Iranian Journal of Educational Sociology

Journal Website

Article history:
Received 01 May 2025
Revised 03 July 2025
Accepted 12 July 2025
Published online 25 August 2025

Iranian Journal of Educational Sociology

Volume 8, Issue 3, pp 1-14

Quarterly Iranian Journal of Educational Sociology

E-ISSN: 2645-3460

Proposing a Suitable Integrated Model of Cooperative Learning Styles and Its Impact on Academic Achievement and Mathematics Anxiety Among Ninth-Grade Students: A Mixed-Methods Study

Ali. Shahrabi Farahani[1*], Mohammad Reza. Keramati[1], Mohammad. Javadipour[1], Keyvan. Salehi[1]

[1] Curriculum and Educational Methods and Planning Department, Faculty of Psychology and Educational Sciences, University of Tehran, Tehran, Iran

*** Corresponding author email address**: alifarahani92@gmail.com

Article Info

Article type:
Original Research

How to cite this article:
Shahrabi Farahani, A., Keramati, M. R., Javadipour, M., & Salehi, K. (2025). Proposing a Suitable Integrated Model of Cooperative Learning Styles and Its Impact on Academic Achievement and Mathematics Anxiety Among Ninth-Grade Students: A Mixed-Methods Study. *Iranian Journal of Educational Sociology, 8*(3), 1-14.
https://doi.org/10.61838/kman.ijes.8.3.10

ABSTRACT

Purpose: This study aimed to evaluate the effectiveness of an integrated cooperative learning model in reducing mathematics anxiety and enhancing academic achievement among ninth-grade students.

Methods and Materials: A mixed-methods exploratory research design was employed. In the qualitative phase, a conceptual framework was developed by synthesizing cooperative learning strategies from existing literature and focus group interviews with educators. The final model incorporated multiple cooperative strategies, including the jigsaw method, problem-based learning, team games tournament, and peer teaching. In the quantitative phase, a quasi-experimental method with pretest-posttest and control group design was used. Sixty ninth-grade students from two mathematics classes in Tehran were randomly assigned to either the control group (traditional instruction) or the experimental group (integrated cooperative model). Mathematics anxiety was measured using a standardized questionnaire, and academic achievement was assessed through math tests. Data were analyzed using ANCOVA to control for pretest differences.

Findings: ANCOVA results indicated a significant effect of the integrated cooperative learning model on reducing mathematics anxiety, $F(1, 57) = 83.449$, $p < .001$, with a large effect size ($\eta^2 = 0.594$). Additionally, a significant improvement in academic achievement was observed in the experimental group compared to the control group, $F(1, 56) = 6.236$, $p < .001$, with a moderate effect size ($\eta^2 = 0.100$).

Conclusion: These findings support the use of structured, student-centered, and collaborative instructional methods as viable alternatives to traditional teaching, particularly in mathematics classrooms where anxiety and low achievement are prevalent.

Keywords: *Cooperative learning, mathematics anxiety, academic achievement, instructional model, secondary education, collaborative teaching.*

1. Introduction

Teaching and learning in a modern classroom are no longer considered mere activities of knowledge transmission, as education has become a multifaceted concept aimed at fostering critical thinking, collaboration, and learner interaction (Jafari Sani et al., 2017; Kafshchian Moghadam et al., 2024; Nelson, 2017). In light of this multifaceted approach in curriculum and related learning objectives, there is an increasing need for cooperation to establish an effective learning environment. In other words, the focus is no longer on teacher-centered methods; instead, strategies have shifted toward learner-centered and learning-centered approaches (Mahmodi et al., 2023; Nazari Ardabili et al., 2024; Por Jafari shir Joposht et al., 2024).

In Iran's educational system, teachers often rely on traditional methods—particularly lecturing—that encourage students to memorize and repeat scientific concepts. In mathematics education specifically, in addition to lectures, excessive homework and practice exercises are used as tools for teaching (Bijani Kashk & Pourzal, 2023). Despite the emphasis on active student engagement, intellectual growth, and independent thinking, traditional methods continue to dominate. According to educational experts, students learn more effectively and enjoy the process when engaged in active learning; they participate more and assume responsibility for their own learning (Karamati, 2017, 2019). One of the most recognized active learning methods is cooperative learning, which has drawn increasing attention from scholars (Agwu & Nmadu, 2023; Diani & Dwijanto, 2020; Gillies et al., 2023; Johnson & Johnson, 2019; Marashi & Khatami, 2017; Nazari, 2023; Tarawneh, 2012). In this study, in addition to identifying various styles of cooperative learning through expert interviews and a review of scholarly resources, a practical, integrated model of cooperative learning styles for teaching mathematics in the lower secondary level is developed with the goal of improving math instruction.

The concept of cooperative learning refers to classroom techniques in which students work in small groups of two or more. Each group is assigned specific tasks to achieve a particular objective, and the group members receive instruction tailored to the group's collective performance (Tarawneh, 2012). Al-Heila (1999) demonstrated that cooperative learning is one of the instructional methods endorsed by the contemporary educational reform movement, with studies confirming its effectiveness in promoting academic achievement and the development of teamwork skills in everyday life. Learners can engage in two types of activities within cooperative learning: innovative activities that stimulate student motivation for interaction, and cognitive activities. The aim of these activities is to transfer knowledge, facts, and rules to students. This approach also enhances the overall effectiveness of instruction, especially for students (Abd Algani & Abu Alhaija, 2021).

One of the goals of cooperative learning is to enable students to engage in mathematics learning out of internal satisfaction, rather than through external incentives. If this goal is achieved, students will be equipped to create favorable learning conditions for themselves in the future, not only in mathematics but in other subject areas as well. The reason this study adopts a cooperative learning approach is that research shows it supports student development in multiple dimensions: fostering teamwork skills, encouraging independence, teaching responsibility, and cultivating leadership abilities. One of the implicit goals of cooperative learning is to strengthen leadership potential, as all group members are expected to take turns in leadership roles, thus improving their self-confidence (Koskinen & Pitkäniemi, 2022).

Several studies have shown the effectiveness of cooperative learning in enhancing creative thinking and reading skills (Habibi-Kaleybar, 2018), increasing creativity and academic motivation, fostering creative thinking and mathematical creativity, improving self-regulation, and boosting motivation for academic achievement (Polat et al., 2022). Other studies have confirmed its role in increasing creativity and motivation in language learning (Marashi & Khatami, 2017).

Given the numerous constraints in Iranian school environments, it is essential to first identify these limitations. With those in mind, cooperative learning styles and approaches must be adapted to fit these conditions in order to enhance students' learning outcomes, make math instruction more enjoyable, and increase students' intrinsic motivation. Moreover, given the limited number of studies addressing the impact of cooperative learning on mathematics anxiety and academic achievement—and the fact that few have examined all these variables together—this combination represents a novel contribution. Therefore, the present study seeks to answer the following questions: Is it possible to design a suitable integrated model of cooperative learning styles? And does this integrated model impact students' academic achievement and mathematics anxiety?

E-ISSN: 2645-3460

2. Methods and Materials

This study employed an exploratory mixed-methods research design. The objective was to identify, through qualitative methods, the key components of cooperative learning styles applicable to mathematics instruction, as well as the dimensions of an integrated cooperative learning model and the initial framework for such a model. Subsequently, the effectiveness of this model was assessed using quantitative methods. Therefore, the first phase of the study, the qualitative part, was categorized as descriptive and library-based research, which involved reviewing the literature on cooperative learning over a five-year period leading up to 2023. The second phase, the quantitative part, was conducted using a quasi-experimental design in which two groups—experimental and control—were compared based on researcher-led interventions.

By integrating qualitative and quantitative findings, a comprehensive perspective was achieved—one that would not have been attainable through either method alone. Moreover, mixed-methods research contributes significantly to clarifying the similarities and differences among specific aspects of a phenomenon. Utilizing both types of data allows the researcher to generalize findings to the broader population while also gaining deeper insight into the phenomenon of interest. This approach also enables theoretical testing and refinement based on participant feedback.

For participant selection in the focus group, purposive sampling was used. This method ensured that only individuals with substantial understanding and expertise in the subject matter were included. Accordingly, based on consultation with university faculty members, a focus group was formed comprising four curriculum specialists and six experienced ninth-grade mathematics teachers. Their perspectives were used to examine the identified indicators, dimensions, and categorizations of the integrated cooperative learning model. Participant information for the focus group is presented in the table below:

Table 1

Focus Group Participant Information

No.	Gender	Age	Academic Degree	Field of Study	Research/Professional Experience (Years)
1	Male	38	M.Sc.	Mathematical Statistics	6
2	Male	49	Ph.D.	Educational Management	17
3	Female	46	M.Sc.	Mathematics Education	16
4	Male	51	Ph.D.	Educational Sciences	18
5	Female	47	M.Sc.	Statistics (Mathematical Statistics)	13
6	Male	58	Ph.D.	Curriculum Planning	22
7	Male	38	M.Sc.	Statistics	17
8	Female	39	M.Sc.	Mathematics Education	11
9	Male	54	B.Sc.	Mathematics	24
10	Male	48	Ph.D.	Educational Technology	18

Using purposive sampling helped identify information-rich cases for in-depth investigation, thereby enabling a comprehensive understanding of the research questions. Given communication constraints, the snowball sampling technique was also utilized. In this approach, initial participants were asked to refer other qualified individuals to the researcher, facilitating the identification of additional specialists.

Following the completion of the learning sessions on Chapter 2 of the mathematics textbook, the post-test and a follow-up survey on mathematics anxiety were conducted to determine the effects of the cooperative learning program on students' academic progress and anxiety levels in the experimental group. The post-test was based on Chapter 2, which both control and experimental groups had studied during the same time period. At this stage, due to various reasons, some students were absent, and their scores were excluded from the final analysis. The remaining data were subjected to statistical analysis.

The quantitative phase of the study was conducted in the field. Initially, Chapter 1 of the ninth-grade mathematics textbook was fully taught by two teachers in two conveniently selected classrooms. A pre-test was then administered to students in both classrooms, and a questionnaire was distributed to both groups. The intervention phase then commenced: students taught by the researcher constituted the experimental group, while the other class followed traditional instruction as the control group for Chapter 2. After completing the intervention, a post-test based on Chapter 2 was administered, and the questionnaire was redistributed.

Quantitative data analysis was conducted using SPSS version 26. The analyzed data included results from the mathematics exams (pre-test and post-test) and responses to the student questionnaire. For academic achievement, ANCOVA, independent t-tests, and paired t-tests were applied. For questionnaire responses related to mathematics anxiety, ANCOVA was used. The assumptions tested for ANCOVA in the quantitative data analysis included independence of scores for each participant, normality (tested using the Kolmogorov–Smirnov test), homogeneity of variances (tested using Levene’s test), and homogeneity of regression slopes.

3. Findings and Results

In the qualitative phase of the present study, an effort was made to examine the integrated model of cooperative learning based on prior domestic and international studies conducted over the past five years. To clarify the findings, descriptive statistics derived from the literature review are presented first, followed by the results of inferential analysis.

A review of national and international studies over a five-year period revealed that 45 articles—quantitative, qualitative, and mixed-methods—had been conducted on the relationship between cooperative learning styles and strategies in the context of mathematics instruction. The results of these studies are presented in the following table. For accurate coding in subsequent analyses, each article was assigned a unique identifier: “QN” for quantitative, “QL” for qualitative, and “M” for mixed-methods studies. Additionally, each entry includes the authors’ names, year, research method, sample, and cooperative learning styles or strategies identified.

Table 2

Preliminary Information Related to Extracted Studies

Article ID	Authors and Year	Study Location	Method	Sample	Cooperative Learning Styles
QN1	Emani Saribegloo et al. (2019)	Iran	Quantitative	Students, Teachers	Reverse Jigsaw Method
QN2	Mousavi & Sardari (2019)	Iran	Quantitative	Students	Jigsaw Method
QN3	Nosrati (2019)	Iran	Quantitative	Students	Brainstorming, Problem-Based Learning
QN4	Keyhan & Pooreh (2020)	Iran	Quantitative	Students	Reverse Jigsaw Method
QN5	Niaris & Ghiyoumi (2020)	Iran	Quantitative	Students	Team-Based Cooperative Learning
QN6	Afsharizadeh et al. (2020)	Iran	Quantitative	Students	Inductive Method, Jigsaw Method
QN7	Ghaffari et al. (2020)	Iran	Quantitative	Students	Inductive Method
QN8	Khatib Zanjani & Alizadeh (2020)	Iran	Quantitative	Students	Peer-Assisted Learning
QN9	Rezaei & Sohrabi (2021)	Iran	Quantitative	Students	Problem-Based Learning
QN10	Ahmadabadi et al. (2021)	Iran	Quantitative	Students	Reverse Jigsaw Method, Group Reporting
QN11	Jafarabadi Ashtiani & Noumanov (2021)	Iran	Quantitative	Students	E-learning with Problem-Based Learning
QN12	Bahrami et al. (2021)	Iran	Quantitative	Students	Problem-Based Learning
QN13	Saadatnejad et al. (2021)	Iran	Quantitative	Students	Brainstorming
QN14	Jafari & Nik Amal (2022)	Iran	Quantitative	Students	Jigsaw Method
QN15	Owrak & Saif (2022)	Iran	Quantitative	Students	Problem-Based Learning
QN16	Ranjeh et al. (2023)	Iran	Quantitative	Students	Collaborative Thinking
QL1	Arabi et al. (2023)	Iran	Qualitative	Teachers	Team Games Tournament
QN17	Kane (2019)	USA	Quantitative	Students	Puzzle-Based Instruction, Peer-Assisted Learning
QN18	Lestari et al. (2019)	Japan	Quantitative	Students	Puzzle-Based Instruction
QN19	Jian (2019)	China	Quantitative	Students	Flipped Classroom
QN20	Chrisnawati et al. (2019)	Indonesia	Quantitative	Students	Numbered Heads, Discovery Learning, Problem-Based Learning, Team Games Tournament
QL2	Erbil (2020)	-	Qualitative	-	Flipped Classroom
QN21	Hutapea & Anggraini (2020)	Indonesia	Quantitative	Students	Flipped Classroom
QN22	Abd Algani & Abu Alhaija (2021)	Jordan	Quantitative	Students, Teachers	Group Progress Division, Puzzle-Based Instruction, Team-Based Cooperative Reading
QN23	Villacrés Guerra (2021)	Spain	Quantitative	Students	Project-Based Method
QN24	Hossein-Mohand et al. (2021)	Spain	Quantitative	Teachers	Reverse Jigsaw Method, Project-Based Method, Team Games Tournament

QN25	Kong (2021)	Philippines	Quantitative	Students	Brainstorming, Group Reporting, Problem-Based Learning, Group Games
QN26	Knopik & Oszwa (2021)	Spain	Quantitative	Students	Problem-Based Learning
QL3	Suárez-Pellicioni et al. (2021)	Spain	Qualitative	Students	Puzzle-Based Instruction
QN27	Batoy et al. (2022)	Philippines	Quantitative	Students	Jigsaw Method
M1	Sugianto et al. (2022)	Indonesia	Mixed	Students	Team Games Tournament with Rainbow Math Cards
QN28	Rafiei Taba Zavareh et al. (2022)	Iran	Quantitative	Students	Jigsaw Method
QL4	Anrrango Colta (2022)	Spain	Qualitative	Students	Team Games Tournament, Problem-Based Learning, Project-Based Method
QL5	Benavides Aldaz (2022)	Ecuador	Qualitative	Students	Reverse Jigsaw Method
QN29	Harahap & Harahap (2022)	Indonesia	Quantitative	Students	Peer Teaching
QN30	Purba (2022)	India	Quantitative	Students	Group Progress Division
QN31	Komariyah (2022)	Indonesia	Quantitative	Students	Group Resume Model
QN32	Istikomah & Juandi (2023)	Turkey	Quantitative	Students	Pair Dialogue and Brainstorming
QL6	Fatimah et al. (2023)	-	Qualitative	-	Jigsaw Method
QN33	Kartini (2023)	Indonesia	Quantitative	Students	Pair Dialogue and Brainstorming
QN34	Sarikaya & Eğmir (2023)	Turkey	Quantitative	Students	Group Progress Division, Team Games Tournament
QN35	Smit et al. (2023)	Switzerland	Quantitative	Students	Mastery Learning Method
QL7	Boye & Agyei (2023)	Ghana	Qualitative	Teachers	Problem-Based Learning
QL8	Qiu et al. (2023)	China	Qualitative	Students	Peer Teaching
QN36	Cortez et al. (2023)	Philippines	Quantitative	Students	Electronic Brainstorming

To reach an integrated cooperative learning model, the criteria and indicators associated with each learning style were first examined, and then, based on this analysis, a cooperative learning model was developed by integrating selected styles. In this process, coding was applied to the indicators and criteria of each cooperative learning style to ensure all core aspects were considered. The final outcome presents the distribution and frequency of cooperative learning styles. It is noteworthy that the order of styles is based on their frequency of occurrence in national and international studies, indicating their generalizability and effectiveness. The results of the analysis of cooperative learning styles are shown in the table below.

Table 3

Classification of Cooperative Learning Styles

Cooperative Learning Style	Criteria	Indicators	Article IDs
Problem-Based Learning	Active learning	Each group is given a problem in the form of a question to assess capability— all individuals are actively involved in the group task	QN3, QN9, QN11, QN12, QN15, QN20, QN25, QN26, QL4, QL7
	Confidence building	Developing knowledge and skills, free and constructive participation, problem analysis, evaluating proposed solutions, expressing thoughts and emotions	
	Group approach	Cooperation, idea exchange, data collection and evaluation, task allocation	
Jigsaw Method	Synergy	Each student studies a section and teaches it to others	QN2, QN6, QN14, QN27, QN28, QL6
	Attitude improvement	Individual access to content, sufficient time to study, expert group formation for clarification	
Team Games Tournament	Communication skills	Use of Rainbow Math Cards, peer teaching, expressing ideas through math games	QL1, QN20, QN24, M1, QL4, QN34
	Motivation enhancement	Easier study process, group relaxation, reduced fear of punishment	
Reverse Jigsaw	Thematic unity	Presence in main and expert groups, awareness of diverse interpretations of a single topic	QN1, QN4, QN10, QN24, QL5
	Social support	High support from peers and teachers, student control over processes, anxiety reduction	
Puzzle-Based Instruction	Information integration	Breaking down educational content, sharing knowledge within group	QN17, QN18, QN22, QL3

Brainstorming	Divergent thinking	Linking solutions and ideas, idea generation, no criticism or judgment, voluntary participation	QN3, QN13, QN25
	Negotiation-based	Enhancing info transfer skills, open discussions, teacher as facilitator	
Flipped Classroom	Blended learning environment	Combining in-person and digital learning, use of audio-visual materials	QN19, QL2, QN21
Progress-Based Grouping	Grading system	Individual base score, group average based on adjusted scores, formative evaluation	QN22, QN30, QN34
Project-Based Method	Project-driven process	Organizing tasks on a timeline, linking school learning with real life	QN23, QN24, QL4
Team-Based Cooperative Learning	Interdependence	Shared responsibility, collaborative success, group interviews and discussions	QN5, QN22
Peer-Assisted Learning	Group-based experience	Engaging students in team-based learning using four performance-focused tasks	QN8, QN17
Group Reporting	Collective report	Forming one group during the course, tracking cognitive progress through group comparison	QN10, QN25
Collaborative Thinking	Alternative to questioning	Encouraging participation in responses, clarifying roles in group response process	QN16, QN36
Inductive Method	Teaching–learning process	Generalizing from details, discovering rules, organizing data, analysis, and conclusions	QN6, QN7
Peer Teaching	Peer teachers	Students teaching sections to each other, conducting diagnostic testing	QN29, QL8
Pair Discussion	Responsibility-oriented	Students share equal responsibilities, critical thinking encouraged	QN32, QN33
Discovery Learning	Identification-based learning	Teacher as facilitator, data collection, classification, reorganization	QN20
	Self-discovery	Inquiry-based learning, reasoning development, self-assessment	
Numbered Heads Together	Autonomy	Ensuring individual accountability within group learning	QN20
	Positive interdependence	Helping one member affects all, fostering prosocial behavior	
Collaborative Reading	Cognitive activities	Reading, summarizing, writing reports	QN22
Group Games	Joyful and engaging environment	Motivation through structured, themed games	QN25
Group Resume Model	Knowledge exchange	Solving tasks individually, peer correction, group discussion on answers	QN31

As shown in the table above, a total of 21 cooperative learning styles or strategies with 29 core criteria were identified in the domain of mathematics education during the study period. Among these, the most frequently cited approaches were problem-based learning and the jigsaw method. Consequently, the criteria and indicators of these two strategies were adopted as the core components in the design of the integrated model. The operational indicators of the remaining strategies were added as reinforcing elements to enhance the robustness of the model.

To develop the integrated cooperative learning model, a preliminary version was created based on the identified strategies for mathematics instruction. This model outlines the main activities and session structure for implementing cooperative learning in mathematics. It also defines the essential roles required for effective implementation.

Following the development of the preliminary model, the first stage of validation was carried out with a focus group. Participants provided feedback on the proposed techniques and instructional procedures. After collecting and analyzing expert and teacher opinions, modifications were made to the implementation process and new components were added. The final model was designed accordingly.

Taking expert feedback into account, the cooperative learning guide for mathematics instruction was structured into three main levels: Pre-Design Activities, Implementation (initial, intermediate, final stages), and Evaluation.

Table 4

Stages of Implementing the Cooperative Learning Guide for Mathematics Instruction

Main Stage	Activities	Planned Content	Additional Notes
Level 1: Pre-Design	Initial Familiarization	Selection of validated techniques, planning number of sessions and scheduling, designing implementation steps, preparing method explanations for students, combining or splitting methods (based on cognitive/personality levels)	This may occur at the start of implementation or as a redesign after a successful trial
Level 2: Implementation	Initial	Explaining the learning process, clarifying evaluation methods, organizing students into groups	Grouping of 4–6 students with varying skill levels, assigning group leader, recorder, expert subgroup
	Intermediate	Presenting the problem, dividing group tasks, guiding the problem-solving process	Assigning leadership, providing audiovisual resources aligned with content
		Brainstorming, group collaboration, peer discussion, using educational games	Facilitating idea exchange, banning criticism, dividing learning content, individual study of course sections
		Clarifying learning objectives, generating initial responses	Group agreement to eliminate unsuitable or duplicate ideas
		In-group agreement, asking teacher for clarification	Expert groups formed to resolve misunderstandings and ensure content mastery
		Individual and group info-sharing, reviewing answer validity, supporting peers	Correcting misconceptions, converting students into peer-teachers
		Participating in Q&A sessions, intergroup discussions, summary and synthesis	Prioritizing ideas based on relevance and importance
	Final	Conducting short individual quizzes, assessing each group's learning, assigning grades, identifying top students for in-class recognition	Base and adjusted scores are recorded; the "impact column" shows score differences from previous tests; top-ranked students in each team are listed
Level 3: Evaluation	Reflective Review	Surveying students, assessing strengths and weaknesses based on feedback and learning outcomes	Active participation of both teacher and students is essential

As noted in the table, the use of base and adjusted scores is derived from the progress-based grouping approach. Each student's base score is calculated by subtracting a constant value (set at 5) from their average score on the previous test in the same subject area. At the end of the term, the adjusted scores of all members in a group are totaled and averaged to determine the final group score.

On the other hand, ranking the top-performing students within each team is conducted based on defined criteria (six points for high performance, four for average, and two for low performance). These individual scores are ultimately added to the total team score to which the student belongs. Moreover, the descriptions of the roles of various groups in the aforementioned cooperative learning approach are as follows:

- **Group Leader (Team Head or Guide):** Reads the assigned problem to all group members and, with the help of the group advisor, is responsible for overseeing group dynamics and maintaining a positive emotional environment. The group leader facilitates and organizes the teamwork process.
- **Secretary:** The secretary is responsible for note-taking during discussions (brainstorming), recording key ideas and terms to aid in the final synthesis of the group's ideas.
- **Group Advisor (Teacher):** The teacher's role is to prepare students mentally for the topic, attract their attention to the objectives, clarify the importance of methods and how they are implemented, formulate the problem or topic under discussion, design thought-provoking questions, select appropriate resources, clarify learning rules, form student groups, assign roles (leader, secretary), establish evaluation methods, and highlight overlooked or under-discussed issues.
- **Expert Group:** This group consists of students who have studied the same content and are tasked with mastering and troubleshooting specific sections of the learning material. This group is separate from the main group and is intended to strengthen inter-group interaction for a deeper understanding of specific content. After collaborative problem-solving, each member returns to their original group to share what they have learned.

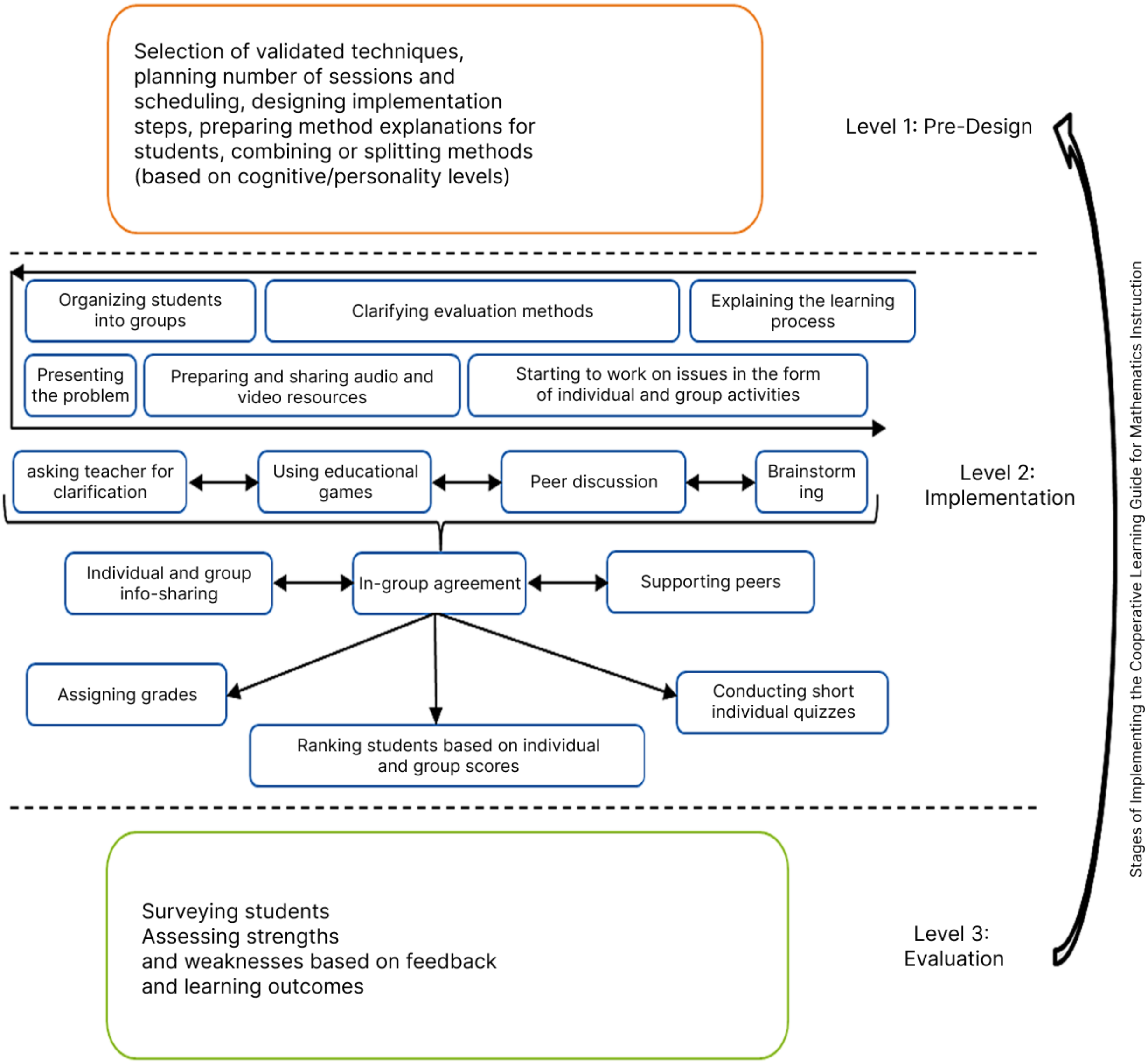
Based on the above considerations and through the integration of identified strategies and techniques for

E-ISSN: 2645-3460

teaching mathematics, the final integrated model of cooperative learning for mathematics instruction is presented in the figure below. This figure outlines the general activities and session structures of the model and includes the key roles necessary for its proper implementation. Additionally, to increase clarity, specific details of each level are also presented in short descriptive statements within the figure.

Figure 1

Final Integrated Model of Cooperative Learning Styles for Mathematics Instruction



According to the final model presented, the implementation process of the integrated cooperative learning model for mathematics instruction can be summarized in the following levels:

1. **Pre-Design Level:** At this stage, the instructor selects certain techniques and methods based on students' behavioral and personality characteristics and designs the initial cooperative learning approach for teaching mathematics.
2. **Implementation Level:** This includes all practical instructional activities. Initially, in the introductory session, the researcher explains the course structure, student roles, and group assignments. In subsequent sessions, instructional processes and feedback continue consistently, and the teacher monitors the quality and outcomes of the implemented activities.

E-ISSN: 2645-3460

3. **Evaluation Level:** At this final level, the teacher evaluates the effectiveness of each method and technique applied, based on how well students have learned the instructional content. Insights gained from this stage inform the design of future optimized models.

To better understand how the final model was achieved, it is useful to refer to the opinions of the focus group members, whose feedback contributed to the transition from the initial to the final version of the model. As shown in the diagram, explanations of the learning process, clarification of assessment strategies, descriptions of individual and group activities, and group formation are all part of the introductory stage within the second level (implementation). Therefore, in the first level (pre-design), matters such as method selection, session planning, and instructional design should be prioritized by teachers.

As indicated in the final model's annotations, the pre-design stage occurs at the beginning of the cooperative learning intervention and can also function as a redesign phase after an initial classroom trial. It can be modified based on the capabilities of both the teacher and students. Thus, the application of the integrated model requires multiple iterations over different time periods to allow teachers to arrive at a near-optimal version suitable for their specific classroom conditions and student levels. Nevertheless, experience shows that this model remains adaptable to diverse situations, underscoring the critical importance of maintaining a dynamic learning environment.

Given the iterative and fluid nature of the final model's stages, it can be concluded that implementing such an approach may vary depending on classroom conditions, students' personality traits, and even the teacher. Nevertheless, the core framework of the model remains consistent. Each round of implementation allows for updating the activities and techniques used, thereby enhancing the final cooperative learning model.

To validate the final integrated model, Content Validity Ratio (CVR) and Content Validity Index (CVI) tests were employed. These tests assessed the comprehensiveness of the criteria included in the final integrated cooperative learning model for mathematics instruction. The results are presented in the table below.

Table 5

Results of CVR and CVI Tests for the Final Integrated Cooperative Learning Model

Level	Activity	CVI Result	CVR Result
Pre-Design	Selection of cooperative learning-based techniques and methods	100 - Confirmed	100 - Confirmed
	Defining the number of sessions and scheduling	100 - Confirmed	100 - Confirmed
	Designing how sessions will be executed and collecting feedback	100 - Confirmed	100 - Confirmed
	Providing clear explanations to enhance students' understanding	90 - Confirmed	80 - Confirmed
	Merging or separating methods to facilitate learning	100 - Confirmed	100 - Confirmed
Implementation	Explaining the learning process	100 - Confirmed	100 - Confirmed
	Clarifying assessment methods and individual/group activities	100 - Confirmed	80 - Confirmed
	Group formation and role assignment	100 - Confirmed	100 - Confirmed
	Problem formulation by teacher	90 - Confirmed	100 - Confirmed
	Preparing and sharing audiovisual resources	90 - Confirmed	80 - Confirmed
	Starting problem-solving via individual and group tasks	100 - Confirmed	100 - Confirmed
	Brainstorming	90 - Confirmed	100 - Confirmed
	Inter-group discussions	100 - Confirmed	100 - Confirmed
	Use of group games	100 - Confirmed	100 - Confirmed
	Asking questions to the teacher	90 - Confirmed	80 - Confirmed
	Information integration	90 - Confirmed	100 - Confirmed
	Peer-to-peer support and troubleshooting	90 - Confirmed	100 - Confirmed
	Intra-group consensus	100 - Confirmed	100 - Confirmed
	Individual quizzes	100 - Confirmed	100 - Confirmed
	Group grading	100 - Confirmed	100 - Confirmed
	Ranking students based on individual and group scores	100 - Confirmed	100 - Confirmed
Evaluation	Student survey on each method and technique used	100 - Confirmed	100 - Confirmed
	Observation of student feedback during learning activities	90 - Confirmed	100 - Confirmed
	Evaluation of individual and group learning effectiveness	100 - Confirmed	100 - Confirmed

As shown, all activities in the final integrated cooperative learning model met acceptable standards in content validity. Therefore, the model can be confidently implemented among students.

Upon finalizing the model, the study transitioned into its quantitative phase using a quasi-experimental design, implementing pretest–intervention–posttest stages with control and experimental groups. The effectiveness of the integrated cooperative learning model for mathematics instruction was examined. First, descriptive statistics related to the Mathematics Anxiety Questionnaire and Academic Achievement Tests were presented, followed by the analysis of responses and test data from ninth-grade students.

Table 6

Descriptive Statistics for Mathematics Anxiety and Academic Achievement (Pretest and Posttest)

Variable	Group	N	Min	Max	Mean	Std. Deviation	Variance	Std. Error
Math Anxiety (Pretest)	Control	30	1.08	4.72	3.10	0.977	0.955	–
	Experimental	30	1.36	4.88	3.19	1.066	1.137	–
Math Anxiety (Posttest)	Control	30	1.16	4.36	3.28	0.703	0.495	–
	Experimental	30	1.20	3.86	2.76	0.856	0.733	–
Academic Achievement (Pretest)	Control	30	–	–	14.567	4.197	–	0.766
	Experimental	30	–	–	13.125	4.635	–	0.846
Academic Achievement (Posttest)	Control	30	–	–	13.717	3.888	–	0.710
	Experimental	30	–	–	15.933	3.423	–	0.625

The results indicate that prior to the intervention, the mathematics anxiety levels in both the control group (M = 3.10, SD = 0.977) and the experimental group (M = 3.19, SD = 1.066) were nearly equivalent. However, following the intervention, the experimental group reported a reduced mean anxiety score (M = 2.76, SD = 0.856), while the control group showed a slight increase (M = 3.28, SD = 0.703), suggesting a positive effect of the integrated cooperative learning model on reducing math anxiety.

Regarding academic achievement, the control group had a higher pretest mean score (M = 14.567) compared to the experimental group (M = 13.125). Post-intervention, the experimental group's academic performance improved markedly (M = 15.933, SD = 3.423), surpassing the control group (M = 13.717, SD = 3.888). This trend suggests that participation in the integrated cooperative learning model contributed to greater academic improvement in mathematics.

To evaluate the effectiveness of the integrated cooperative learning model on reducing mathematics anxiety and enhancing academic achievement, an Analysis of Covariance (ANCOVA) was performed. This statistical method adjusted posttest scores based on pretest values, allowing for a more accurate assessment of the intervention’s impact.

Table 7

ANCOVA Results: Effect of the Integrated Cooperative Learning Model on Mathematics Anxiety and Academic Achievement

Outcome Variable	Group	Pretest Mean (SD)	Posttest Mean (SD)	F-Value	df	p-value	Partial Eta Squared
Mathematics Anxiety	Control	3.100 (0.977)	3.280 (0.703)				
	Experimental	3.189 (1.066)	2.764 (0.856)	83.449	1, 57	.000	0.594
Academic Achievement	Control	14.567 (4.197)	13.717 (3.888)				
	Experimental	13.125 (4.635)	15.933 (3.423)	6.236	1, 56	.000	0.100

The ANCOVA results for mathematics anxiety demonstrate a statistically significant difference between the control and experimental groups after adjusting for pretest scores, $F(1, 57) = 83.449$, $p < .001$. The partial eta squared ($\eta^2 = 0.594$) indicates a large effect size, suggesting that the integrated cooperative learning model significantly reduced mathematics anxiety among students in the experimental group compared to the control group, whose anxiety actually increased slightly from pretest (M = 3.100, SD = 0.977) to posttest (M = 3.280, SD = 0.703).

Similarly, in terms of academic achievement, the experimental group showed a significant improvement from pretest (M = 13.125, SD = 4.635) to posttest (M = 15.933, SD = 3.423), whereas the control group experienced a slight decline from pretest (M = 14.567, SD = 4.197) to posttest (M = 13.717, SD = 3.888). This difference was also statistically significant, $F(1, 56) = 6.236$, $p < .001$, with a moderate effect size ($\eta^2 = 0.100$).

These findings provide strong evidence that the integrated cooperative learning model was effective in both reducing math anxiety and enhancing academic performance in ninth-grade mathematics instruction.

4. Discussion and Conclusion

The findings from the current study provide compelling evidence for the effectiveness of an integrated cooperative learning model in reducing mathematics anxiety and enhancing academic achievement among ninth-grade students. The results of the ANCOVA analyses revealed statistically significant differences in both outcomes between the experimental and control groups, with large and moderate effect sizes, respectively. Specifically, students who participated in the integrated cooperative learning model reported significantly lower mathematics anxiety and higher academic achievement scores compared to those in traditional classrooms. These results underscore the pedagogical value of blending multiple cooperative strategies in mathematics instruction.

This outcome aligns with previous research that consistently demonstrates the benefits of collaborative and cooperative learning in enhancing both cognitive and affective domains of student learning. For instance, Ork and Saif (2022) found that cooperative learning significantly improved students' academic achievement and reduced anxiety in mathematics (Ork & Saif, 2022), confirming the dual impact observed in the present study. Similarly, Bijani Keshk and Pourzal (2023) reported that cooperative teaching strategies, particularly those involving structured group interactions and peer-assisted activities, had a notable effect in reducing math anxiety among elementary students (Bijani Kashk & Pourzal, 2023). These studies collectively reinforce the conclusion that anxiety in mathematics is not simply an internal trait but a malleable emotional response that can be shaped through classroom dynamics and instructional methods.

The effectiveness of the integrated model can also be explained by social interdependence theory, which highlights the importance of positive interdependence, individual accountability, and promotive interaction as key elements in cooperative learning (Johnson & Johnson, 2019). By engaging students in purposeful collaboration—such as in jigsaw tasks, group problem-solving, and peer-led discussions—the model fosters an environment where students feel emotionally supported and cognitively challenged. This approach reduces fear of failure and enhances motivation, which in turn contributes to both improved performance and reduced anxiety. The structure of the final model, with its emphasis on pre-design, active implementation, and reflective evaluation, mirrors best practices advocated by global cooperative learning scholars (Gillies et al., 2023).

The study's findings are also consistent with international research on collaborative learning's effects in math education. For example, Akinoso, Olafare, and Akoinoso (2021) found that collaborative teaching significantly improved secondary students' attitudes and performance in mathematics (Akinoso et al., 2021). Likewise, Agwu and Nmadu (2023) confirmed that students taught through cooperative engagement exhibited higher achievement and a more positive academic self-concept compared to their peers in traditional settings (Agwu & Nmadu, 2023). The current results not only affirm these patterns but also demonstrate that a systematically integrated approach—rather than reliance on a single strategy—can yield stronger educational outcomes. This reinforces the perspective that the synthesis of cooperative learning techniques, such as brainstorming, team games, flipped instruction, and peer teaching, provides a more robust learning framework.

Additionally, the significant reduction in anxiety in the experimental group resonates with the work of Busari and Akinoso (2020), who emphasized the role of learning environment and instructional methods in moderating students' anxiety levels (Busari & Akinoso, 2020). A similar sentiment is echoed by Zangeneh and Khodamoradi (2017), who showed that collaborative assignments improved students' long-term memory retention and reduced their fear of math assessments (Zanganeh & Khodamoradi, 2017). The current study's emphasis on student agency, structured interaction, and emotional safety in learning environments likely contributed to similar reductions in anxiety. This is particularly important given the growing recognition of emotional and psychological barriers as critical obstacles to learning in STEM fields (Jeong, Hmelo-Silver, & Jo, 2019; Hoang et al., 2023).

The observed improvement in academic performance is also well-supported in the literature. For instance, Abd Algani & Abu Alhaija (2021) reported substantial gains in math performance among students engaged in cooperative learning strategies (Abd Algani & Abu Alhaija, 2021) that mirror the components of the current model. The increased academic achievement in the experimental group can be attributed to the model's active learning structure, which includes continuous feedback, peer explanation, and project-based assessment. As Bacsal, Ibanez, and Pentang (2022) note, the jigsaw method—used as one of the core techniques in this study—encourages not only knowledge acquisition but also accountability and peer-based motivation (Batool et al., 2018).

From a broader educational perspective, these findings support meta-analytical research indicating that cooperative learning environments lead to deeper conceptual understanding and improved classroom climate (Jeong et al., 2019; Koskinen & Pitkäniemi, 2022). More specifically, the combination of methods used in this study appears to optimize cognitive engagement and minimize anxiety-inducing factors, a dual benefit rarely achieved in conventional instructional methods (Mathias et al., 2024; Shi et al., 2020). Moreover, the model's design, with structured roles like group leader, secretary, and expert groups, aligns with Johnson and Johnson's (2019) call for well-defined roles and responsibilities in cooperative learning to ensure equitable participation and cognitive accountability (Johnson & Johnson, 2019).

Another critical component contributing to the model's effectiveness is the integration of student voice and formative assessment, as emphasized in prior studies (Nazari, 2023; Tarawneh, 2012). In this study, students were actively involved in feedback cycles, group discussions, and peer-led instructional episodes. These elements promote student autonomy and meta-cognitive awareness, which are increasingly recognized as essential skills for 21st-century learners (Ivone et al., 2020; Kim et al., 2022). The combination of formative assessments, collaborative problem-solving, and gamified learning also reflects contemporary frameworks for meaningful learning in mathematics (Diani & Dwijanto, 2020; Kovacheva et al., 2022).

Taken together, the findings of this study not only corroborate the existing body of research on cooperative learning in mathematics but also demonstrate the added value of an integrated instructional model that combines multiple cooperative strategies. In doing so, the model effectively addresses both the cognitive and emotional dimensions of learning, thereby offering a holistic and replicable framework for mathematics education in diverse classroom settings.

Despite the promising results, several limitations should be acknowledged. First, the study sample was drawn from a single educational district, which may limit the generalizability of the findings. Differences in school culture, teacher training, or resource availability could influence how the model performs in other contexts. Second, the intervention duration was relatively short. While positive effects were observed, longer-term implementations are necessary to assess the model's sustainability and impact over time. Third, the study primarily relied on self-report questionnaires and achievement tests; more nuanced insights might be obtained through qualitative methods such as classroom observations or interviews with students and teachers.

Future studies should explore the application of this integrated model in different subject areas and educational levels to assess its cross-disciplinary utility. Comparative studies involving other instructional methods (e.g., inquiry-based learning, blended learning) could help further validate the model's relative effectiveness. It would also be beneficial to investigate the long-term effects of the model on students' attitudes, self-efficacy, and retention of mathematical concepts. In addition, incorporating qualitative approaches—such as student reflections, teacher journals, or video analysis—could provide a richer understanding of the interpersonal dynamics and cognitive processes that underlie the model's success.

Educators should consider adapting the integrated cooperative learning model to fit their specific classroom contexts, taking into account students' readiness, interests, and existing classroom norms. Professional development initiatives should train teachers not only in individual cooperative strategies but also in how to blend them effectively to maximize student outcomes. Schools should also encourage a culture of collaborative learning by redesigning classroom spaces, adjusting assessment methods to include peer and group evaluations, and supporting teachers in iterative implementation and reflection cycles. The flexibility and scalability of the model make it a practical tool for promoting deeper learning and emotional well-being in mathematics education.

Authors' Contributions

Authors equally contributed to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We hereby thank all participants for agreeing to record the interview and participate in the research.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

References

Abd Algani, Y. M., & Abu Alhaija, Y. F. (2021). The effect of the co-operative learning method on students' academic achievement in mathematics. *Multicultural Education*, *7*(3), 329-339. http://ijdri.com/me/wp-content/uploads/2021/03/35.pdf

Agwu, U. D., & Nmadu, J. (2023). Students' interactive engagement, academic achievement and self- concept in chemistry: An evaluation of cooperative learning pedagogy. *Chemistry Education Research and Practice*, *24*, 688-705. https://doi.org/10.1039/D2RP00148A

Akinoso, S. O., Olafare, F. O., & Akoinoso, Z. B. (2021). Effect of collaborative teaching approach on secondary school students achievement in attitude towards mathematics. *International Journal of Research and Innovation in Applied Science (IJRIAS*, *6*(8), 1-5. https://www.researchgate.net/publication/354333183_Effect_of_Collaborative_Teaching_on_Secondary_School_Students'_Achievement_in_and_Attitude_towards_Mathematics

Batool, S., Tahir, T., & Habib, M. (2018). Relationship of teachers' professional competence and achievement of students at university level. *Turkish Journal of Teacher Education*, *7*(1), 51-60. https://tujted.com/makale/612

Bijani Kashk, L., & Pourzal, A. (2023). The Effectiveness of Collaborative Teaching Method on Reducing Math Anxiety in Elementary School Students. *New Advances in Behavioral Sciences*, *8*(56), 81-87. https://ijndibs.com/article-1-808-fa.html

Busari, A. O., & Akinoso, S. O. (2020). Mathematics anxiety and personality characteristics of secondary schools' students in Lagos State, Nigeria. *Journal of Positive Psychology and Counselling*, *6*, 12-23. https://www.researchgate.net/publication/344451904_Mathematics_Anxiety_and_Personality_Characteristics_of_Secondary_Schools_Students_in_Lagos_State_Nigeria

Diani, A. H., & Dwijanto, D. (2020). Mathematical creative thinking ability observed from student learning motivation in Jigsaw Cooperative Learning assisted by problem cards. *Unnes Journal of Mathematics Education*, *9*(1), 66-73. https://doi.org/10.15294/ujme.v9i1.38102

Gillies, R. M., Millis, B., & Davidson, N. (2023). *Contemporary global perspectives on cooperative learning: Applications across educational contexts*. Routledge. https://doi.org/10.4324/9781003268192

Habibi-Kaleybar, R. (2018). Studing the effectiveness of teaching the thinking and research lesson in a collaborative way on creative thinking and reading skills of primary schools' sixth grade students. *Thinking and Children*, *8*(2), 1-20. https://fabak.ihcs.ac.ir/article_4292.html

Ivone, F. M., Mukminatien, N., & Tresnadewi, S. (2020). Blended learning to strengthen high school teacher competencies in facing the 21st century. *Graha Pengabdian Journal*, *2*(1), 18-26.

Jafari Sani, S., Keshavarzi, Z., & Seadatee Shamir, A. (2017). The effects of train composition with brain learning approach based on the Educational self-efficacy and written ability of students. *Iranian Journal of Educational Sociology*, *1*(3), 56-65. http://iase-idje.ir/article-1-61-en.pdf

Jeong, H., Hmelo-Silver, C. E., & Jo, K. (2019). Ten years of computer-supported collaborative learning: A meta-analysis of CSCL in STEM education during 2005-2014. *Educational Research Review*, *28*, 100284. https://doi.org/10.1016/j.edurev.2019.100284

Johnson, D. W., & Johnson, R. T. (2019). Social interdependence theory and cooperative learning: The teacher's role. In R. M. Gillies, A. Ashman, & Terwel (Eds.), *Teacher's role in implementing cooperative learning in the classroom* (pp. 9-37). Springer. https://doi.org/10.1007/978-0-387-70892-8_1

Kafshchian Moghadam, A., Maleki, H., & Sadeghi, A. (2024). Designing a Citizenship Rights Curriculum Model for the Second Period of Elementary Education [Research Article]. *Iranian Journal of Educational Sociology*, *7*(2), 1-7. https://doi.org/10.61838/kman.ijes.7.2.1

Karamati, M. (2017). *Collaborative Learning and Academic Achievement with a Metacognitive Approach*. Zist-e Shad Publications.

Karamati, M. (2019). *Implementing Collaborative Learning in the Classroom*. Zist-e Shad Publications. https://www.researchgate.net/publication/366882383_Implementing_Collaborative_Learning_Method_in_Speaking_Class_Students'_View

Kim, J., Lee, H., & Cho, Y. H. (2022). Learning design to support student-AI collaboration: Perspectives of leading teachers for AI in education. *Education and Information Technology*, *27*, 6069-6104. https://doi.org/10.1007/s10639-021-10831-6

Koskinen, R., & Pitkäniemi, H. (2022). Meaningful learning in mathematics: A research synthesis of teaching approaches. *International electronic journal of mathematics education*, *17*(2), em0679. https://doi.org/10.29333/iejme/11715

Kovacheva, Z., Kaloyanova, K., Naydenova, I., & Saranova, E. (2022). Effective methods for teaching mathematics and informatics in higher education in the digital world. *Tem*

Journal, *11*(2), 876-881. https://doi.org/10.18421/TEM112-48

Mahmodi, A., Yarahmadi, Y., & Moradi, O. (2023). Comparing the Effectiveness of Reverse Learning Model and Cooperative Learning on the Academic Engagement of Secondary School Students. *Sociology of Education*, *10*(1), 366-376. https://doi.org/10.22034/ijes.2023.2003494.1415

Marashi, H., & Khatami, H. (2017). Using cooperative learning to boost creativity and motivation in language learning. *Journal of Language and Translation*, *7*(1), 43-58. https://www.researchgate.net/publication/324310825_Using_Cooperative_Learning_to_Boost_Creativity_and_Motivation_in_Language_Learning

Mathias, J., Saville, C., & Leech, S. (2024). Engaging non-mathematics students in mathematics learning through collaborative teaching. *Teaching Mathematics and its Applications: An International Journal of the IMA*, *43*(1), 67-80. https://doi.org/10.1093/teamat/hrad003

Nazari, A. (2023). Impact of using the STAD model of cooperative learning on autonomy and attitude of Iranian secondary school EFL learners. *Journal of Language, Culture, and Translation*, *5*(2), 48-76. https://journals.iau.ir/article_702922.html

Nazari Ardabili, S. Z., Benisi, P., & Vatankhah, H. (2024). Designing the Maturity Management Model of Educational Technology in Iranian Schools. *Sociology of Education*, *10*(1), 314-326. https://doi.org/10.22034/ijes.2024.2022649.1536

Nelson, A. E. (2017). Methods faculty use to facilitate nursing students' critical thinking. *Teaching and Learning in Nursing*, *12*(1), 62-66. https://doi.org/10.1016/j.teln.2016.09.007

Ork, M., & Saif, M. H. (2022). The Effect of Collaborative Learning on Academic Achievement, Attitude, and Anxiety in Mathematics. Tehran.

Polat, Ö., Sezer, T., & Akyol, N. A. (2022). Collaborative learning with mind mapping in the development of social skills of children. *Participatory educational research*, *9*(1), 463-480. https://doi.org/10.17275/per.22.25.9.1

Por Jafari shir Joposht, M., Shakibaei, Z., & Zarei, H. (2024). `Provide a Model for Parents' Educational Assistance to Empower Online Education in Critical Situations. *Sociology of Education*, *10*(1), 31-44. https://doi.org/10.22034/ijes.2023.2006736.1434

Shi, Y., Ma, Y., MacLeod, J., & Yang, H. H. (2020). College students' cognitive learning outcomes in flipped classroom instruction: A meta-analysis of the empirical literature. *Journal of Computers in Education*, *7*(1), 79-103. https://doi.org/10.1007/s40692-019-00142-8

Tarawneh, S. H. (2012). The effect of using the cooperative teaching method on achievement in mathematics and the attitude toward it for female students of the eighth basic grade. *Damascus University Journal*, *28*(3), 449-471.

Zanganeh, H., & Khodamoradi, H. (2017). The Impact of Task-Based Collaborative Learning on Learning and Retention of Ninth-Grade Students in Mathematics. *Teaching Research*, *5*(1), 47-64. https://www.researchgate.net/publication/355789734_The_Impact_of_Task-based_Collaborative_Output_Activities_on_Learner_Engagement_in_Writing_Tasks