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Research Article

Exploring the effects of the successful intelligence model on fourth-grade students' learning of fractions

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This study investigated how teaching practices grounded in the Successful Intelligence Model influence fourth-grade students' learning of fractions and their mathematics achievement. A quasi-experimental design was employed using a pretest–posttest control group structure with 56 students attending a public elementary school during. Over a six-week implementation period, the experimental group engaged in learning activities that emphasized analytical, creative, and practical thinking, while the control group followed the standard curriculum prescribed by the Ministry of national education. Data were collected through the Sternberg triarchic abilities test and a Fractions achievement test, and analyzed using both dependent and independent samples *t*-tests. The findings demonstrated that instruction aligned with the Successful Intelligence framework led to notable gains in mathematics achievement compared with traditional instruction. In addition, students in the experimental group showed clear improvements in the analytical, practical, and creative domains of intelligence. These results indicate that integrating the Successful Intelligence Model into classroom teaching not only supports academic growth but also encourages the development of diverse cognitive abilities. The study concludes by recommending the application of this model to different subjects and grade levels to promote flexible and student-centered learning environments.

Keywords: Academic achievement; Fractions; Mathematics instruction; Primary education; Successful intelligence model; Triarchic theory of intelligence

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1. Introduction

Education is a dynamic and multifaceted process through which individuals not only acquire knowledge but also learn to apply it meaningfully in everyday contexts (Organisation for Economic Co-operation and Development [OECD], 2023; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020). In today's rapidly changing world, successful learners are distinguished less by their capacity to memorize and more by their ability to reason, think creatively, and solve problems (Saavedra & Opfer, 2012; Trilling & Fadel, 2009; Voogt & Roblin, 2012). Accordingly, instructional approaches that prioritize 21st-century learning skills aim to promote students' balanced growth across cognitive, emotional, and social domains (Rehman et al., 2024; Saavedra & Opfer, 2012; Trilling & Fadel, 2009). Especially in the early years of schooling, teaching methods play a decisive role in helping students build the competencies they will need to

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meet future academic and life challenges (OECD, 2023).

Among contemporary frameworks designed to enhance the quality of education, the Successful Intelligence Model—which stems from Sternberg's Triarchic Theory of Intelligence—has received growing attention. The model proposes that real-world success depends not solely on academic ability but on the effective integration of analytical, creative, and practical intelligence (Sternberg, 1999; Sternberg & Grigorenko, 2004). Sternberg (2015) defines "successful intelligence" as the capacity to apply these three forms of intelligence in a balanced manner to achieve personal and cultural goals. Unlike traditional conceptions that confine intelligence to cognitive performance, this model highlights the adaptive and purposeful use of knowledge in authentic situations (Sternberg, 2018, 2021a).

When implemented in classroom settings, the Successful Intelligence Model supports active engagement and multidimensional learning. Students are encouraged to participate in activities that challenge them to reason, create, and apply knowledge to new circumstances. Rather than receiving information passively, they interpret, question, and reconstruct it in line with their own understanding. Previous research illustrates the positive effects of this model: Saw and Han (2021) found that students who participated in Successful Intelligence-based programs demonstrated stronger creative thinking and cognitive flexibility, while Sternberg and Grigorenko (2004) reported notable improvements in academic performance across the analytical, practical, and creative domains. Similarly, Rehman et al. (2024) showed that instructional methods inspired by multiple-intelligence and project-based approaches enhance learners' creativity and problem-solving skills, reinforcing the call of international organizations (OECD, 2023; UNESCO, 2020) for education systems to nurture lifelong learning and critical thinking alongside academic competence.

Mathematics is a field in which students' cognitive skills are deeply engaged, yet the subject's abstract nature often poses significant learning barriers. Many students struggle to relate mathematical symbols and operations to real-world meaning, which hinders conceptual understanding and transfer of knowledge (Haara, 2022; Rehman et al., 2024). One of the most persistent challenges in this regard is learning fractions—a topic that demands flexible reasoning about part–whole relationships. Research indicates that elementary students frequently perceive numerators and denominators as independent entities, preventing them from developing proportional reasoning (Malone & Fuchs, 2017; Siegler et al., 2011). Such findings underscore the need for instructional models that combine reasoning, visualization, and creative problem-solving. Activities developed within the Successful Intelligence framework may therefore provide meaningful opportunities to support students' understanding of fractions while engaging their diverse cognitive abilities.

Over the past decade, an increasing number of studies have examined the educational applications of the Successful Intelligence Model. Findings consistently reveal its potential to enhance academic performance, stimulate higher-order thinking, and create learning environments that honor individual differences (Ferrando et al., 2016; Saw & Han, 2021; Stemler et al., 2009). A meta-analysis by Saw and Han (2021) demonstrated that students taught through this model showed marked gains in both achievement and motivation. However, research in Türkiye on the use of this model, particularly in mathematics education at the primary level, remains limited. This scarcity highlights the need for empirical evidence on how the model functions in local contexts and with younger learners.

The present study therefore aims to investigate the effects of teaching based on the Successful Intelligence Model on fourth-grade students' achievement in fractions and their intelligence profiles. Specifically, it seeks to answer the following questions:

RQ 1) Do teaching activities based on the Successful Intelligence Model significantly improve students' academic achievement in fractions?

RQ 2) Do these activities lead to significant changes in students' analytical, practical, and creative intelligence scores?

RQ 3) Is there a meaningful relationship between students' academic achievement and their successful intelligence scores?

By addressing these questions, the study aims to contribute to the development of innovative instructional strategies in mathematics education that consider individual learner differences. Furthermore, by encouraging teachers to design tasks that integrate multiple dimensions of intelligence, this research aspires to enrich classroom practices and foster cognitive diversity in elementary education.

2. Theoretical Framework

Recognizing and addressing individual differences in education helps students better understand how they learn and enhances the quality of instruction. Traditional perspectives on intelligence tend to link success to a single cognitive dimension, assuming that intellectual ability is uniform across learners. In contrast, modern theories describe intelligence as a multifaceted construct shaped by cultural, emotional, and contextual influences (Sternberg, 2003; Sternberg & Grigorenko, 2006). From this standpoint, intelligence encompasses not only how individuals process information but also how they adapt to their environments, interpret experiences, and construct meaning from them (Sternberg, 2021a).

Within this framework, Sternberg's Triarchic Theory of Intelligence conceptualizes intelligence as a threefold system developed through ongoing interactions with environmental and cultural contexts. The theory includes analytical, creative, and practical components. Analytical intelligence involves reasoning, analyzing, and evaluating information; creative intelligence concerns the generation of new ideas and innovative approaches to problem-solving; and practical intelligence refers to applying learned knowledge effectively to real-life situations and social contexts (Sternberg, 1999, 2015).

According to Sternberg (2021a), success in life depends on an individual's ability to balance and integrate these three components. Intelligence, therefore, is not a fixed trait but a capacity that grows through learning experiences. Individuals can learn to switch flexibly between analytical, creative, and practical modes of thinking, which strengthens adaptability and cognitive versatility. In this sense, successful intelligence offers a dynamic perspective that supports lifelong learning and adaptive thinking (Sternberg, 2018; Yu et al., 2025).

Educationally, the Successful Intelligence Model translates this theoretical view into a classroom approach that invites learners to engage their analytical, creative, and practical intelligences in parallel. It proposes that teaching should go beyond the direct transmission of knowledge, providing students with opportunities to express creativity, test ideas, and relate their learning to real-world experiences (Sternberg, 2002; Sternberg & Grigorenko, 2004). Through such experiences, students reconstruct information in light of their prior knowledge, becoming active participants rather than passive recipients. Learning, as envisioned in this model, involves cognitive engagement as well as emotional awareness and problem-solving flexibility (Mohkamkar et al., 2024).

Recent studies provide strong support for the educational value of this model. Research demonstrates that learning environments designed around successful intelligence improve academic achievement, creativity, and social competence, while also enhancing students' psychological well-being (Alismail et al., 2025; Kordnoghabi & Veisi, 2024). For instance, Kordnoghabi and Veisi (2024) found that creative engagement mediated the relationship between successful intelligence and students' sense of wisdom and well-being. Similarly, Alismail et al. (2025) reported that fostering metacognitive awareness through this model contributes to sustainable educational development. Together, these findings suggest that successful intelligence is intertwined with both cognitive and emotional dimensions of learning, offering a holistic foundation for sustainable education.

Sternberg's framework aligns with the 21st-century skills outlined by international organizations such as UNESCO (2020) and the OECD (2023). The OECD Learning Compass 2030 envisions learners as adaptive individuals capable of integrating cognitive, emotional, and social growth. Within this view, the Successful Intelligence Model supports critical and creative thinking, self-regulation, problem-solving, and social awareness (Rehman et al., 2024; Trilling & Fadel, 2009; Voogt & Roblin, 2012). Likewise, UNESCO (2020) emphasizes that education should move beyond knowledge acquisition to include ethical and value-based learning, promoting social responsibility. The Successful Intelligence Model, by encouraging reflection and collaboration, aligns with these priorities and nurtures students' motivation, self-awareness, and sense of connection to others (Saw & Han, 2021; Sternberg, 2018).

Empirical research conducted in different educational settings supports the efficacy of this model. In a comprehensive meta-analysis, Saw and Han (2021) concluded that programs designed around successful intelligence led to measurable gains in academic achievement, cognitive flexibility, and creativity. Mohkamkar et al. (2024) likewise found that this approach increases students' self-awareness and academic engagement, while Alghazo et al. (2023) reported improvements in creative language use and classroom participation when English teachers applied successful intelligence strategies. An important feature of the Successful Intelligence Model is its sensitivity to cultural contexts. Sternberg and Grigorenko (2006) argue that intelligence cannot be separated from the cultural norms and values within which individuals operate. The model thus combines universal cognitive processes with local experiences, allowing for culturally responsive and adaptable learning environments. By doing so, it provides a foundation for developing educational systems that promote inclusivity and sustainability in learning.

In conclusion, the Successful Intelligence Model offers a comprehensive framework that cultivates analytical reasoning, creativity, adaptability, and social awareness—skills that are increasingly vital in 21st-century education. Its holistic approach not only prepares students to meet academic challenges but also helps them navigate the complex realities of modern life. By emphasizing the interplay between cognitive, emotional, and social dimensions, the model fosters a culture of learning in which diverse forms of intelligence are acknowledged and nurtured. Incorporating this model into teaching practices can therefore enrich instruction and support students' development as capable, reflective, and socially responsible learners.

3. Method

3.1. Research Design

This study employed a quantitative research approach within a quasi-experimental framework using a pre-test–post-test control group design. This design represents a strong experimental framework that allows for a comparative analysis of how an experimental intervention (independent variable) influences a dependent variable (Creswell & Creswell, 2018; Fraenkel et al., 2020). In this study, the independent variable was the instructional approach, which had two levels: instruction based on the Successful Intelligence Model in the experimental group [EG] and instruction implemented in accordance with the current MoNE curriculum in the control group [CG]. The dependent variables included students' academic achievement scores on the topic of Fractions and their analytical, creative, practical, and total intelligence scores measured by the Sternberg Triarchic Abilities Test [STAT]. This arrangement allowed for a comparative investigation of the effects of different instructional approaches on students' cognitive performance (Sternberg, 2021a; Zhang et al., 2012).

The quasi-experimental design was preferred because classroom structures in educational settings often do not allow for random assignment (Cook & Campbell, 1979; Shadish et al. 2002). Accordingly, the existing classroom configurations were preserved: The EG received instruction based on the Successful Intelligence Model, while the CG was taught using the traditional instructional process aligned with the Ministry of National Education curriculum. This design ensured that the internal validity of the study was maintained while examining the impact of the intervention on students' achievement and intelligence development. Before the experimental implementation, both groups were administered pre-tests, and after the intervention, post-tests were conducted using the Fractions Achievement Test [FAT] and the STAT. This arrangement made it possible to quantitatively and comparatively assess the effects of the Successful Intelligence Model-based instructional activities on students' cognitive achievement and intelligence components. Overall, this research design provided an appropriate framework for evaluating the effectiveness of instructional interventions and enabled the reliable observation of changes in students' learning processes (Field, 2024). The general structure of the design is summarized in Table 1.

Table 1
Structure of the Research Design

Group	*Pre-test*	*Instructional Process*	*Post-test*
EG	FAT and STAT	Instruction based on the Successful Intelligence Model	FAT and STAT
CG		Instruction based on the MoNE curriculum	

This structure allowed the impact of the instructional intervention to be evaluated comparatively both within groups (pre-test–post-test) and between groups.

3.2. Participants

The study sample comprised 56 fourth-grade students attending a public primary school in Istanbul. The students were from two classes with similar socio-economic backgrounds. One class was designated as the EG (n = 28), while the other served as the CG (n = 28).

Since random assignment was not feasible and the existing classroom structure was preserved, the study was designed as quasi-experimental. Prior to the research, necessary permissions were obtained from the school administration, parents were informed about the study, and written consent for voluntary participation was collected. The research process adhered to established ethical standards.

Before the intervention, both groups were administered the FAT and the STAT to determine whether they were equivalent in terms of achievement and intelligence levels. The STAT consists of three sub-dimensions measuring students' performances in analytical, creative, and practical intelligence. The pre-test mean scores obtained from these tests were compared using an independent samples *t*-test, and the results are presented in Table 2.

Table 2
Independent Samples t-Test Results for Pre-Test Scores on the FAT and STAT

Test Dimensions and Groups	*N*	*Mean*	*SD*	*t*	*p*
FAT					
EG	28	43.57	10.84	.62	.54
CG	28	42.21	11.15		
STAT – Analytical Intelligence					
EG	28	22.36	3.97	.48	.63
CG	28	21.89	4.22		
STAT – Creative Intelligence					
EG	28	24.72	4.31	.51	.61
CG	28	24.11	4.55		
STAT – Practical Intelligence					
EG	28	20.81	3.65	.43	.67
CG	28	20.32	3.84		
STAT – Total Score					
EG	28	67.89	8.43	.49	.63
CG	28	66.47	9.10		

As shown in Table 2, the mean scores of the EG and CG on both the FAT and the overall and subdimensions of the STAT are quite similar. This result suggests that both groups were comparable at the baseline level before the intervention began.

In addition, the similarity in the pre-test mean scores of the STAT subdimensions (analytical, creative, and practical) demonstrates that students exhibited a homogeneous distribution in terms of intelligence types before the instructional process.

Therefore, it can be inferred that the differences observed during the implementation process resulted not from the initial characteristics of the groups but from the instructional activities based on the Successful Intelligence Model. Since no statistically significant difference was found between the pre-test scores of the EG and CG, the groups were considered equivalent at the outset, and the study proceeded with these students.

3.3. Data Collection Tools

3.3.1. Fractions achievement test

The FAT was developed by the researchers to measure fourth-grade students' academic achievement in the topic of fractions. During the development process, the learning outcomes specified in the Ministry of National Education [MoNE] (2018) mathematics curriculum were taken into consideration, and a table of specifications was prepared based on the instructional time allocated for each outcome in the annual plan. The table specified which items corresponded to each learning outcome in order to ensure balanced representation of the content domain. The test covered topics including recognizing and modeling fractions, comparing unit fractions, determining a fraction of a quantity, comparing fractions with equal denominators, and performing addition and subtraction operations with fractions.

Initially, the test consisted of 16 items, including some scenario-based and multi-part questions, resulting in 23 sub-items in total. To ensure content validity, the test items were reviewed by three mathematics education academics and three experienced classroom teachers. Based on the feedback received from these experts, necessary revisions were made to improve the clarity, accuracy, and grade-level appropriateness of the items. Experts generally agreed that the test adequately represented the curriculum outcomes and that the terminology and concepts were appropriate for the target grade level.

A pilot study was conducted with 205 students. The pilot test was administered during a single class period. The collected data were analyzed using the SPSS software package to examine the reliability of the test. Internal consistency was calculated using the Cronbach's Alpha coefficient, which is commonly used to evaluate the reliability of tests containing multiple items measuring the same construct.

The analysis indicated that the Cronbach's Alpha reliability coefficient was .714. Therefore, the reliability coefficient obtained in this study suggests that the Fractions Achievement Test has an acceptable level of internal consistency and can be considered a reliable instrument for measustudents' achievement in fractions. Consequently, the Fractions Achievement Test was used as a data collection tool in this study to evaluate students' academic achievement in the fractions unit.

3.3.2. Sternberg Triarchic Abilities Test

The STAT was developed by Sternberg (1993) to assess individuals' analytical, creative, and practical intelligence (Chooi et al., 2014; Sternberg, 1985, 1988). Sternberg argued that traditional intelligence tests largely measure analytical capacity but fail to adequately capture individuals' creative and practical abilities (Brody, 2003). Therefore, STAT was designed to provide a more comprehensive assessment of intelligence and to reveal how individuals process information across different contexts (Sternberg, 1991a, 1991b, 1993).

The primary purpose of STAT is to evaluate how intelligence operates when individuals process information in various situations (Bermejo García et al., 1996; Sternberg, 1985). The test measures three domains of intelligence: analytical intelligence (reasoning and problem-solving), creative intelligence (generating original ideas and innovative thinking), and practical intelligence (applying knowledge to real-life situations). These dimensions are based on Sternberg's triarchic theory of intelligence, which conceptualizes intelligence as an interaction between cognitive processes and environmental contexts (Sternberg, 2021a).

STAT has several versions developed for different age groups. The version used at the elementary school level is called STAT-E, whereas the high school version is referred to as STAT-H (Galvez et al., 1996). In the present study, the STAT-E version designed for elementary school students was used. The test consists of 90 multiple-choice items and includes three subdimensions: analytical, creative, and practical intelligence. Each subdimension contains 30 items, including 10 verbal, 10 numerical, and 10 figural questions. Each item has four response options, and scoring is conducted dichotomously as 0 (incorrect) and 1 (correct).

The Turkish adaptation of STAT-E was conducted by Ekinci (2014), and its psychometric properties were examined within the framework of Classical Test Theory. In addition, Yaltırık (2021) and Baş Dönergüneş (2021) analyzed the test items using Item Response Theory. In their study conducted with 596 fourth- and fifth-grade students, Rasch model analyses indicated that item difficulty parameters ranged between –1.86 and 2.82, suggesting that the items represent different levels of difficulty and demonstrate acceptable fit indices. The reliability coefficients were reported as .978 for analytical intelligence, .992 for practical intelligence, and .982 for creative intelligence, while the overall reliability coefficient of the test was .998. These findings indicate that the STAT-E test has a high level of reliability.

Based on these psychometric properties, the STAT-E test is considered a reliable and valid instrument for assessing students' analytical, creative, and practical intelligence. Therefore, it was used as a data collection tool in this study to determine students' intelligence profiles.

3.4. Implementation Process and Instructional Content

3.4.1. EG implementation

The instructional intervention implemented in the EG was designed based on the Successful Intelligence Model. The implementation lasted six weeks. The activities were structured to support the analytical, creative, and practical dimensions of intelligence, as proposed in Sternberg's triarchic theory of intelligence.

The instructional process aimed not only to help students acquire conceptual knowledge about fractions but also to encourage them to analyze, creatively represent, and apply mathematical knowledge in real-life contexts. Accordingly, the activities were organized into three categories: analytical activities focusing on comparison and evaluation, creative activities encouraging imagination and production, and practical activities connecting mathematical concepts with daily-life situations.

To promote active participation, various instructional techniques such as group discussions, modeling activities, visual representations, creative drama, storytelling, and problem-solving tasks were incorporated into the lessons. These activities allowed students to explore fraction concepts through different cognitive processes and learning experiences.

The overall structure of the instructional activities organized according to the Successful Intelligence Model is presented in Table 3. As shown in Table 3, the instructional activities were designed to integrate analytical, creative, and practical thinking processes throughout the learning experience. Analytical activities supported students' conceptual understanding by encouraging them to compare, evaluate, and analyze fractions. Creative activities allowed students to express mathematical ideas through imagination and multiple representations. Practical activities, on the other hand, connected mathematical learning with everyday contexts, enabling students to apply their knowledge to authentic situations. Through this multidimensional structure, the instructional process aimed to support both conceptual learning and the development of diverse cognitive abilities.

Table 3
Summary of the Instructional Activities Based on the Successful Intelligence Model

Week	*Intelligence Dimension*	*Key Concepts*	*Instructional Goals*	*Example Activities*
Week 1	Analytical, Creative, Practical	Evaluation, imagination, application	Introduce fractions and activate prior knowledge	Students were informed about the study and pre-tests were administered. Students discussed what fractions represent in daily life. Creative drama and everyday examples (music notes, food portions) were used.
Week 2	Analytical	Evaluating, comparing, explaining	Analyze fractions by identifying similarities and differences	Students compared fraction models and discussed similarities and differences. They examined representations of simple and mixed fractions.
	Creative	Creating, imagination, visualization	Encourage creative understanding of fractions	Students produced drawings and short stories related to fractions and explained real-life meanings.
	Practical	Applying knowledge	Connect fractions with daily-life experiences	Students created examples such as cooking recipes and real-life fraction models.
Week 3	Analytical	Comparing, evaluating	Develop analytical reasoning through fraction comparison	Students compared unit fractions using visual models and symbols (>, <).
	Creative	Imagining, designing	Develop creative thinking through modeling	Students created visual models of unit fractions using different shapes.
	Practical	Applying knowledge in social contexts	Relate fractions to daily-life situations	Students prepared short persuasive speeches about selling products in fractional quantities.
Week 4	Analytical	Evaluating, comparing	Analyze relationships between groups and fractions	Students examined how group sizes change and compared group structures.
	Creative	Producing, imagining	Enhance creativity through artistic activities	Students created colorful visual fraction models using materials such as pastel paints.
	Practical	Applying knowledge	Reinforce concepts through hands-on practice	Students solved problems involving finding fractions of groups.
Week 5	Analytical	Critical thinking	Develop evaluation skills	Students evaluated and discussed previous activities.
	Creative	Creating, dramatization	Develop creativity through problem-based learning	Students created fraction scenarios and performed drama activities.
	Practical	Application	Apply fractions to real-life problems	Students solved real-life addition and subtraction problems involving fractions.
Week 6	Analytical, Creative, Practical	Evaluation, reflection, consolidation	To summarize the learning process based on the Successful Intelligence framework and assess	Students reflected on the activities conducted during the intervention and discussed what they learned about fractions. The instructional process was summarized in terms of analytical, creative, and practical thinking skills. Finally, post-tests were administered to both groups.

3.4.1. CG implementation

In the CG, the fractions unit was taught through the instructional practices typically used in regular classroom instruction and aligned with the recommendations of the Ministry of National Education (MoNE, 2018) mathematics curriculum. The instruction was primarily based on teacher explanations, question–answer interactions, and individual practice activities.

During the lessons, the teacher introduced the concepts of fractions using explanations and examples provided in the textbook. Students followed the textbook sequentially and solved practice questions individually under the teacher's guidance. The teacher provided explanations when necessary, demonstrated solution procedures on the board, and asked short questions to check students' understanding.

The instructional process mainly emphasized procedural understanding and practice through textbook exercises. Students completed worksheets and solved problems related to recognizing fractions, comparing fractions, determining a fraction of a quantity, and performing addition and subtraction operations with fractions. The lessons were conducted in a whole-class format, and students generally worked individually rather than collaboratively.

The duration of the instruction in the CG was the same as in the EG and lasted six weeks. No activities specifically designed to support analytical, creative, or practical intelligence were included in the CG instruction.

3.5. Data Analysis

Before proceeding with data analysis, the normality distribution of the scores obtained from the measurement instruments was examined. The assumption of normality was first tested using the Shapiro–Wilk test, followed by an evaluation of skewness and kurtosis coefficients. According to the data presented in Table 4, all p-values from the Shapiro–Wilk test were found to be greater than .05, indicating that the data did not significantly deviate from a normal distribution. Furthermore, the skewness and kurtosis coefficients fell within the range of –1.5 to +1.5, indicating that the data met the assumption of normal distribution (Tabachnick & Fidell, 2013).

Table 4
Results of the Normality Analysis of the Data

Variable	*Shapiro–Wilk p*	*Skewness*	*Kurtosis*
FAT			
Pre-Test	.168	−0.274	−0.519
Post-Test	.224	−0.437	−0.964
STAT – Total Score			
Pre-Test	.094	0.328	−0.332
Post-Test	.112	−0.415	−0.880
STAT – Analytical Intelligence			
Pre-Test	.131	−0.246	−0.658
Post-Test	.188	−0.382	−1.045
STAT – Creative Intelligence			
Pre-Test	.176	0.141	−0.214
Post-Test	.207	−0.527	−0.936
STAT – Practical Intelligence			
Pre-Test	.140	−0.318	−0.775
Post-Test	.197	−0.474	−0.822

As shown in Table 4, the p values for both pre-test and post-test scores of all five variables were greater than .05. In addition, the skewness and kurtosis coefficients were within the ±1.5 range. Based on these results, it was concluded that the data were normally distributed. Accordingly, paired-samples *t*-tests were used to examine the differences between the pre-test and post-test scores within each group, whereas independent-samples *t*-tests were employed to compare the post-test scores of the EG and CG. Furthermore, the Pearson product–moment correlation coefficient was calculated to examine the relationship between students' achievement scores and their STAT subdimension scores. The level of significance was set at $p < .05$. The results of the data analysis were presented using tables and graphs, and the statistical findings were interpreted and discussed in detail in the discussion section.

4. Findings

4.1. The Effect of Instructional Activities Based on the Successful Intelligence Model on Students' Academic Achievement

The pre-test and post-test scores of the EG and CG on the FAT were compared, and an independent-samples t-test was carried out to identify any significant difference between the groups. The results are presented in Table 5.

Table 5
T-test results for the pre-test and post-test scores of the EG and CG on the FAT

Group and test	*N*	*Mean*	*SD*	*t*	*p*
EG					
Pre-Test	28	43.57	10.84	10.12	<.001
Post-Test	28	71.93	9.46		
CG					
Pre-Test	28	42.21	11.15	3.28	.003
Post-Test	28	51.64	10.27		

As shown in Table 5, both the EG and CG demonstrated an increase in their post-test scores compared to their pre-test scores. The EG's mean score increased from 43.57 in the pre-test to 71.93 in the post-test, while the CG's mean score increased from 42.21 to 51.64. The results of the t-test indicated that the increase observed in the EG was statistically significant ($p < .05$). Although the CG also showed a statistically significant improvement between pre-test and post-test scores, the magnitude of this increase was considerably lower than that observed in the EG.

These findings suggest that instructional activities based on the Successful Intelligence Model contributed substantially to students' academic achievement in the topic of fractions. While students in the CG improved their performance following the regular curriculum instruction, the higher increase observed in the EG indicates that the Successful Intelligence Model-based instructional activities were more effective in enhancing students' learning outcomes.

4.2. The Effect of Successful Intelligence Model-Based Instruction on Types of Intelligence and Overall Intelligence Scores

The pre-test and post-test mean scores of the EG and CG on the STAT subdimensions (analytical, creative, and practical) as well as the overall STAT total score were compared. The analysis results are shown in Table 6. As shown in Table 6, the students in the EG demonstrated significant increases in their analytical, creative, practical, and overall STAT total scores after the implementation ($p < .05$). The comparison of pre-test and post-test mean scores indicates that the EG showed notable improvements across all STAT dimensions following the instructional intervention. In contrast, no statistically significant differences were found between the pre-test and post-test mean scores of the CG ($p > .05$).

These results suggest that the instructional activities based on the Successful Intelligence Model contributed to the development of students' analytical, creative, and practical intelligence as well as their overall successful intelligence levels. While slight increases were observed in the CG's mean scores, these changes were not statistically significant. Therefore, the findings indicate that the observed improvements in the EG may be attributed to the implementation of the Successful Intelligence Model-based instruction.

Table 6
Comparison Results of the EG and CG Pre-Test and Post-Test Scores on the STAT Subdimensions and Total Score

Test Dimensions and Groups	*N*	*Pre-test Mean*	*Post-test Mean*	*t*	*p*
STAT – Analytical Intelligence					
EG	28	22.36	28.18	7.25	<.001
CG	28	21.89	23.25	1.64	.110
STAT – Creative Intelligence					
EG	28	24.72	30.41	6.83	<.001
CG	28	24.11	25.02	0.97	.338
STAT – Practical Intelligence					
EG	28	20.81	27.37	8.02	<.001
CG	28	20.32	21.15	1.22	.230
STAT – Total Score					
EG	28	67.89	85.96	8.44	<.001
CG	28	66.47	69.42	1.48	.147

4.3. The Relationship between Students' Achievement Scores and Successful Intelligence Scores

The post-test scores from the FAT and the STAT total and subdimension scores were analyzed using the Pearson product–moment correlation coefficient. The results of this analysis are presented in Table 7.

Table 7
Results of the Correlation Analysis for the EG's Post-Test Scores

Scale/Subdimension	*Achievement Test*	*STAT Total*	*Analytical*	*Practical*	*Creative*
Achievement Test	–				
STAT Total	.636**	–			
Analytical	.578**	.879**	–		
Practical	.304	.634**	.492**	–	
Creative	.554**	.817**	.524**	.261	–

Note. Correlations significant at the p < .01 (two-tailed) level are indicated with **.

As shown in Table 7, based on the post-test data of the EG, a moderate positive correlation was found between the Achievement Test and the STAT total score (r = .636, p < .01). Similarly, moderate correlations were identified between the achievement test and analytical intelligence (r = .578, p < .01) as well as creative intelligence (r = .554, p < .01). The STAT total score showed a high positive correlation with analytical intelligence (r = .879, p < .01) and creative intelligence (r = .817, p < .01), and a moderate correlation with practical intelligence (r = .634, p < .01). Furthermore, analytical intelligence was moderately correlated with practical (r = .492, p < .01) and creative intelligence (r = .524, p < .01). However, the correlation between practical and creative intelligence was low and non-significant (r = .261, p > .05).

Overall, these findings indicate that students' academic achievement in the fractions topic was positively associated with their successful intelligence levels. In particular, analytical and creative intelligence showed moderate relationships with achievement, suggesting that students who demonstrated stronger analytical reasoning and creative thinking skills tended to achieve higher mathematics scores. Although practical intelligence showed a positive correlation with achievement, this relationship was not statistically significant. In addition, the strong correlations between the STAT total score and its subdimensions confirm that analytical, practical, and creative intelligence collectively contribute to the overall structure of successful intelligence.

5. Discussion

This study examined the effects of instructional activities based on the Successful Intelligence Model on fourth-grade students' academic achievement and intelligence types in the topic of fractions. The findings revealed that the model led to significant improvements in students' achievement levels as well as their analytical, creative, practical, and overall intelligence scores. These results suggest that the Successful Intelligence Model supports deeper learning by activating multiple modes of thinking during the learning process. According to the triarchic theory of intelligence, effective learning occurs when analytical, creative, and practical thinking processes are integrated within instructional environments (Xiang, 2025). Similarly, Sternberg (2021b) emphasized that intelligence should be understood as an interaction between the person, the task, and the situation, indicating that instructional approaches addressing diverse cognitive processes may enhance students' learning outcomes.

The findings also showed that both the EG and CG improved their achievement scores from pre-test to post-test. This result indicates that students in the CG were also able to learn the fractions topic through instruction aligned with the national curriculum. However, the comparison of post-test scores revealed a statistically significant difference in favor of the EG. This finding suggests that instructional activities structured according to the Successful Intelligence Model may provide richer learning opportunities than conventional instruction. Similar findings have been reported in previous studies demonstrating that successful intelligence-based instruction enhances students' analytical, creative, and practical thinking skills and contributes to improved academic performance (Azid & Md-Ali, 2020; Yu et al., 2025).

The results related to intelligence dimensions indicated significant improvements in analytical and practical intelligence scores in the EG, while the increase in creative intelligence was not statistically significant. One possible explanation for this finding is that the development of creative thinking often requires longer instructional periods and more extensive creative learning experiences. In addition, the fractions topic may provide more opportunities for analytical reasoning and practical application than for creative exploration. Previous research also indicates that the development of creative thinking may depend on the duration and diversity of learning activities implemented in instructional environments (Ordoni et al., 2024). Therefore, the stronger development observed in analytical and practical intelligence in this study may be related to both the nature of the mathematical content and the duration of the instructional intervention.

Previous research also supports the effectiveness of instructional approaches grounded in the triarchic theory of intelligence in mathematics education. For example, Simanullang et al. (2024) reported that mathematics learning models developed according to the triarchic intelligence framework improve students' conceptual understanding and strategic thinking skills. Similarly, studies examining students' intelligence profiles and instructional practices indicate that multidimensional teaching approaches can support the development of different intelligence dimensions simultaneously (Kiyugan & Accad, 2025). These findings align with the results of the present study, suggesting that learning environments integrating analytical, creative, and practical learning experiences contribute positively to students' academic development.

Another important finding of the present study was the positive relationship between students' academic achievement scores and their successful intelligence scores. The correlation analysis revealed moderate relationships between achievement scores and several dimensions of the STAT test. This finding supports the view that academic success is closely associated with the balanced development of multiple cognitive abilities (Asiedu Menlah & Boateng, 2025; Kurdal & Kaplan, 2026). Sternberg's theory conceptualizes successful intelligence as a dynamic interaction among analytical, creative, and practical processes rather than as a single cognitive ability (Xiang, 2025). Supporting this perspective, Nguyen et al. (2022) proposed a framework for assessing students' intellectual development based on the triarchic theory of intelligence, emphasizing the importance of integrating diverse cognitive competencies within educational practices.

Research has also highlighted broader educational outcomes associated with successful intelligence-oriented instructional practices. For instance, Mohammadinezhad et al. (2023) reported that teaching styles based on successful intelligence positively influence students' psychological needs and identity development. Similarly, Sabbah and Aldin (2022) found that students demonstrating high academic performance tend to exhibit behavioral characteristics associated with analytical, creative, and practical intelligence dimensions. These findings indicate that successful intelligence-based instructional approaches may contribute not only to academic achievement but also to students' broader cognitive and personal development.

Overall, the findings of this study contribute to the growing body of literature emphasizing the educational benefits of instructional environments that integrate multiple modes of thinking. By providing students with opportunities to engage in analytical reasoning, creative exploration, and practical problem solving, the Successful Intelligence Model may support deeper conceptual understanding and foster more meaningful learning experiences in mathematics education.

6. Conclusion and Implications

This study investigated the effects of instructional activities based on the Successful Intelligence Model on fourth-grade students' academic achievement and intelligence types in the topic of fractions. The results demonstrated that the model significantly improved students' mathematics achievement and supported the development of analytical and practical intelligence. These findings support the theoretical assumptions of the triarchic theory of intelligence, which suggests that learning becomes more effective when analytical, creative, and practical thinking processes are integrated within instructional environments (Xiang, 2025).

The results also indicated that students in the EG reconstructed their mathematical understanding through reasoning, discussion, and real-life applications rather than relying solely on procedural learning. Such learning experiences allow students to actively engage with mathematical concepts and apply their knowledge in meaningful contexts. Previous studies similarly report that successful intelligence-based instructional environments enhance students' cognitive flexibility and thinking skills (Azid & Md-Ali, 2020; Yu et al., 2025).

Although the results showed significant improvements in analytical and practical intelligence, the increase in creative intelligence was not statistically significant. This finding may be related to the relatively short duration of the intervention and the limited opportunities for creative exploration within the fractions topic. Previous research suggests that the development of creative thinking tends to benefit from sustained and iterative instructional processes, as well as from varied learning experiences that involve inquiry, design, collaboration, reflection, and meaningful exploration (Aziz et al., 2026; Dima et al., 2026; Fikri et al., 2026; Nasution et al., 2025; Ordoni et al., 2024).Therefore, longer implementations of successful intelligence-based instructional approaches may produce stronger improvements in students' creative thinking abilities.

The positive correlation found between academic achievement and intelligence scores further supports the argument that successful intelligence represents an interaction among multiple cognitive processes rather than a single ability. Educational research increasingly emphasizes that learning environments encouraging diverse thinking processes can enhance both academic success and broader cognitive development (Mohammadinezhad et al., 2023; Nguyen et al., 2022). Similarly, Research examining students' cognitive characteristics suggests that stronger academic or mathematical performance is often associated with higher levels of analytical thinking, mathematical reasoning, creative problem-solving, and the ability to apply knowledge in meaningful or real-life contexts, rather than with a single undifferentiated cognitive trait alone (Arabacı & Baki, 2023; Sabbah & Aldin, 2022; Süzen & Kula Ünver, 2025).

From a pedagogical perspective, the findings suggest that mathematics instruction should incorporate activities that stimulate analytical reasoning, creative thinking, and practical problem solving simultaneously. Learning environments that include exploration, discussion, and real-life applications may support students' deeper conceptual understanding and improve their ability to transfer mathematical knowledge across contexts. Research examining instructional practices aligned with intelligence dimensions also highlights that multidimensional learning environments can address diverse learning needs and support students' cognitive development (Kiyugan & Accad, 2025; Simanullang et al., 2024).

Future research could examine the implementation of the Successful Intelligence Model across different grade levels, subject areas, and educational contexts. Longer-term studies may also provide deeper insights into how successful intelligence-based instructional approaches influence students' creativity, motivation, and higher-order thinking skills. In addition, integrating successful intelligence-based instructional practices with interdisciplinary learning environments may contribute to the development of more comprehensive educational practices.

In conclusion, the findings of this study demonstrate that the Successful Intelligence Model represents an effective instructional approach for improving students' academic achievement while simultaneously supporting the development of diverse cognitive abilities. By encouraging students to engage in analytical, creative, and practical thinking processes, the model may contribute to the development of learners who are adaptable, reflective, and capable of applying their knowledge in real-life situations.

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Data Availability: The data supporting the findings of this study are available from the corresponding author upon reasonable request. To protect participant confidentiality, full transcripts are not publicly available.

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