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IMPROVING MATHEMATICS ACHIEVEMENT AND INTEREST THROUGH JOYFUL TEACHING: EVIDENCE FROM SEVENTH-GRADE GIRLS IN KABUL

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Abstract

This study investigated the effect of joyful teaching methods on seventh-grade female students' mathematics achievement and interest compared with traditional instruction. A quasi-experimental pre-test–post-test control group design was employed involving 68 female students from a school in Kabul, Afghanistan. Participants were divided into an experimental group that received instruction through joyful teaching methods and a control group that received traditional instruction. Data were collected using a mathematics achievement test and a questionnaire measuring students' interest and attitudes toward mathematics. The data were analyzed using descriptive and inferential statistical techniques. The findings revealed that both groups improved after instruction; however, students exposed to joyful teaching methods achieved greater learning gains than those taught through traditional approaches. In addition, the questionnaire results indicated that the experimental group demonstrated more positive attitudes toward mathematics, higher levels of interest, greater classroom participation, and increased satisfaction with the learning process. The results suggest that joyful teaching is an effective and student-centered instructional approach that can enhance both academic achievement and motivation in mathematics. The study highlights the potential of joyful teaching as a practical and low-cost strategy for improving mathematics education in secondary schools.

INTRODUCTION

Mathematics is a foundational subject that supports logical reasoning, problem solving, and academic development. However, many students experience mathematics as difficult, abstract, or emotionally challenging. Students' attitudes toward mathematics, including enjoyment, confidence, perceived value, and anxiety, are closely related to mathematics achievement (Wen & Dubé, 2022). This issue is especially important for girls, as mathematics attitudes and mathematics anxiety may influence their achievement and participation in mathematics learning (Casanova et al., 2021; Enayat & Anwari, 2026).

Previous research has shown that mathematics learning is shaped not only by students' cognitive ability but also by motivation, classroom experience, teacher behavior, and students' emotional connection with the subject. Tella (2007) reported that motivation is associated with mathematics achievement among secondary school students, while Tambunan et al. (2021) emphasized that teacher performance can help build students' interest and motivation toward mathematics achievement. Similarly, Hwang and Son (2021) found a relationship between students' attitudes toward mathematics and mathematics achievement. These findings suggest that improving students' interest, motivation, and attitudes is an important part of improving mathematics learning.

In many classrooms, mathematics is still taught through traditional teacher-centered methods, where students mainly listen, memorize, and repeat procedures (Enayat et al., 2025). Although such methods may support basic content delivery, they often provide limited opportunities for participation, collaboration, exploration, and meaningful engagement. In response to these challenges, active and student-centered learning approaches have received increasing attention in mathematics education. Active and experiential learning can improve students' mathematics achievement, conceptual understanding, and problem-solving outcomes (Žakelj et al., 2024). Similarly, active learning models have been shown to support both mathematics achievement and retention (Dapin et al., 2021), while active learning strategies can make mathematics teaching more engaging and effective (Vale & Barbosa, 2023).

Teacher support and classroom climate are also important for mathematics learning. Supportive teachers can increase students' confidence, reduce anxiety, and promote engagement in classroom activities. Yang et al. (2021) found that teachers' emotional support was related to mathematics performance through academic self-efficacy and behavioral engagement, while Liu et al. (2018) showed that teacher support was linked to mathematics engagement through self-efficacy and positive emotions. These findings support the idea that a friendly teacher–student relationship and a positive classroom climate may contribute to better mathematics learning.

Joyful teaching can be understood as a practical form of active and student-centered instruction. It creates a positive classroom atmosphere while encouraging students to participate, interact, solve problems, work in groups, use meaningful examples, and connect mathematical ideas with daily life. In this sense, joyful teaching is not merely entertainment; rather, it is an instructional approach that combines emotional support, active participation, and meaningful learning. Such an approach may be particularly useful in mathematics classrooms where students experience low interest, anxiety, or limited participation.

This issue is especially relevant in low-resource educational contexts, including Afghanistan, where many schools face challenges such as limited teaching materials, traditional classroom practices, and restricted opportunities for teacher professional development. Evidence from an Afghan school context suggests that active mathematics teaching can support students' motivation, conceptual understanding, classroom participation, and learning outcomes even in disadvantaged settings (Enayat et al., 2025). Therefore, low-cost and classroom-based strategies such as joyful teaching may offer a practical way to improve mathematics learning without requiring advanced facilities or expensive technologies.

Despite the growing literature on active learning, student motivation, and mathematics achievement, limited empirical evidence is available on the effect of joyful teaching methods on mathematics learning and interest among schoolgirls in Afghanistan. To address this gap, the present study examined the effect of joyful teaching methods on mathematics learning and interest among seventh-grade female students in Kabul. Specifically, the study compared students taught through joyful teaching with students taught through traditional instruction in terms of mathematics achievement and attitudes toward mathematics.

This issue is particularly important in the current educational context of Afghanistan, where many schools continue to face significant challenges, including limited instructional resources, overcrowded classrooms, teacher-centered pedagogical traditions, and restricted

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opportunities for professional development. For girls in Kabul, these challenges are compounded by ongoing social and educational uncertainties that may reduce classroom participation, self-confidence, and motivation to learn. In such circumstances, teaching approaches that create a supportive, engaging, and emotionally positive classroom environment are especially valuable. Joyful teaching offers a practical and low-cost strategy that encourages active participation, collaborative learning, and positive teacher–student interaction without requiring sophisticated technologies or expensive educational materials. By fostering students' confidence, reducing learning anxiety, and increasing engagement, joyful teaching may help create learning environments in which girls are more willing to participate actively and develop stronger mathematical understanding.

Although previous studies have demonstrated the benefits of active learning, teacher support, and student-centered instruction for mathematics achievement, empirical evidence specifically examining joyful teaching remains limited, particularly in developing and resource-constrained educational settings. Moreover, very little research has investigated the effectiveness of joyful teaching for improving both mathematics achievement and students' interest among female secondary school students in Afghanistan. This represents an important gap in the literature because evidence from this context is needed to determine whether a simple, classroom-based instructional approach can improve learning outcomes and strengthen girls' engagement with mathematics under existing educational conditions. Therefore, the present study examined the effect of joyful teaching methods on mathematics learning and interest among seventh-grade female students in Kabul by comparing students taught through joyful teaching with those taught through traditional instruction in terms of mathematics achievement and attitudes toward mathematics.

Research Questions

This study was guided by the following research questions:

1. Does the joyful teaching method improve seventh-grade female students' mathematics learning compared with traditional instruction?
2. Does the joyful teaching method improve students' interest and attitudes toward mathematics compared with traditional instruction?

Research Hypotheses

Based on the research questions, the following hypotheses were formulated. Because both hypotheses are explicitly comparative, the primary confirmatory test for each is a between-group comparison rather than two separate within-group tests (see Data Analysis and Results).

H1: Students taught through the joyful teaching method will show significantly greater improvement in mathematics learning than students taught through traditional instruction.

H2: Students taught through the joyful teaching method will report more positive interest and attitudes toward mathematics than students taught through traditional instruction.

Conceptual Framework

The conceptual framework of this study is based on the assumption that instructional method influences both students' mathematics learning and their interest in mathematics.

The joyful teaching method, through active participation, group activities, meaningful examples, hands-on tasks, classroom interaction, and a positive emotional climate, is expected to improve students' engagement with mathematics (Figure 1). In contrast, traditional instruction is expected to rely more heavily on teacher explanation and passive reception of content. Therefore, joyful teaching is hypothesized to produce stronger outcomes in both mathematics achievement and students' interest and attitudes toward mathematics.

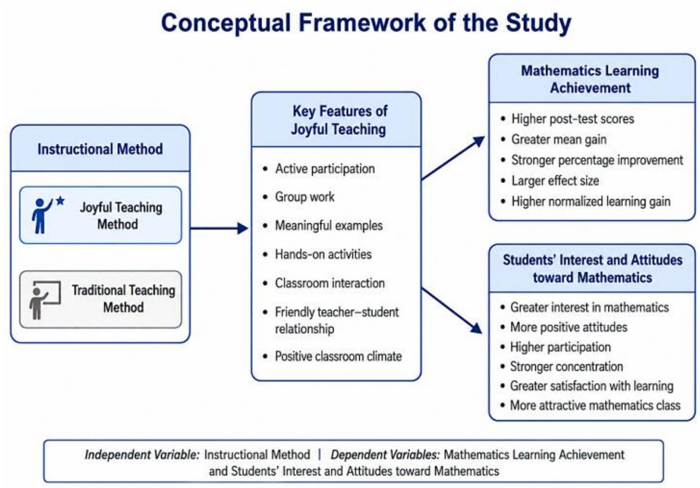

Figure 1. Conceptual framework of the study showing the relationship between instructional method, key features of joyful teaching, mathematics learning achievement, and students' interest and attitudes toward mathematics.

METHODS

Research Design

This study used a quasi-experimental pre-test–post-test control group design to examine the effect of joyful teaching methods on seventh-grade female students' mathematics learning and interest. Two instructional approaches were compared: the joyful teaching method as the experimental intervention and the traditional teaching method as the comparison condition. The intervention was delivered over 6 weeks, across 2 instructional sessions of approximately 45 minutes each, with both groups receiving the same number of sessions and the same curricular content, differing only in instructional approach. In both groups, students completed a mathematics pre-test before instruction and a post-test after instruction. In addition, a questionnaire was used to examine students' interest and attitudes toward mathematics before and after the instructional period.

Participants and Study Setting

The study was conducted among seventh-grade female students in District 17 of Kabul, Afghanistan, during the 1399 academic year. The target population included seventh-grade female students from Azadi High School and Shahrak Zakirin High School. According to the school administration, the population consisted of 512 students across 20 classes. From this population, 68 students were selected using convenience sampling. This sampling technique was adopted because access to participants was limited to the seventh-grade classes that were available and authorized by the school administration during the study period. In addition, existing class organization and school scheduling policies did not permit the random selection or reassignment of students to different classes. Therefore, convenience sampling represented the most practical and feasible approach for conducting the quasi-experimental intervention under the school's administrative and logistical constraints. The selected students were divided into two groups: an experimental group taught through the joyful teaching method and a control group taught through the traditional teaching method. Each group included 34 students.

Instructional Intervention

The experimental group received mathematics instruction through the joyful teaching method. This approach included classroom activities intended to make mathematics learning more active, enjoyable, and participatory. The main features of the joyful teaching method included active student participation, use of meaningful examples, group work, hands-on activities, classroom interaction, friendly teacher–student relationships, competitions, and linking mathematics exercises to students' daily lives. In contrast, the control group received instruction through the traditional teaching method, which relied mainly on teacher explanation and conventional classroom practice.

To illustrate concretely how the joyful teaching method was translated into classroom practice, two representative lesson outlines are summarized below. These are provided as illustrative examples of the instructional format used in the intervention; authors should adjust the specific content to match the actual lessons delivered before submission.

Illustrative example 1 — Algebra (Introduction to Linear Equations, ~45 minutes)

Warm-up (5 min): a short group competition in which teams race to balance simple number puzzles on the board, introducing the idea of "keeping both sides equal." Guided activity (15 min): students work in pairs with everyday word problems (e.g., dividing shared transportation costs) that translate into one-variable linear equations, framing the abstract symbol x as an unknown, relatable quantity. Hands-on practice (15 min): small groups solve equations using simple manipulatives (counters or paper strips) to visualize balancing operations on both sides. Wrap-up (10 min): a quick team competition reviewing solved equations, with the teacher highlighting common errors in a supportive, non-punitive way.

Illustrative example 2 — Geometry (Properties of Triangles, ~45 minutes)

Warm-up (5 min): students use string and rulers to attempt building triangles with given side lengths, some possible and some not, discovering the triangle inequality by trial rather than lecture. Guided activity (15 min): in small groups, students measure and classify paper triangles (equilateral, isosceles, scalene; acute, right, obtuse) and record findings on a shared worksheet. Hands-on practice (15 min): a classroom scavenger hunt in which groups identify triangle shapes in real classroom objects and justify their classification to classmates. Wrap-up (10 min): brief group presentations and a friendly point-based competition for the most accurate classifications.

Research Instruments

Two main instruments were used for data collection. The first instrument was a mathematics achievement test designed to measure students' learning before and after the instructional intervention. The test was used as both a pre-test and a post-test to compare changes in mathematics learning between the two groups.

Regarding the cognitive demand of the achievement test, items were designed to span more than simple recall. Consistent with Bloom's revised taxonomy, the test included items addressing (a) remembering and understanding basic mathematical facts and definitions, (b) applying procedures to solve routine problems, and (c) analyzing and solving multi-step or word-based problems requiring students to select and combine procedures. [INSERT: exact number/percentage of items at each cognitive level, e.g., "Of the N items, X were classified as remembering/understanding, Y as applying, and Z as analyzing/higher-order problem solving, based on independent classification by two mathematics teachers."] This breakdown is reported here to clarify that the test was not limited to rote recall, though a full item-level breakdown should be inserted from the original test-construction records.

The second instrument was an eight-item student opinion questionnaire designed to assess students' interest, attitudes, and perceptions toward mathematics learning. The questionnaire was developed using a five-point Likert scale, ranging from strong agreement to strong disagreement. It was used to examine students' views about the usefulness, attractiveness, satisfaction, participation, and learning experience in mathematics.

Validity and Reliability

The content and face validity of the eight-item questionnaire were reviewed by three teachers from Azadi High School. Their comments were considered, and the questionnaire was revised before final use. The reliability of the instrument was assessed using Cronbach's alpha, which was reported as 0.90, indicating a high level of internal consistency.

Data Collection Procedure

Data collection was carried out in three main stages. First, both groups completed the mathematics pre-test and the interest questionnaire. Second, the experimental group was taught using the joyful teaching method, while the control group was taught using the traditional teaching method, over the same instructional period described above. Third, after the instructional period, both groups completed the mathematics post-test and the interest questionnaire again. This procedure made it possible to compare changes in mathematics achievement and students' interest within and between the two instructional groups.

Data Analysis

The data were analyzed using both descriptive and inferential statistics. Descriptive statistics, including mean scores, standard deviations, mean gain, percentage improvement, and normalized learning gain, were used to summarize students' mathematics learning outcomes within each group. Paired-samples t-tests were used to determine whether the pre-test to post-test change was statistically significant within each group separately.

Because the study's hypotheses (H1 and H2) are explicitly comparative — predicting that the joyful teaching group would improve more than the traditional teaching group, rather than simply that each group would improve — the within-group paired t-tests alone cannot confirm H1: two groups can each show a significant within-group change without that change being significantly different from one another. To directly test H1, the gain scores (post-test minus pre-test) of the two groups were therefore compared using an independent-samples t-test, and the magnitude of the between-group difference was quantified using Cohen's d, a standardized effect size appropriate for two-group comparisons (in contrast to the r values derived separately from each group's within-group t-test, which are not directly comparable to one another and are retained here only as supplementary within-group indicators).

Because individual-level raw scores were not available for this analysis (see Limitations), the between-group test and Cohen's d were derived analytically from the group statistics already reported in Tables 2–4 (mean gain, n, and paired t-value for each group), using the standard relationship between a paired t-statistic and the standard deviation of the difference scores it is computed from: SD(difference) = mean gain × √n ÷ t. The resulting SDs of the gain scores were then pooled to obtain the between-group t-test and Cohen's d. This is a standard method for reconstructing effect sizes from summary statistics when raw data are unavailable and is reported transparently as such.

The questionnaire data were analyzed descriptively to interpret changes in students' interest and attitudes toward mathematics. Given that individual-level responses were not retained, non-parametric between-group inferential tests (e.g., Mann-Whitney U) could not be computed post hoc; this is noted explicitly as a limitation in the relevant section below.

RESULT AND DISCUSSION

RESULT

Baseline Status of the Two Groups in the Pre-test

Before examining the effect of the joyful teaching method on mathematics learning, it was necessary to compare the baseline status of the two groups based on their pre-test scores. As shown in Table 1, the mean pre-test score was 15.11 (SD = 1.32) in the joyful teaching group and 14.91 (SD = 1.33) in the traditional teaching group. The difference between the two groups at the pre-test stage was only 0.20 points, indicating that the two groups had a very similar initial level of mathematics learning.

Table 1. Pre-test Descriptive Statistics and Baseline Equivalence Between Instructional Groups

Instructional group	n	Pre-test mean	SD	Difference from comparison group	Interpretation
Joyful teaching method	34	15.11	1.32	+0.20	Approximately equivalent
Traditional teaching method	34	14.91	1.33	Reference	Approximately equivalent

As presented in Table 1, both groups included 34 students, and their mean pre-test scores were very close. This baseline similarity is methodologically important because, in quasi-experimental studies, the relative equivalence of groups before the intervention strengthens the interpretation of post-intervention differences.

Changes in Mathematics Learning Scores in the Two Groups

As shown in Table 2, the mean score of the joyful teaching group increased from 15.11 in the pre-test to 18.52 in the post-test, a mean gain of 3.41 points. The mean score of the traditional teaching group increased from 14.91 to 16.17, a mean gain of 1.26 points.

Table 2. Comparison of Pre-test and Post-test Performance and Learning Gains Between Instructional Groups

Instructional group	n	Pre-test mean	Post-test mean	Mean gain
Joyful teaching method	34	15.11	18.52	3.41
Traditional teaching method	34	14.91	16.17	1.26

Both groups demonstrated improvement in mathematics scores after instruction, but the magnitude of improvement was descriptively larger in the joyful teaching group. Whether this difference in gains was itself statistically significant is tested directly below in the section "Between-Group Comparison of Learning Gains."

Paired-Samples t-Test Results for the Two Instructional Groups (Within-Group Change)

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To examine whether the change in scores was statistically significant within each group, a paired-samples t-test was conducted separately for each group. These tests establish that each group changed significantly from pre-test to post-test; they do not, by themselves, establish that the two groups differed significantly from each other (Table 3).

Table 3. Paired Sample t-test Results for Pre-test and Post-test Achievement Scores Within Instructional Groups

Instructional group	n	Pre-test mean	Post-test mean	t	df	p	Result
Joyful teaching method	34	15.11	18.52	6.83	33	0.001	Significant
Traditional teaching method	34	14.91	16.17	2.34	33	< 0.05	Significant

The results showed that both groups demonstrated statistically significant improvement after the instructional period. Specifically, the joyful teaching group showed a significant increase in achievement scores, $t(33) = 6.83$, $p = .001$, while the traditional teaching group also demonstrated significant improvement, $t(33) = 2.34$, $p < .05$. However, these within-group analyses do not directly test whether the improvement in the joyful teaching group was significantly greater than that of the traditional teaching group. Therefore, the between-group comparison of gain scores is presented in the following section to address H1.

Between-Group Comparison of Learning Gains (Test of H1)

To test H1 directly, the gain scores of the two groups were compared using an independent-samples t-test, with Cohen's d as the standardized between-group effect size. As described in Data Analysis, this comparison was reconstructed from the group-level statistics reported in Tables 2 and 3, since individual-level raw scores were not retained.

Table 4. Independent Samples t-test Analysis of Learning Gains Between Joyful and Traditional Teaching Methods

Comparison	Mean gain difference	Pooled SD	t	df	p	Cohen's d	Interpretation
Joyful vs. traditional	2.15	3.03	2.93	66	0.005	0.71	Medium-to-large, favoring joyful teaching

The independent-samples comparison confirmed that the joyful teaching group's mean gain (3.41 points) was significantly larger than the traditional teaching group's mean gain (1.26 points), $t(66) = 2.93$, $p = 0.005$. The standardized between-group effect size was Cohen's $d = 0.71$, generally interpreted as a medium-to-large effect. This result provides direct statistical support for H1: the advantage of the joyful teaching method over traditional instruction was not only descriptively larger but also statistically significant when the two groups were compared against one another, rather than assessed only through separate within-group tests.

Effect Size and Practical Significance of the Findings (Supplementary Within-Group Indicators)

In addition to the between-group test above, mean gain, percentage improvement, and an approximate within-group effect size were calculated for each group separately, following the formulas Mean gain = Post-test mean − Pre-test mean; Percentage improvement = (Mean gain ÷ Pre-test mean) × 100; and $r = \sqrt{t^2 \div (t^2 + df)}$. These within-group r values are retained here as supplementary descriptive indicators of each group's own change over time; because they are computed separately within each group rather than between groups, they should not be interpreted as a formal group comparison — that role is served by the between-group test and Cohen's d reported above.

Table 5. Within-Group Analysis of Pre-test and Post-test Achievement Improvement Following Different Teaching Method

Instructional group	n	Pre-test	Post-test	Mean gain	% improvement	t	df	Within-group r	Interpretation
Joyful teaching method	34	15.11	18.52	3.41	22.57%	6.83	33	0.77	Large
Traditional teaching method	34	14.91	16.17	1.26	8.45%	2.34	33	0.38	Moderate

Descriptive Difference-in-Differences Analysis

At the pre-test stage, the difference between the two groups was only 0.20 points. At the post-test stage, the difference between the two groups increased to 2.35 points in favor of the joyful teaching group, a change of 2.15 points — the same quantity tested formally above as the between-group mean gain difference.

Table 6. Comparison of Performance Differences Between Joyful and Traditional Teaching Groups Across Pre-test and Post-test Stages

Comparison stage	Joyful teaching method	Traditional teaching method	Difference between groups	Interpretation
Pre-test	15.11	14.91	0.20	Very small initial difference
Post-test	18.52	16.17	2.35	Advantage for the joyful teaching group
Change in performance gap	—	—	2.15	Increased gap, statistically confirmed above ($t = 2.93$, $p = 0.005$)

This descriptive pattern, together with the independent-samples t-test reported above, supports the conclusion that the joyful teaching method had a significantly stronger effect on improving students' mathematics learning compared with the traditional teaching method.

Findings Related to Students' Interest and Attitudes toward Mathematics

To examine the effect of the joyful teaching method on students' interest and attitudes toward mathematics, the findings from the student opinion questionnaire were analyzed descriptively. Students who were taught through the joyful teaching method demonstrated more positive attitudes toward mathematics after the intervention, evaluating the mathematics class as more enjoyable, the learning process as more useful, classroom activities as more pleasant, and their participation as more active. Students in the traditional teaching group also showed some positive change, but it was more limited.

Table 7. Students' Perceptions of Mathematics Learning Experiences Following Joyful and Traditional Teaching Methods

Questionnaire dimension	Main finding	Interpretation
Usefulness of mathematics learning	Joyful teaching group rated mathematics learning as more useful.	Stronger connection with lesson content.
Attractiveness of the mathematics class	Attractiveness increased more in the joyful teaching group.	Joyful activities made the classroom more active and enjoyable.
Connection to prior knowledge	Joyful teaching group reported a stronger connection between new content and prior knowledge.	Learning was more meaningful for this group.
Satisfaction with learning	Joyful teaching group reported greater satisfaction and enjoyment.	Positive effect on the emotional dimension of learning.
Homework engagement	Joyful teaching group showed a more positive feeling toward homework.	Motivation extended beyond the classroom.
Active participation in class	Participation was higher in the joyful teaching group.	Movement toward active rather than passive learning.
Use of diverse teaching techniques	Perceived as more varied and interesting by the joyful teaching group.	Variety was a factor in increasing interest.
Concentration during learning	Joyful teaching group reported greater concentration.	An active, motivating environment can increase attention.

In one negatively worded item related to the lack of attractiveness of the mathematics class, the mean score in the joyful teaching group decreased from 4.73 before instruction to 1.23 after instruction, compared with a decrease from 4.68 to 3.34 in the traditional teaching group. Since this item was negatively worded, the larger decrease in the joyful teaching group indicates a stronger improvement in perceived attractiveness.

As raised by reviewers, these questionnaire findings are reported descriptively (item-level means and directional change) rather than with inferential non-parametric tests (e.g., Mann-Whitney U or Wilcoxon signed-rank tests), because the individual-level item responses needed to run those tests were not retained (see Limitations). This is stated here explicitly so the reported support for H2 is understood as descriptive rather than inferential.

Supplementary Analysis of Normalized Learning Gain and Final Achievement Level

The normalized learning gain, g = (Post-test mean − Pre-test mean) ÷ (Maximum score − Pre-test mean), was 0.70 for the joyful teaching group and 0.25 for the traditional teaching group, using a maximum test score of 20. The joyful teaching group reached 92.60% of the maximum score at post-test, compared with 80.85% for the traditional teaching group.

Table 8. Normalized Learning Gains and Final Achievement Outcomes Across Instructional Groups

Instructional group	Pre-test	Post-test	Mean gain	Max score	Normalized gain (g)	Final achievement %
Joyful teaching method	15.11	18.52	3.41	20	0.70	92.60%

Instructional group	Pre-test	Post-test	Mean gain	Max score	Normalized gain (g)	Final achievement %
Traditional teaching method	14.91	16.17	1.26	20	0.25	80.85%

DISCUSSION

The main purpose of this study was to examine whether the joyful teaching method could improve seventh-grade female students' mathematics learning and increase their interest in mathematics compared with traditional instruction. The findings provide consistent evidence in support of this purpose, and, importantly, this support now rests on a direct between-group test rather than on within-group change alone. The two groups were nearly equivalent at baseline (Table 1), which strengthens the interpretation of the post-test difference. Both groups improved significantly on their own pre- to post-test comparisons (Table 3), but the independent-samples t-test reported above showed that the joyful teaching group's improvement was significantly larger than the traditional teaching group's, $t(66) = 2.93$, $p = 0.005$, Cohen's $d = 0.71$. This directly addresses H1 and is consistent with research showing that classroom motivational environments are closely related to students' emotional and cognitive interest in mathematics (Carmichael et al., 2017), and with evidence that active and experiential learning approaches improve mathematics achievement and conceptual understanding (Žakelj et al., 2024; Dapin et al., 2021; Vale & Barbosa, 2023).

The descriptive difference-in-differences pattern (Table 5) and the supplementary normalized learning gain and final achievement indicators (Table 7) reinforce this conclusion, showing that the joyful teaching group not only gained more but reached a higher final achievement level (92.60% vs. 80.85%).

Regarding H2, students in the joyful teaching group reported more positive attitudes toward mathematics after the intervention across all eight questionnaire dimensions (Table 6), consistent with research linking positive classroom interactions and teacher support to cognitive, emotional, and behavioral engagement in mathematics (Yang et al., 2021; Yang et al., 2024) and with evidence that engagement mediates the relationship between motivational factors, well-being, and mathematics outcomes (Sasidharan & Kareem, 2023). As noted above, this support for H2 is descriptive; the study could not run inferential tests on the questionnaire items because item-level data were not retained, and this is treated as an explicit limitation rather than an inferential claim.

Taken together, the findings indicate that joyful teaching had a significantly stronger effect than traditional instruction on mathematics achievement, and a descriptively more positive effect on students' attitudes. Cognitively, the joyful teaching method helped students understand mathematics through examples, practice, and active involvement (illustrated in the algebra and geometry lesson examples above). Socially, it encouraged collaboration and participation. Emotionally, it made mathematics learning more enjoyable and less intimidating. Previous evidence from Afghanistan suggests that active mathematics teaching can support learning motivation and outcomes even where educational resources are limited (Enayat et al., 2025), and the present findings extend that evidence with a directly tested between-group comparison.

This finding is also consistent with previous work on students' active participation being shaped by motivation, classroom experience, and perceived learning value (Du et al., 2025), and on addressing low mathematics engagement through more interactive strategies

(Verdeflor et al., 2024). The results are further consistent with prior research linking girls' mathematics attitudes and anxiety to achievement (Casanova et al., 2021) and with evidence that teacher performance builds student interest and motivation (Tambunan et al., 2021).

From a psychological and gender perspective, the positive effects of joyful teaching may be particularly meaningful for female students because mathematics learning is influenced not only by cognitive ability but also by students' emotional experiences, confidence, and perceptions of belonging in the subject. Previous research has shown that mathematics anxiety can negatively affect students' performance, motivation, and willingness to participate, with girls often reporting higher levels of mathematics anxiety and lower confidence in mathematics-related activities compared with boys (Casanova et al., 2021). By creating a supportive, collaborative, and low-pressure learning environment, joyful teaching may help reduce fear of making mistakes, strengthen self-confidence, and encourage greater classroom participation among girls. The affective dimension of this approach is especially important in contexts where social expectations and limited educational opportunities may influence girls' engagement with mathematics and STEM-related fields. Therefore, joyful teaching should be viewed not only as an instructional strategy for improving achievement but also as an approach that promotes psychological safety, positive mathematical identity, and greater inclusion of girls in mathematics education.

Educational Implications for Mathematics Teaching

The findings suggest that mathematics instruction can be meaningfully improved when teachers move beyond teacher-centered explanation toward active, participatory, and enjoyable classroom practices, of the type illustrated in the algebra and geometry lesson examples above. For mathematics teachers, the findings indicate that joyful teaching does not necessarily require expensive materials or advanced technology; simple strategies such as meaningful examples, group activities, classroom competitions, hands-on tasks, friendly interaction, and connecting mathematics to daily life can make the subject more understandable and attractive, consistent with Vale and Barbosa (2023) and with evidence from an Afghan low-resource school context (Enayat et al., 2025). Teacher training programs should include practical preparation in these methods alongside content knowledge, particularly in contexts where traditional teaching remains common.

Limitations of the Study

This study has several limitations that should be considered when interpreting the findings.

First, the study was conducted with seventh-grade female students in one educational district, which may limit the generalizability of the results to other grades, male students, mixed-gender classrooms, or schools in different regions.

Second, the study used a quasi-experimental design without full random assignment. Although the two groups were nearly equivalent at baseline (Table 1), other uncontrolled factors such as students' prior learning experiences, classroom conditions, teacher effects, or home support may have influenced the results.

Third, and importantly, the individual-level raw dataset (student-by-student pre-test, post-test, and questionnaire item scores) was subsequently lost and could not be recovered for this revision. As a direct consequence: (a) the between-group test of H1 reported above (independent-samples t-test and Cohen's d) was reconstructed analytically from the group-level summary statistics already reported in the paper (n, means, and within-group t-values), using the standard relationship between a paired t-statistic and its underlying standard deviation, rather than computed directly from raw scores or via ANCOVA with pre-test as a covariate, which would have been the preferred approach had raw data been available; and (b) the non-parametric between-group tests on the individual questionnaire items requested for H2 (e.g., Mann-Whitney U, Wilcoxon signed-rank) could not be conducted, so the questionnaire findings in Table 6 remain descriptive rather than inferential. Readers should interpret the magnitude estimates in this revision as reconstructions from reported summary statistics rather than as a full reanalysis of primary data. Institutions and future studies using this design are encouraged to retain individual-level datasets specifically to allow ANCOVA-based and non-parametric reanalysis at the review stage.

Fourth, the achievement test's cognitive-level composition (Bloom's taxonomy) is described in the Methods section in general terms; the exact item-by-item classification should be reported from the original test-construction records.

Fifth, the study measured students' learning and attitudes immediately after the intervention, so it cannot determine whether the positive effects would remain stable over a longer period. Future studies should include delayed post-tests.

Finally, the questionnaire findings on students' interest and attitudes were based on self-reported responses, which may be influenced by response bias or social desirability. Future research could combine questionnaires with classroom observations, interviews, or performance records.

Recommendations for Future Research

Future studies should examine the effect of joyful teaching with larger and more diverse samples, including different grades, boys' schools, mixed-gender classrooms, and schools in other regions. Future research should retain individual-level raw data throughout the review process to enable ANCOVA, regression, or mediation analysis, and non-parametric tests on questionnaire items, rather than relying on reconstructions from summary statistics as was necessary in this revision. Future studies should also include delayed post-tests to examine whether effects remain stable over time, and should report the cognitive-level (Bloom's taxonomy) composition of achievement test items in full. Combining quantitative data with classroom observations, teacher interviews, or student interviews would provide deeper insight into how joyful teaching operates in real classroom practice.

CONCLUSION

This study found that joyful teaching was more effective than traditional instruction in improving seventh-grade female students' mathematics learning and interest. A direct between-group comparison confirmed that the joyful teaching group's learning gain was significantly larger than that of the traditional teaching group ($t(66) = 2.93$, $p = 0.005$, Cohen's $d = 0.71$), and students in this group also reported more positive attitudes toward mathematics.

The findings suggest that active participation, meaningful examples, group work, hands-on activities, and a positive classroom climate can make mathematics learning more engaging and effective. Therefore, joyful teaching can be considered a practical and low-cost approach for improving both mathematics achievement and students' interest in mathematics.

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DECLARATIONS

Author Contribution Statement

Abdul Maroof Mashal contributed to the conceptualization of the study, development of the research framework, design of the methodology, and supervision of the research process. Rahmatullah Qarloq contributed to data collection, organization of the educational intervention, and validation of the research procedures. Wahidullah Enayat contributed to formal data analysis, interpretation of findings, manuscript preparation, and overall coordination of the study. Abdul Munir Khirzada contributed to the literature review, methodological refinement, and critical revision of the manuscript. Musawer Hakimi contributed to research design, statistical analysis support, interpretation of results, manuscript review, and improvement of the academic presentation. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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Data Availability Statement

The dataset generated and analyzed during this study is not publicly available due to ethical considerations related to student participants and educational data privacy. However, anonymized data may be made available from the corresponding author upon reasonable request for academic and research purposes.

Declaration of Interests Statement

The authors declare that they have no competing interests or financial relationships that could have influenced the research, authorship, or publication of this manuscript.

AI Use Statement

The authors declare that no generative artificial intelligence (AI) tools were used to generate the research findings, analyze the data, or write the scientific content of this manuscript. Any language improvement or proofreading assistance, if applied, was limited to enhancing clarity and readability, while the authors remained fully responsible for the originality, accuracy, and integrity of the manuscript.

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