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The Effectiveness of Instructional Games Based on Social Constructivist Approach in Interaction with Learning Styles on Improving Affective Yield and Learning Achievement in Mathematics Among Female Students

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A B S T R A C T

Objective: The current research aimed to examine the effectiveness of instructional games based on the social constructivist approach in interaction with learning styles on improving affective yield and learning achievement in mathematics among female middle school students.

Methods and Materials: The research method was a quasi-experimental design with pre-test, post-test, and a control group, including a two-month follow-up stage. The population consisted of all female middle school students in public schools in Hamedan during the 2023-2024 academic year. Initially, using simple random sampling, a school from district 1 of Hamedan was selected, and 100 students meeting the research criteria were chosen and then randomly divided into two experimental groups (25 students in deep learning and 25 in surface learning) and two control groups (25 in deep learning and 25 in surface learning). The experimental groups were exposed to six 90-minute sessions of instructional games based on the social constructivist approach; however, the control groups received no intervention and remained on a waiting list. Data were collected using Biggs and colleagues' (2001) two-factor learning process questionnaire, McCoach and Siegle's (2003) attitude towards school questionnaire, and a researcher-made questionnaire assessing mathematics learning. Data analysis was conducted using SPSS version 24, in both descriptive and inferential statistics (mixed ANOVA and Bonferroni post-hoc tests).

Findings: The results showed the intervention were significantly effective in improving affective yield and mathematics learning achievement ($P<0.05$). Additionally, the results indicated that instructional games based on the social constructivist approach were more effective in students with a deep learning style than those with a surface learning style in improving affective yield and mathematics learning achievement ($P<0.05$).

Conclusion: Based on the findings of this study, it can be concluded that instructional games based on the social constructivist approach can be an appropriate teaching method for improving affective yield and learning achievement, especially in middle school students with a deep learning style.

Keywords: *Instructional games, Social constructivist approach, Learning styles, Affective yield, Mathematics learning.*

1. Introduction

Mathematics has been a significant part of the instructional curriculum from the early years of schooling. In recent years, there has been an increased focus in our country on understanding and deeply comprehending mathematical concepts in a practical manner. This shift has led to changes in the content of mathematics textbooks, the organization of training courses for teachers, and familiarizing them with methods of teaching mathematics (Shirani Bidabadi et al., 2020). Therefore, it can be said that mathematics plays a crucial role in students' learning of other subjects (Wondem et al., 2023). However, some students struggle with learning mathematics, and their learning level is not satisfactory (Paraide et al., 2022). This situation can also affect the affective yield of students. It is observed that students with high self-perception in academics and confidence in their abilities are more likely to engage in various academic activities. Conversely, learners with low academic progress, especially in mathematics, have weaker self-perception in academics, which is a significant factor affecting their affective yield (McCoach & Siegle, 2003).

On the other hand, the learning situation of students in mathematics and their affective yield cannot be examined without considering the learning processes they undergo. Learning processes and styles are influential factors in students' learning (Aghaziarati et al., 2021; Kulasingam & Kaviza, 2022). Learning processes are a set of mental activities that learners or students engage in while studying to effectively receive, organize, and recall information (Abedin et al., 2022). These processes are categorized into surface and deep learning (Hoffmann et al., 2021). Surface learning is a process where students focus only on completing their education, driven by fear of failure. Their intention is merely to memorize content they believe will be needed for evaluations (Mehdinezhad & Esmaeeli, 2015). In contrast, deep learning refers to an approach where intrinsic motivation leads to understanding and comprehension of subjects, and the learner strives to find meaning and connect it with prior knowledge and experiences (Zhou et al., 2022).

Another aspect of learning processes is the strategic approach, where the primary motive of learners is to complete their education with the highest grades possible. Competitive spirit also motivates individuals to study. The main goal is to achieve success, and for this purpose, individuals are prepared to use any tool to reach their goals (Dehghani et al., 2022; Trigwell & Prosser, 2004). It is believed that students who have deep motivation and strategies in their learning processes exhibit higher academic self-efficacy throughout their instructional journey (Aydemir & Bayram Arlı, 2022). Given the complexity of today's world, no one is exempt from the need for education and learning.

Education and learning are integral parts of human life. Thus, the traditional perception of education cannot be sustained, and conventional teaching methods are no longer suitable for addressing the needs of learners in today's advanced society. There is a clear need for transformation and reform in the structure of education and the instructional system (Kordbche et al., 2022; Parsakia, 2023). One of the important methods for learning, particularly in mathematics, is the use of games (Pan et al., 2022).

Playing is an enjoyable activity that is highly appealing to children, and incorporating games in education can enhance motivation in students, leading to better learning (MahdaviNasab et al., 2017). Extensive and increasing research in the area of instructional games is one of the significant reasons for the importance of this variable. Several researchers (Bahr & Rieth, 1989; Burenheide, 2006; Christensen & Gerber, 1990; Hajizad et al., 2014; Moradi & Maleki, 2015; Okolo, 1992; Saleh Sedghpour & Gholamrezaei, 2013; Shariatmadari et al., 2011; Trotter, 2005; Wakefield, 1997) have examined and studied the positive effects of instructional games in teaching-learning activities. Furthermore, some research has shown that instructional games have the potential to be used for enhancing learning in classrooms (Maxwell et al., 2004; Peters, 1998), making education enjoyable (Kirk, 2004), solidifying learning and improving retention, and increasing students' motivation in mathematics (Moradi & Maleki, 2015). Cakmak, Isiksal, and Koc (2014) have referred to the positive impact of the gaming method on learning geometry (Cakmak et al., 2014). Ke and Grabowski (2007) confirm the role of instructional games in academic progress among

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students (Ke & Grabowski, 2007). The learner-centered game design approach is a fruitful and innovative method for teaching and learning (Frossard et al., 2012), and the subject of learner-centeredness and the application of the constructivist approach is emphasized by education experts. According to Zemlinski and Wilcox (2010), employing constructivism and constructivist learning perspectives in game design enables players to fully engage in learning activities, offering opportunities for problem-solving, self-expression, and experiential learning (Zemliansky & Wilcox, 2010). It can also be said that game-based learning can provide immersive experiences in authentic environments, enabling students to develop and demonstrate mastery of basic knowledge through complex concepts, metacognitive skills, and higher-level creativity (Gosper & McNeill, 2012). Overall, as discussed, learner-centered education is a primary driver behind policy and practice in modern education (Coleman & Money, 2020), and with the move towards embracing learner-centricity in classrooms, especially in mathematics learning, understanding where such games are presented and the untapped potentials they hold is vital. Therefore, this research aims to identify the effects of games based on the constructivist approach by examining whether instructional games based on the social constructivist approach, in interaction with learning styles, are effective in improving affective yield and learning achievement in mathematics among female middle school students.

2. Methods and Materials

2.1. Study Design and Participants

The research method, based on its objective, was applied and from the perspective of data collection, it was classified as a quantitative study of the semi-experimental type, involving a pre-test, post-test design with a control group, and a two-month follow-up. The study population comprised all female middle school students studying in public schools in Hamedan during the 2023-2024 academic year. Given the extensive population, cluster random sampling was employed in this research. Firstly, one of the two instructional districts in Hamedan was randomly selected, followed by the random selection of a 600-student school for the research sample. To reach the desired sample, the two-factor learning process questionnaire was administered among fifth-grade students, and 100 students meeting the research criteria were randomly divided into four groups of 25 each (25 in the instructional games group with surface learning style, 25 in the instructional games group with deep learning style, 25 in the control group with surface learning style, and 25 in the control group with deep learning style). Since the suggested group size in instructional research is 15 students, this study, aiming for greater generalizability of results, chose a group size of 25. Informed consent from the student, teacher, and parents, an age range of 11-12 years, enrollment in middle school, and absence of learning disorders or other developmental problems such as ADHD, autism, etc., were the criteria for participation. Exclusion criteria included missing more than two sessions of instructional games, simultaneous participation in other courses or instructional interventions during the study, and incomplete questionnaire responses in the post-test and follow-up phases. Ethical principles maintained in the research included explaining the study objectives, obtaining informed consent, ensuring voluntary participation and the right to withdraw, answering questions, providing results to students and their families upon request, offering intervention sessions to the control group after the post-test and follow-up, and assuring participants and their families of the harmlessness of the instructional game interventions.

2.2. Measures

2.2.1. Learning Process

The Revised Two-Factor Learning Process Questionnaire (R-LPQ-2F) by Biggs et al. (2001): This 20-item questionnaire measures two approaches - surface (surface motivation with questions 3, 7, 11, 15, and 19; surface strategy with questions 4, 8, 12, 16, and 20) and deep (deep motivation with questions 1, 5, 9, 13, and 17; deep strategy with questions 2, 6, 10, 14, and 18). Responses are based on a Likert scale from 1 (strongly disagree) to 5 (strongly agree) (Biggs et al., 2001). The validity of the scale in Iran was examined using factor analysis, yielding values for the Chi-square to degrees of freedom ratio (X^2/d), the Adjusted Goodness of Fit Index (AGFI), the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) of 2.13, 0.91, 0.91, and 0.05, respectively (Kamari et al., 2014). In another study, Cronbach's alpha was used to assess reliability, reporting a coefficient of 0.88 (Sheivandi et al., 2017). Internationally, Hoffman et al. (2021) also reported a reliability coefficient of 0.88 using Cronbach's alpha (Hoffmann et al., 2021). For this research, Cronbach's alpha was used for reliability assessment, yielding coefficients of 0.71 for pre-test, 0.82 for post-test, and 0.91 for follow-up.

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2.2.2. *Attitude Towards School*

The Attitude towards School Questionnaire (MIDAS) by McCoach & Siegle (2003) (McCoach & Siegle, 2003): This questionnaire, standardized in Iran by Mesarabadi (2010), initially included 35 items. However, questions 10, 14, and 21, having low commonality (below 0.50) compared to other items, were excluded, leaving 32 items across five subscales: attitude towards the teacher (questions 1, 7, 11, 12, 13, 25, and 28); motivation/self-regulation (questions 6, 8, 18, 20, 24, 26, 27, 29, and 30); attitude towards school (questions 4, 5, 9, 15, and 35); self-perception in academics (questions 2, 3, 16, 31, 33, and 34); and value orientation towards goals (questions 17, 19, 22, 23, and 32) (Mesrabadi, 2011). Items are rated on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). The questionnaire's validity and reliability were examined by the original authors, resulting in a Chi-square to degrees of freedom ratio (X^2/d) of 1.581, a Comparative Fit Index (CFI) of 0.910, a Root Mean Square Error of Approximation (RMSEA) of 0.059, and a Cronbach's alpha coefficient of 0.89 (McCoach & Siegle, 2003). In the Iranian standardization, coefficients were 0.93 for attitude towards the teacher and class, 0.89 for motivation/self-regulation, 0.92 for attitude towards school, 0.81 for self-perception in academics, and 0.73 for value orientation towards goals (Mesrabadi, 2011). In this study, Cronbach's alpha was used to assess reliability, yielding coefficients of 0.82 for pre-test, 0.76 for post-test, and 0.92 for follow-up.

2.2.3. *Mathematics Learning Achievement*

To assess mathematics learning achievement among middle school students, a teacher-made academic progress test based on Bloom's cognitive domain taxonomy was used. This test comprised 20 questions, each scored between 0 and 1, with a total score range of 0 to 20. Content validity was ensured through the incorporation of fifth-grade mathematics curriculum content, instructional objectives, existing lesson plans, and expert opinions from mathematics teachers. Reliability was assessed using Cronbach's alpha, resulting in coefficients of 0.80 for the pre-test, 0.70 for the post-test, and 0.82 for the follow-up.

2.3. *Intervention*

2.3.1. *Instructional Games*

The instructional games designed based on social constructivism, as outlined by Mahdavi Nasab et al. (2015), encompass several key principles. Each session begins with a problem-centered approach, engaging students in challenges or questions that mimic real-world situations. Collaboration is emphasized, with students working in groups, fostering peer-to-peer interaction. The learner-centered design utilizes stronger students as group leaders, enhancing peer learning. Authentic activities in the games mirror real-life scenarios, making learning more relatable and practical. The teacher's role in providing guidance, support, feedback, and monitoring ensures a structured yet flexible learning environment. This approach not only enhances problem-solving skills but also fosters a deeper understanding and application of mathematical concepts in everyday life (MahdaviNasab et al., 2017).

2.4. *Data analysis*

Descriptive statistics, such as mean and standard deviation, and inferential statistics, including mixed ANOVA (repeated measures), were used. Additionally, the "Bonferroni post-hoc test" and SPSS software version 24 were utilized for comparing assessment stages (pre-test, post-test, follow-up) and instructional games based on the social constructivist approach in interaction with learning styles (surface and deep).

3. Findings and Results

In this study, the statistical population consisted of all female middle school students studying in public schools in Hamedan during the 2023-2024 academic year. Of the 100 students selected, 39% were in the tenth grade, 21% in the eleventh grade, and 40% in the twelfth grade. The table shows the mean and standard deviation of the age of the experimental and control groups. The obtained F-value for comparing the mean ages of the four groups was F = 0.648, which was not statistically significant (sig = 0.586), indicating the age homogeneity of the four groups.

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Table 1

Mean and Standard Deviation of Dependent Variables in Experimental and Control Groups by Learning Styles

Variable	Stage	Experimental				Control			
		Mean		SD		Mean		SD	
		Deep	Surface	Deep	Surface	Deep	Surface	Deep	Surface
Attitude towards Teacher	Pre-test	31.72	31.24	1.563	1.581	31.70	31.55	1.660	1.668
	Post-test	34.96	34.00	1.060	1.555	31.88	31.80	1.453	1.581
	Follow-up	34.92	33.96	1.187	1.485	31.88	31.84	1.453	1.599
Motivation/Self-Regulation	Pre-test	27.80	27.80	0.707	0.707	27.92	28.16	0.702	1.143
	Post-test	30.96	30.16	1.020	0.800	27.96	28.24	0.735	0.128
	Follow-up	30.92	1230	1.115	0.833	28.00	28.20	0.707	1.000
Attitude towards School	Pre-test	15.04	15.00	0.611	0.577	15.00	14.96	0.577	0.611
	Post-test	19.56	18.44	1.083	1.003	15.04	15.00	0.611	0.577
	Follow-up	19.52	18.40	1.122	1.000	15.08	14.96	0.572	0.539
Self-Perception in Academics	Pre-test	17.68	17.84	0.852	0.800	17.72	17.84	0.843	0.800
	Post-test	21.84	20.64	1.463	0.907	17.76	17.88	0.879	0.833
	Follow-up	21.80	20.60	1.528	0.913	17.76	17.80	0.879	0.913
Value Orientation towards Goals	Pre-test	15.08	15.04	0.640	0.676	15.04	15.00	0.611	0.577
	Post-test	19.52	18.48	1.262	1.005	15.12	15.08	0.726	0.572
	Follow-up	19.44	18.44	1.387	1.003	15.16	15.04	0.688	0.539
Mathematics Learning Achievement	Pre-test	15.28	15.68	0.792	0.945	15.56	15.72	0.961	0.891
	Post-test	17.64	17.12	0.907	1.054	15.60	15.76	0.957	0.970
	Follow-up	17.60	17.08	1.000	1.115	15.56	15.72	1.003	0.936

Table 1 presents the mean and standard deviation of the dependent variables for the experimental and control groups (with surface learning style) at different assessment stages (pre-test, post-test, and follow-up). Subsequently, the results of the mixed ANOVA are provided. The assumptions for this statistical analysis were examined, including the normality of the dependent variables assessed by the Shapiro-Wilk test. The homogeneity of variances (post-test) was confirmed by Levene's test ($P < 0.05$). The results of Box's test for the equality of variance-covariance matrices were not statistically significant, indicating the assumption of equality of variance-covariance matrices was met.

Table 2

Results of Mauchly's Test of Sphericity for Affective Yield and Mathematics Learning

Dependent Variables	Mauchly's W	Chi-Square	Df	p
Attitude towards the Teacher	0.092	226.602	2	0.001
Motivation/Self-Regulation	0.137	188.586	2	0.001
Attitude towards School	0.144	184.247	2	0.001
Self-Perception in Academics	0.083	236.777	2	0.001
Value Orientation towards Goals	0.126	196.504	2	0.001
Mathematics Learning Achievement	0.139	187.419	2	0.001

According to Table 2, the Mauchly's Test of Sphericity showed a significant level of 0.001 for affective yield, thus rejecting the sphericity assumption. Consequently, the assumption of equal variances and more precisely, the homogeneity of covariance matrices was not confirmed, leading to a deviation from the standard F-statistical model. Therefore, the Greenhouse-Geisser test was used to examine the within-subject effects of treatment, with results presented in Table 3.

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Table 3

Results of Between-Subject Effects on Affective Yield and Mathematics Learning Achievement

Dependent Variables	Source	F	P	Effect Size
Attitude towards the Teacher	Group	13.516	<0.001	0.297
	Time	194.898	<0.001	0.670
	Group × Time	64.379	<0.001	0.668
Motivation/Self-Regulation	Group	33.805	<0.001	0.514
	Time	243.390	<0.001	0.717
	Group × Time	77.662	<0.001	0.708
Attitude towards School	Group	144.822	<0.001	0.819
	Time	504.504	<0.001	0.840
	Group × Time	167.672	<0.001	0.840
Self-Perception in Academics	Group	65.405	<0.001	0.671
	Time	225.259	<0.001	0.701
	Group × Time	79.093	<0.001	0.712
Value Orientation towards Goals	Group	115.597	<0.001	0.783
	Time	393.804	<0.001	0.804
	Group × Time	124.804	<0.001	0.796
Mathematics Learning Achievement	Group	13.275	<0.001	0.293
	Time	114.816	<0.001	0.545
	Group × Time	41.110	<0.001	0.562

Results in Table 3 indicated that instructional games based on the social constructivist approach had a significant impact on improving affective yield. Further, pairwise comparisons of adjusted mean scores for affective yield across different test stages (pre-test, post-test, and follow-up) are shown in Table 4.

Table 4

Results of the Bonferroni Post Hoc Test for Affective Yield and Mathematics Learning Achievement

Dependent Variables	Comparison Stages	Mean Difference	p
Attitude towards the Teacher	Pre-test - Post-test	-1.360	<0.001
	Pre-test - Follow-up	-1.350	<0.001
	Post-test - Follow-up	0.010	0.999
Motivation/Self-Regulation	Pre-test - Post-test	-1.410	<0.001
	Pre-test - Follow-up	-1.390	<0.001
	Post-test - Follow-up	0.020	0.959
Attitude towards School	Pre-test - Post-test	-2.010	<0.001
	Pre-test - Follow-up	-1.990	<0.001
	Post-test - Follow-up	0.020	0.959
Self-Perception in Academics	Pre-test - Post-test	-1.760	<0.001
	Pre-test - Follow-up	-1.720	<0.001
	Post-test - Follow-up	0.040	0.138
Value Orientation towards Goals	Pre-test - Post-test	-2.010	<0.001
	Pre-test - Follow-up	-1.980	<0.001
	Post-test - Follow-up	0.030	0.538
Mathematics Learning Achievement	Pre-test - Post-test	-0.970	<0.001
	Pre-test - Follow-up	-0.930	<0.001
	Post-test - Follow-up	0.040	0.145

To determine where significant differences in affective yield scores occurred, the Bonferroni post-hoc test was used for pairwise comparisons of means. As indicated in Table 4, the difference between pre-test and post-test means (intervention effect) and pre-test and follow-up means (time effect) were more significant than the difference between post-test and follow-up means (intervention stability effect). This suggests that instructional games based on the social constructivist approach had an impact on affective yield in the post-test stage, and this effect persisted in the follow-up stage. However, it was unclear which learning style (deep or surface) interacted more effectively with these games,

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leading to further analysis using the Bonferroni post-hoc test, with results presented in Table 5.

Table 5

Results of the Bonferroni Post Hoc Test for Affective Yield and Mathematics Learning

Variable	Exp.	Control	Mean diff.	p
Attitude towards the Teacher	Deep	Deep	2.040	0.001
		Surface	2.080	0.001
	Surface	Deep	1.400	0.004
		Surface	1.440	0.003
Motivation/Self-Regulation	Deep	Deep	1.933	0.001
		Surface	1.693	0.001
	Surface	Deep	1.400	0.001
		Surface	1.160	0.001
Attitude towards School	Deep	Deep	3.000	0.001
		Surface	3.067	0.001
	Surface	Deep	2.240	0.001
		Surface	2.307	0.001
Self-Perception in Academics	Deep	Deep	2.693	0.001
		Surface	2.600	0.001
	Surface	Deep	1.947	0.001
		Surface	1.853	0.001
Value Orientation towards Goals	Deep	Deep	2.907	0.001
		Surface	2.973	0.001
	Surface	Deep	2.213	0.001
		Surface	2.280	0.001
Mathematics Learning Achievement	Deep	Deep	1.267	0.001
		Surface	1.107	0.001
	Surface	Deep	1.053	0.001
		Surface	0.893	0.003

Table 5 results showed that the mean difference between the experimental group with a deep learning style and the control group (with both deep and surface learning styles) was greater than that between the experimental group with a surface learning style and the control group. This indicates that instructional games based on the social constructivist approach were more effective in improving affective yield when interacting with a deep learning style compared to a surface learning style.

4. Discussion and Conclusion

The aim of this research was to assess the effectiveness of instructional games based on the social constructivist approach in interaction with learning styles on improving affective yield and learning achievement in mathematics among female middle school students. The results showed that these instructional games had a significant impact on affective yield in the post-test phase, and this effect continued in the follow-up phase. Moreover, the results indicated that the mean difference between the experimental group with a deep learning style and the control group was greater than that of the experimental group with a surface learning style, suggesting greater effectiveness of instructional games based on the social constructivist approach when interacting with a deep learning style in improving affective yield. This hypothesis was confirmed, aligning with the previous findings (Bressler et al., 2018; MahdaviNasab et al., 2017; Vasalou et al., 2017). No inconsistent findings were observed for this hypothesis.

Explaining these results, it can be said that students do not learn in a single way; rather, they tend to select methods for study and learning that they find more comfortable and effective. Research findings show that students use various methods for studying and learning their subjects, influenced by factors such as course content. The way course materials are presented in class may facilitate learning for one student while limiting it for another (Mehdinezhad & Esmaeeli, 2015). Therefore, the efficacy of instructional games based on the social constructivist approach varies for students with deep and surface learning styles, and students with a deep learning style can benefit more from such games. In a constructivist learning environment, games create learning

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conditions for learners and, in this context, games can pose problems for students, motivating them to learn, fostering meaningful participation and dialogue, and paying attention to specific situations and contexts. This enables learners to engage with and solve problems based on their understanding and interaction with the environment. Therefore, when students are placed in a social constructivist learning environment and take on a central role in the game, they can experience more meaningful learning and develop more positive emotions and excitement towards learning and the classroom compared to other students. Research has also shown that students with strategic and deep learning approaches perform better in assessments compared to those with a surface learning approach. Thus, it is logical to conclude that there is a difference in the effectiveness of instructional games based on the social constructivist approach in improving affective yield between students with deep and surface learning styles.

Additionally, the results showed that instructional games based on the social constructivist approach had a significant impact on the learning of mathematics in the post-test phase, and this impact continued in the follow-up phase. The results also indicated that the mean difference between the experimental group with a deep learning style and the control group (with both deep and surface learning styles) was greater than the mean difference between the experimental group with a surface learning style and the control group. This suggests that instructional games based on the social constructivist approach are more effective in improving mathematics learning when interacting with a deep learning style compared to a surface learning style. Therefore, the second hypothesis, positing a difference in the effectiveness of instructional games based on the social constructivist approach on the learning of mathematics among students with deep and surface learning styles, was confirmed. This finding aligns with the results of (Bressler et al., 2018; Burenheide, 2006; MahdaviNasab et al., 2017; Oppong-Gyebi et al., 2023; Vasalou et al., 2017), with no conflicting findings for this hypothesis.

Explaining these results, if we consider learning mathematics as forming meaning and perception in mathematics and aim for mathematical proficiency in knowledge and skills, we should create opportunities for students to engage in activities and learning processes focused on the desired mathematical abilities. Utilizing various techniques and methods for data collection, teaching concepts through everyday life lessons, stories, individual and group games, dialogic mathematics, and activities involving environmental patterns, sequences in daily life, are emphasized in this perspective (Shirani Bidabadi et al., 2020). Also, starting mathematics lessons with familiar problems, allowing students to explore and apply their prior knowledge in real life, group work and collective classroom activities, and encouraging students' creativity in finding innovative solutions to problems and discussing them create an effective learning environment. Therefore, employing instructional games based on the social constructivist approach helps students contextualize mathematics learning in tangible, real-world scenarios, and apply this learning in social experiences, using various methods for learning. Students with a deep learning style, as they perform their academic tasks more meticulously, seek deeper understanding, and have an intrinsic interest in learning, benefit more from constructivist teaching environments, leading to better academic progress in mathematics compared to students with a surface learning style. Thus, it is logical to state that there is a difference in the effectiveness of instructional games based on the social constructivist approach on mathematics learning between students with deep and surface learning styles.

5. Limitations & Suggestions

In generalizing the results to similar students in other cities, caution should be exercised as the study population was limited to female middle school students in public schools in Hamedan. Due to time constraints, the research could not conduct a longer-term follow-up to examine the sustainability of the effects of instructional games based on the social constructivist approach and was limited to a two-month follow-up assessment. Although the study could have been conducted on both male and female students, it was limited to female students due to the circumstances. The limitation of data collection tools to questionnaires and not using other measurement tools is another limitation of this study, as there might have been a bias in the responses of middle school girls, who might have given socially desirable answers. It is recommended to replicate this research in other samples, such as female students in other cities, and scientifically examine some of the questions arising from this study and its background to more definitively answer whether instructional games based on the social constructivist approach are a powerful and effective method compared to other instructional interventions in middle schools in addressing students' academic, emotional, and motivational problems. As the follow-up phase in this study

was two months, it is suggested that future research includes longer follow-up periods (more than six months or even a year) to examine the continuity of instructional games based on the social constructivist approach on middle school girls. As each group in this research comprised 25 participants, future researchers are advised to use a larger sample size to increase the generalizability of the results. Since this research was limited to female students, to address this limitation, it is recommended that the research also be conducted on male students, as the gender factor may be decisive in the research outcome. Undertaking applied research on similar topics in the field of the effectiveness of instructional games based on the social constructivist approach in improving other problems of middle school students, such as learning disorders, attention deficit/hyperactivity disorder, etc., is also suggested. Research comparing the effectiveness of instructional games based on the social constructivist approach with other therapeutic and instructional methods such as parent-child relationship-based play therapy (Filial Therapy), attachment-focused play therapy (Theraplay), etc., could yield results on the effectiveness in improving multiple intelligences, affective yield, and mathematics learning.

At a theoretical level, the results of this study can confirm previous research findings on the effectiveness of instructional games based on the social constructivist approach in improving affective yield and mathematics learning among middle school students in interaction with learning styles. Practically, the findings of this study can be used to develop instructional programs based on the social constructivist approach in counseling centers, middle schools, playhouses, etc. Based on the results, it is suggested that playing, being an enjoyable activity with high appeal for children, can be used in education to increase motivation in students, leading to better learning. Therefore, teachers, administrators, and instructional planners in the education organization can use instructional games based on the social constructivist theory in schools and classrooms. Exploring the barriers to the use of instructional games in the classroom is an issue that should be addressed. Additionally, as students play an active role in instructional games based on the social constructivist approach, and teachers act as facilitators, it is recommended that teachers use these types of games in their instruction to improve learning in mathematics. This approach could potentially reduce academic problems in mathematics among students.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

Tayebeh Javidi Momtaz contributed to the study's design, data collection, and analysis. Davood Taghvaei played a key role in implementing the instructional games and overseeing the experimental groups. Zabih Pirani contributed to the literature review, data analysis, and interpretation of the results. Together, the authors collaborated on the conceptualization of the research, interpretation of findings, and the writing of the manuscript.

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