents a powerful tool for changing the teaching dynamics in the subject of mathematics, contributing to a more efficient fulfillment of the learning goals. So, the Smart Board represents a powerful tool for changing the teaching dynamics in the subject of mathematics, contributing to a more efficient fulfillment of the learning goals. In conclusion, the results of this research confirm that the Smart Board has a positive impact on the mathematics learning process and student motivation. Detailed discussion of these points will provide a rich and concise summary of the findings and their implications for the field of education.

Based on the positive results and the challenges identified in the discussion part of the research, some recommendations can be formulated for improving the use of the Smart Board in mathematics lessons. These recommendations will help address the challenges and improve the benefits of this technology in the context of education.

- Ensure that teachers receive ongoing training on the use of the Smart Board. This will help them develop deeper knowledge about device functions and innovative methods for use in teaching.
- Encourage app developers to create personalized math apps that fit the curriculum and student needs. These applications should support efforts to solve exercises and explain concepts.
- Ensure there is an effective technical support structure in the school. This will include quickly resolving technical issues and providing advice on effective use of the Smart Board.
- Encourage the creation and use of educational resources for the Smart Board, including instructional videos, animations, and interactive applications. These resources will help create a more engaging and educational learning environment.
- Encourage teachers to experiment with innovative teaching methods using the Smart Board. Creating interactive presentations and using multimedia materials will help increase student interest and involvement.

- Encourage teachers to use the Smart Board to improve interaction with students. Creating a learning environment where students are actively involved and can express their opinions will increase their motivation and engagement.

### **FURTHER STUDY**

Further study in the realm of technology's impact on mathematics education, specifically Smart Board integration, can take diverse paths to deepen our understanding and refine teaching methodologies. Longitudinal studies are needed to assess the sustained effects of Smart Board usage on students' mathematical performance over an extended period. Additionally, comparative analyses can shed light on the relative effectiveness of Smart Board integration compared to other interactive technologies. Exploring various models of teacher professional development programs focused on Smart Board technology and investigating its impact on diverse learners will contribute to tailored instructional strategies. Moreover, the integration of augmented and virtual reality technologies with Smart Board warrants exploration for creating more immersive learning experiences. Research should also delve into innovative assessment strategies and evaluate the financial implications of Smart Board implementation. Studying the role of parental involvement, inclusive practices, and global perspectives will provide a holistic understanding, ensuring the continuous evolution of technology-enhanced mathematics education.

## ACKNOWLEDGEMENTS

I am grateful to the students of the music high school “Lorenc Antoni” in Prizren form Kosovo who participated in this research. Without their participation research would not have been possible.

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