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The Impact of Math Walks on Enhancing Mathematical Fluency in Elementary Students

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Abstract- Mathematical fluency encompasses not only paper-and-pencil operations but also skills supported through games, activities, and real-life experiences. Math walks are experiential learning activities that enable students to explore mathematical concepts beyond the classroom by connecting movement, the environment, and problem-solving. This study aimed to examine the effects of math walk activities developed for fourth-grade primary school students on their mathematical fluency skills. A mixed-methods design was employed in the study. Quantitative data were obtained through a single-group pretest–posttest design administered to 20 students. In contrast, qualitative data were collected using semi-structured interviews to explore students' views regarding the implementation process. The findings revealed a statistically significant improvement in students' overall mathematical fluency scores following the math walk activities ($p < .05$), particularly in procedural, conceptual, and game-based fluency dimensions, whereas improvement in digital fluency remained limited. The results indicate that math walks provide an effective learning environment that supports the development of mathematical fluency by promoting active participation and real-life mathematical engagement. The study suggests integrating math walk activities into mathematics curricula and expanding activity-based approaches that foster mathematical fluency in elementary education.

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1. Introduction

Mathematical thinking skills are critical for individuals to solve problems they encounter in daily life and maintain academic success. Being strong in mathematics is not limited to computational skills; it also requires higher-level cognitive processes such as analytical thinking, connections, rapid reasoning, and strategy development. Therefore, mathematical fluency



is considered a fundamental life skill not only for mathematics but also for the 21st century (Kilpatrick, Swafford, & Findell, 2001). Mathematical fluency comprises multifaceted skills such as performing operations accurately, flexibly, and rationally in diverse mathematical situations; understanding how and why a calculation is performed; and selecting the appropriate strategy to solve a problem. Therefore, fluency is a holistic construct encompassing both computational automaticity and conceptual understanding.

National Council of Teachers of Mathematics (NCTM, 2014) defines procedural fluency as "applying a procedure accurately, efficiently, and flexibly." It emphasises the transferability of strategies used in this process to other contexts, as well as the student's ability to distinguish between procedures and select the most appropriate method. However, mathematical fluency is not limited to the procedural aspect. The literature offers a broader framework that includes subskills such as conceptual fluency (the ability to understand, connect, and explain), strategic fluency (choosing a problem-solving strategy), game-based fluency (interactive and dynamic learning processes), and digital fluency (thinking quickly and accurately with technology-supported applications). Therefore, for students to become fluent, they must both reach the correct conclusion and make sense of this process.

In recent years, studies on mathematical fluency have focused on the impact of game-based and movement-focused learning approaches. The interactive and engaging nature of games has been reported to stimulate students' cognitive processes and increase automaticity and rapid thinking, particularly in elementary school students (Wang & Han, 2021). Learning environments that combine physical and digital games have been found to develop students' mathematical skills in a more natural and motivating way. In this context, math walks are one activity that supports mathematical fluency.

Math walks are informal learning activities that allow students to explore concepts by connecting mathematics to daily life in settings outside the classroom. This method supports students' active participation in the learning process not only cognitively but also physically and socially. According to Pattison and colleagues (2017), math walks enable students to recognise mathematical patterns they unconsciously encounter in their environment, transforming mathematics from a mere course content into a natural way of thinking. Furthermore, they make learning more permanent by supporting social components such as peer interaction, collaboration, and problem-solving (Vale & Barbosa, 2023). According to Sager and colleagues (2023), math walks are an informal learning activity in which students and facilitators explore mathematical concepts embedded in everyday situations.

In recent years, math walks have attracted increasing attention in international research on mathematics education as an informal, place-based learning approach. Studies conducted in different educational contexts have shown that math walks support students' mathematical noticing, problem-posing skills, and connections between mathematics and real-life environments (Pattison et al., 2017; Milton et al., 2023; Wang & Walkington, 2023; Sayed, Milton, Sager, & Walkington, 2024). These studies emphasise that learning experiences taking place outside traditional classroom settings enhance students' engagement, motivation, and conceptual understanding. Despite these promising findings, existing research has largely focused on students' attitudes, engagement, or everyday mathematical awareness rather than examining the development of multidimensional mathematical fluency skills, particularly at the primary school level.

A review of the literature on how math walks support mathematical fluency reveals that such practices particularly strengthen pattern recognition, rapid mental processing, conceptualisation, and problem-solving skills (Dello Iacono & Ferrara Dentice, 2022; Milton, Sager, Walkington, Sherard, & Petrosino, 2023). However, studies of math walks in the international literature have mostly focused on attitudes, motivation, or everyday mathematics; studies directly examining their impact on mathematical fluency at early ages are limited. In the Turkish context, research on this topic is quite scarce, and experimental studies, in particular, are almost nonexistent. Therefore, a study examining the impact of math walks on mathematical fluency has the potential to fill a significant gap in the field.

The primary starting point of this research is to determine whether math walks at the elementary school level provide a multifaceted learning environment that supports mathematical fluency. Specifically,

determining how math walks affect the development of procedural, conceptual, game-based, and digital fluency in 4th-grade students will provide important insights into both curriculum and classroom and out-of-class activity design. In this study, the effects of math walks on 4th-grade students' mathematical fluency achievement were examined using a mixed-methods approach.

(a) Research Purpose

Mathematical fluency is a fundamental skill enabling students to engage in mathematical thinking processes accurately, flexibly, and efficiently. The development of this multidimensional skill, including procedural, conceptual, game-based, and digital fluency, is particularly critical at the primary school level. Math walks are innovative learning practices that enable students to engage with mathematics outside the classroom and support active, informal learning. However, previous studies on math walks in early grades have primarily focused on students' attitudes and motivation, while empirical research on their effects on mathematical fluency remains limited.

Therefore, this study aimed to examine the effects of math walk activities on different dimensions of mathematical fluency among fourth-grade primary school students and to explore students' views regarding the implementation process. It was hypothesised that math walk activities would significantly improve students' achievement scores in mathematical fluency. In addition, the study seeks to contribute to both theoretical discussions on mathematical fluency and practical applications related to activity-based mathematics instruction and curriculum development in primary education. In line with this general objective, the research problem was defined as follows:

"Do math walks activities have a significant impact on the mathematical fluency achievement of fourth-grade primary school students?"

In line with this general objective, the study investigated whether math walk activities created significant differences in students' procedural, conceptual, game-based, and digital fluency scores. Furthermore, the study explored students' opinions on the implementation process for math walk activities and their perceived relationship to mathematical fluency.

(b) Limitations of the Study

This study has several limitations that should be considered when interpreting the findings. First, the study group consisted of 20 fourth-grade primary school students selected through convenience sampling; therefore, the generalizability of the findings is limited. In addition, the use of a single-group pretest-posttest design without a control group may expose the study to potential threats to internal validity, such as maturation and testing effects. The implementation period was limited to eight class hours, which may not fully reflect the long-term impact of math walk activities on mathematical fluency development. Furthermore, qualitative data were collected only through semi-structured interviews, and observational or process-oriented performance data were not included. Digital fluency activities were also limited to specific technological applications, and different digital environments may produce varying results.

Despite these limitations, the study offers several novel contributions to the literature. Unlike previous research that primarily focuses on students' attitudes or motivation toward math walks, this study provides empirical evidence of the development of multidimensional mathematical fluency skills through math walk activities at the primary school level. By examining procedural, conceptual, game-based, and digital fluency simultaneously through a mixed-methods approach, the study contributes to both the theoretical understanding and the practical implementation of outdoor and activity-based mathematics learning environments.

2. Methods

(a) Research Model

This study examined whether math walk activities developed for 4th-grade primary school students had a significant effect on mathematical fluency achievement. A mixed-design study was used to examine both students' mathematical fluency achievement and their opinions about math walks. Creswell (2021) stated that the quantitative and qualitative data collected in mixed designs were technically combined and supported by the approaches derived from the results. This study examined the effects of math walk activities on mathematical fluency achievement using quantitative and qualitative data. In the quantitative aspect of the study, students were administered pre- and post-tests. In the qualitative aspect of the study, students' opinions and evaluations regarding the process were recorded after the application.

(b) The study group

The study group for this study was determined using a convenient sampling method that was easily accessible to the researcher. The ease of access to samples through convenient sampling accelerates the research (Yıldırım & Şimşek, 2008). The primary criterion for selecting participants for the study was that they were between the ages of 10 and 11 in the fourth grade of primary school. The study group consisted of 20 fourth-grade students studying at a primary school during the 2024-2025 academic year. Information on the study group is provided in Table 1.

Table 1. Study Group Information

Gender	f	%
Female	5	25
Male	15	75
Total	20	100

An examination of the gender distribution of the study group in Table 1 reveals 20 participants, 5 female and 15 male.

Although the study sample was relatively small and the gender distribution was uneven, it was designed as an exploratory implementation to examine the potential effects of math walk activities in an authentic classroom context. Convenience sampling was preferred to ensure accessibility and feasibility during implementation. Rather than achieving statistical generalisation, the study aimed to provide in-depth evidence regarding the effectiveness of math walk practices in supporting mathematical fluency at the primary school level. To minimise potential bias, all participants were exposed to the same instructional process, activities, and assessment procedures throughout the intervention.

This study employed a single-group pretest-posttest design, a weakly experimental design within quantitative research. This design involves administering a pretest to one group, then implementing the planned intervention, completing the necessary procedures, and then administering a posttest. The pretest and posttest consist of tests of the same content administered at different times. This design is based on examining the differences between the pretest and posttest.

(c) Data collection tools

The quantitative dimension of the study consisted of data collected using the "Mathematical Fluency Achievement Test," developed by Usluoğlu (2025) for her doctoral dissertation. After the students completed the math walks, tests of their mathematical fluency achievement were administered as pre-tests and post-tests. The Mathematical Fluency Achievement Test was originally developed and administered in Turkish. For reporting purposes and international accessibility, the instrument was translated into English through a forward-translation process. Researchers and English language teachers reviewed this translated version to ensure linguistic and conceptual equivalence between the Turkish and English versions.

Mathematical Fluency Achievement Test: Developed by Usluoğlu (2025), the test contains 30 questions in total: 10 questions in the procedural fluency section, 10 questions in the conceptual fluency section, 5 questions in the game-based activities section, and 5 questions in the digital fluency section. Questions in the procedural fluency section mostly focus on performing operations quickly and accurately, with answers derived from calculations. Each item consists of 4 options. Those who get the question wrong earn 1 point, and those who get it right earn 2 points. The maximum possible score for this test is 20. Questions in the conceptual fluency section involve explaining, interpreting, and analysing the information in the objective. Each item consists of 4 options. Those who get the question wrong earn 1 point, and those who get it right earn 2 points. The maximum possible score for this test is 20. In game-based fluency, games and activities related to the objectives are included. Those who complete the given games and activities most quickly and accurately are considered successful. Game-based fluency activities are fun and support individual and peer learning. A student who completed the game and provided the correct answer within the allotted time receives 3 points; a student who provided the correct answer but did not complete it within the allotted time receives 2 points; and a student who did not complete it within the allotted time receives 1 point. The maximum score for this section is 15. In digital fluency, students used smart boards to play digital games and activities related to the objectives. The digital games are available on websites easily accessible to all teachers. The student who achieved the fastest and most accurate answer within the allotted time was considered successful in this section of mathematical fluency. A student who completed the game and provided the correct answer within the allotted time receives 3 points; a student who successfully provided the correct answer but failed to complete it within the allotted time receives 2 points; and a student who gave an incorrect answer within the allotted time and failed to complete it receives 1 point. The maximum score for the selected digital games, aligned with the objectives, is 15. The achievement test is presented in Appendix A. During the study, the researchers added math walk activities to their doctoral thesis applications. The application process consisted of 8 hours of math walk activities. The application process for the math walks is as follows:

Application 1: In this activity, the goal is to solve the clues in the treasure hunt and reach the treasure in the classroom. The teacher prepared clues beforehand. Inside colourful envelopes, clues were written to find the treasure inside the classroom. However, the only requirement to open the envelopes was to solve the math problem on the outside. Students who solved the math problem correctly could open the envelope and, using the clue inside, move one step closer to the treasure. Outside the envelopes, four operations skills related to 4-, 5-, and 6-digit numbers, as outlined in the curriculum, were measured. Inside the envelope, clues leading to the treasure in the classroom (e.g., "Move 4 steps forward," "Look under the teacher's desk," etc.) were included. This activity significantly motivated students to solve the problems accurately and quickly and find the treasure during two class periods.

Application 2: This activity involved mathematical operations performed using books and page numbers in the school library. Students determined the page counts of the storybooks they read and then calculated their peers' page counts by performing four operations. For example, a student added the number of pages read by their friend sitting next to them. This activity allowed all students to engage in fun math with their peers for two class periods. The students also thoroughly enjoyed reading outside of the classroom.

Application 3: This activity demonstrates the fun side of doing math outside the classroom. Researchers had students line up in two groups in the schoolyard. The groups faced each other in a row. The researcher (or teacher) stood in the middle as a supervisor. Two students from each group, facing each other, asked and answered a mathematical problem. When both students answered correctly, they could move to the back of their group. This way, the next two students could take turns. First, one student asked the other a mathematical problem. If the other student answered correctly, they earned the right to ask questions. The researchers verified the accuracy of the mathematical problems and their answers. Over two class periods, all students posed mathematical problems to each other and attempted to solve them accurately and quickly. The students were thrilled to represent their group and pose mathematical problems using their answers.

Application 4: This activity aimed to demonstrate the fun aspects of capturing patterns in daily life. Students explored nature in a classroom setting, creating various patterns and conceptually expressing

the rules of patterns. In the activity, students were asked to create patterns using leaves, branches, or stones of different colours and shapes in the schoolyard. For example, one student created a pattern using one yellow leaf, two green leaves, and one branch. He then introduced the pattern and explained the pattern rule. As the activity continued, all students created a pattern from shapes of their choice in their math notebooks and wrote down the rule. Strolling around the schoolyard and creating a mathematical pattern with materials found in nature proved quite enjoyable for the students. Over the course of two class periods, all students were encouraged to create a pattern in nature and draw their own.

The qualitative dimension of the study consisted of a semi-structured interview guide developed by the researchers to gather students' opinions on math walks. Interviews are a powerful method for exploring and making sense of individuals' perceptions, feelings, and values based on their personal experiences (Karahan, Uca, & Gdk, 2022). This method was chosen because, as epni (2009) stated, the interview method is advantageous: it provides the opportunity to ask in-depth questions on a specific topic and, if the answer is incomplete or unclear, to clarify the situation by asking again and completing the response. In support of this view, Patten and Newhart (2018) stated that semi-structured interviews are the most widely used technique in qualitative research. However, when preparing interview questions, the researcher must clearly determine how structured the interview will be and "why they choose structured, unstructured, or semi-structured interview formats" (Merriam & Tisdell, 2015). The semi-structured interview questions prepared for the students in the study are as follows:

1. Do you think the math walks we conducted had a positive or negative impact on your math achievement?
2. How do you think math walks differ from other math activities?
3. How do you think math walks relate to mathematical fluency?

(d) Analysis of data

The quantitative data from the study, including the pre- and post-achievement test scores, were analysed using a statistical program. The quantitative data obtained in the study were analysed using a statistical program. Cronbach's alpha was .86. According to contemporary research methods literature, a reliability coefficient above .70 is considered satisfactory for researchers (Morling, 2017; Howitt & Cramer, 2020). The data showed a normal distribution. The paired-samples t-test was used to analyse the difference between Math Walks activities and mathematical fluency achievement. It can be used in experimental and survey studies where two related measurements or scores are obtained. The paired measures design can be used for repeated measurements of the same subjects or for measurements obtained from paired samples (Bykztrk, 2010). The t-test statistical method was used to analyse the pre- and post-test results for the group, including arithmetic means, standard deviations, differences between pre- and post-tests, and within-group changes.

As part of the qualitative data, students' responses to semi-structured interview questions were analysed using content analysis. To ensure reliability during the qualitative analysis process, a second researcher conducted independent coding, and inter-coder agreement was calculated using the Miles and Huberman (1994) formula:

$$\text{Reliability} = \frac{\text{Agreements}}{\text{Agreements} + \text{Disagreements}}$$

The calculated inter-coder agreement rate was 87%. This rate is above the 70% threshold accepted in qualitative research (Miles & Huberman, 1994). This demonstrates the reliability of the analysis process. Student responses were combined into common theme contents and tabulated. Frequency values were included for each theme.

3. Results and Discussion

The findings of this study provide important contributions to the growing body of research on outdoor mathematics learning by demonstrating that math walk activities can significantly support the development of mathematical fluency in primary school students. Unlike many previous studies

focusing mainly on attitudes (Wang and Walkington, 2023; Dhingra, Walkington, Darwin, & Dickens-Govan, 2025), this study highlights mathematical fluency as a measurable cognitive outcome of math walk practices.

(a) The Quantitative Findings of the Research

To determine whether the math walks activities conducted within the scope of the study affected mathematical fluency achievement, a dependent-samples t-test was conducted on students' pre-test and post-test scores. The results of the analysis are presented in Table 2.

Table 2. Analysis of Pre-test-Post-test Scores

Contents	Measurement	f	\bar{x}	Sd	df	t	p
Procedural	Pre test	20	14,02	1,49	19	-7,35	,00
	Post test	20	17,11	1,44			
Conceptual	Pre test	20	14,09	1,50	19	-6,48	,00
	Post test	20	16,56	1,75			
Game-based	Pre test	20	10,25	3,05	19	-2,14	,04
	Post test	20	11,60	2,40			
Digital	Pre test	20	11,08	2,37	19	-5,87	,56
	Post test	20	11,44	2,67			
Total	Pre test	20	49,46	6,65	19	-4,95	,02
	Post test	20	56,73	6,61			

$p < .05$

As shown in Table 2, there is a difference between the students' pre-test and post-test scores. A significant increase was observed in the procedural fluency section of the mathematical fluency achievement test, $t(19) = -7.35$, $p < .01$. There was another increase in the post-test score on the conceptual fluency section of the test, $t(19) = -6.48$, $p < .01$. When the game-based fluency success of the test was measured, a difference was found in the direction of increase, $t(19) = -2.14$, $p < .01$. The increase was small in the digital fluency section of the test.

The relatively limited improvement observed in the digital fluency dimension may be associated with several contextual factors. Primary school students' familiarity with digital learning environments and technology-supported mathematical applications may vary depending on prior exposure and technological infrastructure. Unlike procedural and conceptual fluency activities, which were reinforced through repeated physical interaction and peer collaboration during math walks, digital fluency tasks required simultaneous cognitive processing and technological interaction. This may have increased students' cognitive load and limited performance gains within the short implementation period. Previous studies have similarly emphasised that the effective development of digital mathematical skills requires sustained exposure and the structured integration of technology into learning environments (Dockendorff & Zaccarelli, 2025). Therefore, longer-term implementations that integrate digital tools more systematically may lead to greater improvements in digital fluency.

When the total test was examined, the average achievement test score was 49.46, while it increased to 56.73 after the math walks activities. In other words, the averages increased by =7.27 points. This means that math-walk applications have a significant effect on participants, who are 4th-grade primary school students, in developing the desired mathematical fluency skills, with an increase in their success levels in the process.

(b) The Qualitative Findings of the Research

The students' answers to the question "Do you think the math walks activities we did had a positive/negative effect on your math success?" are presented under headings in [Table 3](#).

Table 3. Effect of Math Walks activities

Effect	f	%
Positive effect	18	90
Negative effect	2	10

[Table 3](#) shows students' opinions on the effects of math walk activities on their mathematical achievement. According to [Table 3](#), students see that the applications have a positive effect on mathematical achievement to a large extent (90%). Some of the students' answers to the question are as follows:

S8: "The activities we did were very fun. They made me love math more. I believe I was more successful in the last test we took."

S11: "I really like math anyway. The activities we did will make me more successful in math."

S19: "I think it had a positive effect. We had a lot of fun in class. I wish our math classes were always like this."

The students' answers to the question "What do you think makes math walks different from other activities?" are presented under headings in [Table 4](#).

Table 4. Differences Between Math Walks Activities And Other Activities

Differences	f	%
It allows us to move in Mathematics.	16	80
It activates real-life skills through Mathematics.	12	60
It allows us to do math while having fun.	18	90

When [Table 4](#) is examined, it is observed that students generally associate math walk activities with having fun doing math. Students stated that math walk activities involve more physical activity than other math activities. In addition, they stated that math walks are more meaningful for connecting math with real life. Some of the answers given by the students to the question are as follows:

S2: "I think math walks allow us to learn math outside of our classroom. This is both fun and educational."

S14: "With math walks activities, we can even solve problems in our normal lives. Doing math is more fun. I love playing games with math."

S15: "I had a lot of fun with math walk activities. It's not like boring lessons. I think all our lessons should be done with such activities."

The students' answers to the question "How do you think math walk activities are related to mathematical fluency?" are presented under headings in [Table 5](#).

Table 5. Relationship Between Math Walks Activities and Mathematical Fluency

Relationship	Relationship type	f	%
Related	Loving math	12	60
	Being successful in mathematics	15	75
Not related	Boredom with math	1	5
	Unnecessary activities	1	5

When looking at [Table 5](#), it is seen that students generally (60%) say that there is a relationship between math walks activities and mathematical fluency and that this relationship makes them love mathematics. In addition, some students stated that this relationship also helps them succeed in mathematics. A few students stated that math walk activities have no relationship to mathematical fluency and that they are unnecessary and boring. Some of the students' answers to the question are as follows:

S1: "I think it is related. Because with the activity, we both have fun and practice our math skills."

S6: "I think it is related. Being fluent in math means being successful. These activities make us successful in math."

S9: "We had fun in math classes with the activities and games. I believe this helped us become more fluent in math."

The findings of this study also provide important implications for classroom practice and curriculum design. Integrating math walk activities into regular mathematics instruction may support students' engagement with mathematical concepts through real-life experiences and movement-based learning. In particular, combining outdoor activities with collaborative and game-based tasks appears to foster multiple dimensions of mathematical fluency simultaneously. These results suggest that mathematics instruction at the primary school level may benefit from extending learning environments beyond classroom boundaries and incorporating experiential learning opportunities that promote active participation.

4. Conclusion

This study aimed to determine whether the Math Walks activities significantly affected the mathematical fluency skills of 4th-grade primary school students. The study focused on improving mathematical fluency through Math Walks. For this purpose, a mathematical fluency achievement test was administered to the students before the Math Walks activities. After the four sessions, another mathematical fluency achievement test was administered. This allowed for the effects of the Math Walks activities to be explained by observing the difference between each pre- and post-test. The difference between the students' pre- and post-tests was observed. There was a significant increase in achievement in the procedural, conceptual, and game-based fluency sections of the Math Fluency Achievement Test. However, there was a slight increase in achievement in the Digital Fluency section of the test, though it was lower than in the other sections. This is thought to be due to the students' lack of familiarity with digital learning. This difference may have arisen because students' perceptions of mathematics depend on many factors. Indeed, Akman (2022)'s findings regarding students' reading behaviours, interests, motivation, attitudes, reading genres, reading strategies, attention span, distracting stimuli, and fatigue factors across all types of digital reading/activities support this view. Studies (Thorvaldsen, Egeberg, Pettersen, & Vavik, 2011; Siljebo, 2015; Utterberg, Tallvid, Lundin, & Lindström, 2019; Håkansson Lindqvist, 2019; Dockendorff & Zaccarelli, 2025) have shown that digital activities at the primary school level not only capture students' attention but also challenge them.

Another qualitative dimension of the research examined students' views on the practice. This way, the effects of math walks on the development of mathematical fluency were not limited to test results. Students' thoughts on the process were also analysed to assess their effectiveness. The first question posed to the students was whether math walks had any positive or negative impact on mathematical

fluency achievement. Students who thoroughly enjoyed the practice process expressed positive effects. Wang and Walkington (2023) stated that math walks enabled students to see the mathematical world around them more clearly, resulting in success. They also stated that math walks made positive contributions, including the development of higher-order thinking skills, such as creativity.

Another question posed to students in the study concerned the difference between math walks and other activities. Students generally stated that math walks stimulated them and that they engaged in fun math activities outside of class. Furthermore, they felt more confident because they incorporated math into their real lives. Just as a child automates walking, so does the automatization of math skills (Heck & Holleman, 2003; Highfield, 2008). They also emphasised that mathematics is not merely a scientific discipline but a human activity that involves sharing ideas and plans, enriched by collaborative tasks that can be pursued outside the classroom. In this study, students engaged in fun human activities through math walks.

The final question posed within the scope of the study was whether there was a relationship between math walk activities and mathematical fluency. Mathematical fluency requires functional thinking skills such as automatic, creative, and critical thinking regarding numbers, operations, and shapes. According to Vasuki, Celestin, and Kumar (2016), mathematical fluency is a critical skill that students need to develop; it enables them to solve problems effectively, think strategically, and apply mathematical concepts in various contexts. Math walks activities activate mental and physical movements in the context of mathematics, revealing fluent thinking and creative skills. Arroyo, Royer, and Woolf (2011) stated that improved rapid-calculation performance influenced mathematical fluency skills. Based on the students' responses, they suggested that math walk activities fostered success by encouraging more fluent thinking in mathematics. Furthermore, they stated that learning through fun piqued students' interest and led to greater success in procedural, conceptual, game-based, and digital fluency skills.

The results of the study can be summarised as follows: math walks, which utilise active learning methods, stimulate students both mentally and physically. This kinesthetic energy makes mathematical thinking more enjoyable and fosters mathematical fluency. Achievement tests revealed an increase in mathematical fluency after the implementation. This success stems from students actively engaging in the process and connecting mathematics to real-life situations outside the classroom. Math walks, implemented in various settings, motivated students to learn. This increased mathematical fluency, including accuracy, automaticity, flexibility, and rapid thinking. The study revealed a positive correlation between students' math walks and mathematical fluency. Students expressed their enjoyment of the process and their belief that every lesson should proceed in this manner.

The results of the study demonstrate that math walks are an effective method for developing elementary school students' mathematical fluency skills. Significant improvements in students' procedural and conceptual fluency levels demonstrate the effectiveness of the activities in both rapid thinking and conceptual connection. Positive improvements were also observed in game-based and digital fluency; however, these gains could be further strengthened with longer-term interventions. Students' positive feedback on math walk activities indicates increased motivation to learn and the beginnings of connecting math to daily life. This demonstrates that a fundamental skill like mathematical fluency can be effectively supported not only through classroom activities but also through activities that extend beyond the classroom, involve movement, and connect to real-life situations. Overall, it was concluded that math walks offer an innovative approach to elementary school mathematics instruction and contribute significantly to students' mathematical fluency.

Despite the positive findings, several limitations should be considered when interpreting the results. The relatively small sample size and short implementation period may limit the generalizability of the findings. In addition, the unequal gender distribution and contextual characteristics of the study group may have influenced the outcomes. Future studies may investigate the long-term effects of math walk activities using larger and more diverse samples. Further research could also focus on enhancing digital mathematical fluency by integrating technology-supported outdoor activities. Longitudinal studies examining the sustained impacts of math walks across different grade levels would provide deeper insights.

Based on the study's results, several recommendations can be made for practitioners and researchers.

First, the regular integration of math walks into mathematics teachers' lesson plans can support students' development of mathematical fluency. It should be noted that such activities provide opportunities for learning outside the classroom and facilitate students' connection to real-life mathematics. Furthermore, increasing the duration and variety of activities is recommended to foster stronger development in game-based and digital fluency. For researchers, studies conducted across different grade levels, with larger sample sizes, and using experimental designs with control groups will significantly contribute to the literature. Adapting and implementing math walks activities across different mathematical topics can broaden the scope of this approach. Finally, more in-depth analyses using qualitative data collection methods that reveal students' strategies and thinking styles throughout the process are recommended. Integrating outdoor mathematics activities into curricula may support experiential learning approaches and contribute to curriculum development initiatives. Therefore, educators and policymakers may consider incorporating structured outdoor mathematical practices into primary mathematics programs.

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