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Article

The Effect of Collaborative Quantum Learning Model on Teaching Self-Efficacy, Relational Trust of New Teachers, and Their Students' Learning Outcomes

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Abstract

This study investigates the impact of the Collaborative Quantum Learning Model (CQLM) on teaching self-efficacy, relational trust, and student learning outcomes in elementary school settings. The research employed a quasi-experimental pretest-posttest design with control and experimental groups. Participants consisted of recent elementary education graduates with less than two years of teaching experience working in Tehran province schools. From the Ministry of Education's reported total of 13,154 eligible teachers, researchers selected 265 novice educators from Districts 10 and 11 of Tehran for initial screening. Through random assignment, 40 teachers were divided equally into experimental and control groups following baseline assessments of self-efficacy and relational trust. The experimental group participated in an 8-week CQLM intervention totaling 48 instructional hours. Three primary measurement instruments were utilized: the Teaching Self-Efficacy Scale (Tschannen-Moran & Hoy, 2001), the School Relational Trust Survey (Bryk, 2002), and standardized academic performance tests in mathematics, science, and Persian language. Analysis revealed statistically significant improvements in the experimental group for both teaching self-efficacy ($F=10.96$, $p<.05$) and relational trust ($F=7.56$, $p<.05$). However, no significant effect was observed on student learning outcomes ($F=0.60$, $p=.44$). Participant feedback indicated strong approval for the CQLM approach, with many teachers requesting program continuation. The model's effectiveness appeared linked to its alignment with professional development needs, innovative delivery methods, carefully selected content, and developmental approach to learning concepts.

Keywords: collaborative quantum learning model; teaching self-efficacy; school relational trust; learning outcomes; new teacher

Introduction

From a quantum perspective, reality is not merely objective, and understanding it is not only achieved by the senses(Laszlo et al., 2021). The quantum approach emphasizes multidimensional attitudes, contextualism, and dynamic and nonlinear causal relationships (Ghose & Patra, 2023). However However, while quantum principles offer a compelling metaphorical lens for education, their application requires careful delineation to avoid overgeneralization (Davis & Sumara, 2006). The quantum world offers potentially significant and broad implications at the level of human reality (Tuli et al., 2024). According to the quantum perspective, humans are quantum beings, although at first glance, every person seems to be a material being, it also has an intangible and immaterial dimension whose function is thought to be influenced by principles (Efsthadiadis, 2023). Quantum mechanics has shown that behaviors including thoughts, apart from their context, are indefinable, and their context is past and present (Miklus, 2013).

Effective learning and teaching is a complex process that resists singular theoretical framing. Recent debates highlight tensions between viewing learning as a science versus an art (e.g., Eisner, 2002). The quantum education model (Kaur & Venegas-Gomez, 2022) attempts to bridge this divide

by integrating dynamic, non-linear principles from quantum physics (e.g., interconnectedness, probability) into pedagogy. Yet, critics argue that such metaphors risk oversimplification unless explicitly tied to observable educational phenomena (Haggerty, 2020).

The quantum approach to teaching and learning derives its conceptual foundation from core quantum mechanical principles, particularly the notions of interconnectedness, probability, and observer influence. This theoretical alignment allows educators to reinterpret traditional learning environments through a quantum lens, where knowledge transmission is understood as a dynamic, non-linear process rather than a fixed sequence of inputs and outputs. The implementation of quantum teaching and learning through an accessible, dynamic framework revitalizes educators' professional fulfillment while elevating students to unprecedented academic achievement levels. This pedagogical approach, characterized by its fluidity and adaptability, reinvigorates the teaching experience by shifting from rigid instructional methods to interactive, probability-based learning processes. Simultaneously, it propels learners toward sustained cognitive growth that transcends conventional performance benchmarks through its emphasis on interconnected knowledge systems and multidimensional thinking patterns. (Anshu & Arunachalam, 2024). Researches shows that this model enhances student performance (Nabila, 2024). QL brings together the best research-based exercises in education into a single assembly and makes the content meaningful and relevant to learners' lives (Donhauser et al., 2024). In this way, the teacher helps the teacher to present their content in a way that the students are most likely to expect. The quantum model of learning integrates life and learning skills and makes learners effective learners throughout their lives (Lubis et al., 2024). Even in this way, based on the use of more appropriate instructional strategies to retain content, the information acquired by the learners is stored in long memory with high retrieval capability.

Quantum Learning Model (QLM) have been on the rise in recent decades due to the growth of interdisciplinary academic disciplines, and new methods of teaching and learning have been proposed. Some researchers have studied and researched the effects of this method on other variables. One of the variables that can be affected by the QLM is teacher self-efficacy. The fundamental premise that educators' belief systems directly shape their instructional behaviors represents a deceptively simple yet profoundly influential concept. Within educational psychology research, teacher self-efficacy has emerged as a critical construct due to its demonstrated associations with pedagogical effectiveness, classroom strategies, and student learning outcomes (Quines & Pablo Jr, 2023). Grounded in Bandura's (1997) social-cognitive theory of behavioral modification, self-efficacy theory conceptualizes this as an educator's conviction in their capacity to successfully execute profession-specific responsibilities - ranging from curriculum delivery to classroom management (Barni et al., 2019). While both individual characteristics and environmental factors contribute to the formation of teaching self-efficacy, historical limitations in operational definitions and research methodologies have constrained comprehensive understanding of its antecedents and consequences. Contemporary scholarship nevertheless confirms that educators with robust self-efficacy demonstrate greater psychological well-being and professional competence compared to their less confident counterparts (Davis et al., 2024). Although Bandura's (1997) theoretical framework posits self-efficacy as generally stable, empirical evidence suggests these beliefs remain responsive to contextual experiences. Within teacher education paradigms, cultivating strong self-efficacy represents an essential developmental objective, achievable through targeted, meaningful preparatory experiences that enhance pedagogical competence. This reciprocal perspective acknowledges that while instructional quality may result from self-efficacy, teaching performance may simultaneously reinforce efficacy beliefs (Karakose et al., 2023). Furthermore, professional collaboration among educators serves as a potent mechanism for self-efficacy development, as collegial exchanges provide opportunities for reflective critique and perspective-sharing (Alrashidi & Alshammari, 2024).

Teacher education refers to the structured systems and methods that prepare educators with the professional knowledge, skills, attitudes, and competencies required for effective classroom teaching, school participation, and community engagement. ~~Teacher education is the policies and procedures~~

designed to equip teachers with the knowledge, attitudes, behaviors, and skills needed to perform their duties in the classroom, school, and community (Romijn et al., 2021). While, ideally, teacher education is considered to be integrated and comprehensive, it is usually divided into three stages: pre-service, introductory (new teachers, the first 3 to 5 years of teaching), and teacher development (Sanyal, 2013). What has happened in the Iranian teacher education system so far has been pre-service teacher education and, to some extent, teacher development and the domain of new teachers have been largely neglected (Romijn et al., 2021). New teachers are supported professionally after graduation, as they experience real practice and take primary responsibility for their teaching. Since the Collective Quantum Learning Model (CQLM) emphasizes connections between individuals, one of the variables expected to be affected by this type of learning is relational trust. Relational trust refers to the degree of congruence concerning each group's understanding of the expectations and relationships of themselves and others (Tsai et al., 2017). To promote relational trust, school administrators must observe and conform the behavior of others to these mutual expectations. Relational trust represents a critical organizational asset in educational settings, as it emerges through socially constructed interactions among school community members. Its development carries significant consequences for institutional effectiveness and student outcomes (Mayger & Hochbein, 2021). To explore whether relational trust is a key factor in creating a foundation for professional learning communities, we look at how individuals engage about relationships, trust, and their schools as learning communities (Hudson, 2024). Relational trust, which results from professional interactions in educational and learning environments, has been investigated in researches. The role of online environments in building trust (Kanaris & Mujtaba, 2023), the role of trust in increasing student participation and success (Payne et al., 2023), trust multi-professional educational networks (Kolleck, 2023), community building practice (Pound & Edwards-Groves, 2024), trust and knowledge sharing (Capestro et al., 2024) are examples of these studies.

All efforts of those involved in education should end in student learning. In other words, the technical core of the school system is the teaching-learning process (Dimmock, 2020). To ensure student learning, numerous methods and approaches have been proposed throughout the history of education. The latest research and efforts in this field culminate in the concept of Learning Outcomes Assessment (LOA). LOA is the process of clearly stating expectations; setting appropriate high-level criteria and standards; systematically collecting, analyzing, and interpreting evidence to determine how well performance meets the standards and criteria; and using the resulting information to document, explain, and improve performance (Driscoll & Wood, 2023). The results of teacher learning in professional communities in a quantum manner should be reflected in the classroom and in student learning outcomes (Tang, 2024). The effect of QL and quantum teaching in improving students' learning outcomes (SLO) has been shown in research (Şahin & Kılıç, 2024).

Based on studies, some of which were reviewed above, it can be said that the quantum model has an impact on teachers' self-efficacy and relational and student outcomes. CQLM is a specific type of learning that utilizes the brain's natural learning methods to maximize individuals' participation, understanding, competence, reflection, and self-assessment (Ren et al., 2022). This type of learning has been less frequently implemented in the Iranian context, and in this study, we are trying to implement it on a specific segment of the teacher community, namely new teachers. New teachers need to amend and develop their competencies in the post-graduate period, and this method can be useful in improving their competencies.

Research Methods

Quasi-experimental research design used to collect quantitative data. This methodology incorporated a pretest-posttest control group design, as illustrated in Table 1.

Table 1. Pretest-posttest experimental design with control group.

GROUP	PRE-TEST	EXPERIMENT	POST-TEST
RG1	T ₁	CQLM	T ₂
RG2	T ₁	-	T ₂

In this design, the researcher employs a hybrid approach, integrating elements of both the pretest-posttest control group design and the posttest-only control group design. By administering the pretest to only half of the participants, this method allows for an assessment of the pretest’s potential influence while retaining the benefits of pretest data collection. Consequently, this design mitigates threats to validity without compromising the valuable insights gained from pretest measurements.

In this study, elementary education graduates who had not been teaching for more than two years and were working as teachers in Tehran province were included. According to the Ministry of Education, their number was 13,154, and two districts of Tehran with 265 new teachers were selected (Districts 10 and 11). Of these, 20 were selected as the experimental group and 20 as the control group by administering self-efficacy and relational trust tests.

Tools

1. Teaching Self-Efficacy Scale (TSES)

Self-efficacy measurement typically employs quantitative methodologies where participants evaluate their perceived capability to complete specific task demands using standardized rating scales (Burrell et al., 2018). Rooted in social cognitive theory, efficacy beliefs reflect individuals’ forward-looking assessments of their ability to plan, mobilize, and perform the necessary actions to achieve desired outcomes within particular circumstances (Ferreira, 2013). As Ferreira (2013) explains, teacher self-efficacy specifically encompasses educators’ beliefs about external influences on student learning, including socioeconomic factors, home environments, and individual student needs.

The study utilized the Teacher Self-Efficacy Scale (TSES) developed by Tschannen-Moran and Hoy (2001), comprising 24 items measured on a five-point Likert scale. This instrument yields both a composite score and three subscale scores: classroom management (8 items), student engagement (7 items), and instructional strategies (9 items). Iranian validation studies (Hossein Chari et al., 2010) have confirmed the scale’s factorial validity for assessing teacher self-efficacy dimensions. Reliability analyses demonstrate strong internal consistency, with Cronbach’s alpha coefficients of 0.96 for the full scale, and 0.94 (instructional strategies), 0.90 (student engagement), and 0.86 (classroom management) for the subscales (Ostadrahimi et al., 2020).

2. School Relational Trust Scale (SRTS)

Bryk’s (2002) seminal work Trust in Schools developed a comprehensive questionnaire to assess educators’ trust levels across three key relationships: teacher-principal, principal-teacher, and teacher-colleague trust. The research demonstrates that school administrators who cultivate conditions producing affirmative responses to these trust measures can anticipate enhanced professional collaboration, greater openness to innovation, improved parent-staff relationships, and measurable gains in student learning outcomes. This instrument specifically evaluates three dimensions of relational trust: teachers’ confidence in their principal, principals’ trust in faculty members, and mutual trust among teaching colleagues. In the first part, questions 1 to 9 measure teacher-principal trust, in the second part, questions 10 to 15 measure teacher-teacher trust, and in the third part, questions 16 to 26 measure teacher-parent trust. In this questionnaire, a Likert scale with options such as “a lot”, “a lot”, “no opinion”, “a little”, and “very little” is used, and the different responses of the sample individuals to each question in the trust questionnaire is placed in one of the five options above. The numerical value of these five options is numbered from 1 to 5. The numerical value of the questionnaire on managers’ trust in teachers is numbered from 1 to 5. The reliability of

the questionnaires of teachers’ trust in principals, principals’ trust in teachers, teachers’ trust in teachers, teachers’ cooperation with principals, teachers’ cooperation with teachers, and teachers’ cooperation with each other in the school were: 0.87, 0.82, 0.89, 0.89, 0.45, and 0.93, respectively (Jani et al., 2024).

3. Learning Outcomes (LO)

In order to determine the effectiveness of the training course, performance tests were used as learning outcomes. In these tests, mathematics, science, and Persian subjects were considered. In each subject, 5 questions were designed as scenario-based questions. The validity of the instrument was reviewed by two assessment and measurement experts.

Sessions

For curriculum development, this study employs Van den Akker’s framework. The Spider Web Model (Thijs & Van Den Akker, 2009) emphasizes the essential alignment of all curricular components to create a robust curriculum, where learning activities represent just one element. The refined version by Van den Akker and Thijs incorporates additional influential factors, making it more comprehensive. Consequently, this research adopts the enhanced Spider Web Model, utilizing the broader concept of ‘learning opportunities’ rather than the narrower ‘learning activities’ (see Figure 1).

Figure 1. Curricular Spider Web Model (Thijs & Van Den Akker, 2009).

SESSION 1		
Title: Aims & Objectives (Which goals are the students learning)		
Subtitles:	time: 2 h	Teaching Method: Inductive
▪ The identifying of goal, aim and objectives ▪ The importance of goal-setting ▪ Dimension of goal setting ▪ Absolutism or Relativism in Targeting (Dual Approach) ▪ The relationship between goal writing and context ▪ Methods of goal-setting and goal writing		
Exercise 1:	time: 2 h	Teaching Method: Problem solving
Consider a situation where you want to teach the subject of multiplication in a math lesson. To do this, do the following: • A. Set your goals. • B- Why did you choose these goals? • C. What was the relationship between these goals and the context? Now consider a situation where you have a few slow learners and a few fast learners. Do the following for this position: • A. Set your goals. • B- Why did you choose these goals? • C. What was the relationship between these goals and the context? Comparing these two situations, what was the difference in the type of targeting? What factors influenced you're targeting? What are the implications for writing goals?		
Exercise 2:	time: 2 h	Teaching Method: Problem solving
• One of your usual tasks is to write lesson plans or teaching scenarios. • What is the distance between writing a lesson/scenario plan and experienced positions in practicum?		

- Did you change the pre-written scenario in the classroom? If yes, explain which part and why?
 - Could you change the scenario and change the context of the class?

What do you draw from these questions?

SESSION 2

Title: Content (What are the students learning)

Subtitles:	time: 4 h	Teaching Method: Guided Problem/ Exploration plan
▪ Nature of learning ▪ The human need to learn ▪ What should we learn? ▪ The effects of context or conditions on content development ▪ How to develop and create content ▪ How to evaluate content ▪ Reproduce rated content ▪ Flexible content		
Exercise 1:	time: 2 h	Teaching Method: Problem solving
You have been selected as a village teacher. The school does not have the necessary facilities for conducting third grade elementary science experiments. You want to teach the concept of vertebrate and invertebrate animals. To do this, depending on your circumstances, A. Develop the necessary content according to the standards you have trained here. B. Describe the reason for the compilation of such content. C. If you have a good lab, what would your content be like? D. What is the relationship between the designated content and the context?		

SESSION 3

Title: Learning Activities & Objectives (How are the students learning)

Subtitles:	time: 4 h	Teaching Method: Inductive
▪ How do students learn the best? ▪ What are the different ways that students learn? ▪ Why do students learn? ▪ What are the 4 types of learning styles? ▪ What say learning theories? ▪ How we can to understand how students have learned?		
Exercise 1:	time: 2 h	Teaching Method: Problem solving
Consider the following situation: For social science class, eighth-grade students were grouped to give citizens an idea of how to teach the environment and implement it. One group of five students came up with the idea: "Everybody brings a garbage to the city every day" at the low price of his idea, counting that after 36 days in the city we will not have any garbage. A. Provide a model for evaluating how students think. B. What do you think the students' thinking style is? Why? C. Based on learning theories, which theory did the students follow? D. Is the idea of the students perfect and not flawed? If there is a defect, how can it be repaired? What are your plans for it? E. Give an idea in your group about the mentioned situation. Express your evaluation of your idea. What is your thinking style and what learning theory have you used? F. If you were in a different situation, for example in another city where there is no garbage at the city level but there is air pollution, would your thinking be different? Explain your inference.		

SESSION 4

Title: Teacher Role (How is the teacher facilitating the students learning)

Subtitles:	time: 3.5 h	Teaching Method: Problem-solving/ inductive
- What is the role of a teacher as a facilitator? - What does teacher as facilitator mean? - How should a teacher develop himself as a facilitator? - What is the role of a facilitator? - What are the levels of teacher facilitation? - How to identify your level of facilitation as a teacher? - Did my facilitation as a teacher have a good effect on student learning? - What are the criteria and facilitating measurement points?		
Exercise 1:	time: 2.5 h	Teaching Method: Problem-solving
Consider the following: In the math classroom, the teacher designed the place value of numbers. After delivering part of their training with formative assessment, he found that some students did not understand some of the content well. Based on what you learned in this class: A. How can teachers find out about lack of learning? B. What kind of facilitator model should the teacher use? Why? C. If the student still had difficulty understanding the subject after the guidance, what should the teacher do? D. In another group of students, they have not learned the concept of numbers, which is a prerequisite for place value, so how should the teacher play his facilitating role for this position?		

SESSION 5

Title: Materials & Resources (With what are the students learning)

Subtitles:	time: 4 h	Teaching Method: Problem-solving/ Inductive
- The nature of educational materials and resources - Subject-based pattern as a learning resource - Student-based pattern as a source of learning - Community-based paradigm as a learning resource - A holistic paradigm in learning resource selection - Choosing the right pattern in selecting and compiling learning materials and resources - Relationship between learning materials and resources with environmental conditions - Assess the appropriateness of selected learning materials and resources		
Exercise 1:	time: 2 h	Teaching Method: Problem-solving
Movie Presentation (30 Minutes): In this film, the teacher selects and applies learning materials and resources based on the conditions governing the school and classroom and the students' position. After the screening, participants will be asked to discuss the following questions in their groups and present the results of their discussion to the class. A. Why did the teacher choose these resources? B. Could the teacher choose other materials? What would you do if you were a teacher? C. Write your assessment of teacher content selection (based on the criteria you have learned in this class) D. In this film students were gifted schoolchildren. If they were from the lower socioeconomic class, what learning materials and resources would you use? Why? Should the criteria for evaluating learning materials and resources differ in these two communities? State your reasoning.		

SESSION 6

Title: 1. Grouping (With whom the student is learning?) 2. Location (Where are the students learning?)

Subtitles:	time: 4 h	Teaching Method: Inductive
▪ Individual learning and collective learning ▪ Group dynamics and its role in learning ▪ In what context do groups work best? ▪ Group reinforcement methods ▪ The relationship between learning topics and group activity ▪ Methods of teamwork ▪ Assessing group dynamics and group usefulness ▪ The relationship between group dynamics and teaching effectiveness		
Exercise 1:	time: 2 h	Teaching Method: Problem-solving
Consider the following situation: In the art classroom, the teacher intends to teach drawing objects in 3D. That is, students want to make things more realistic. To this end and with what you learned in class: A. Describe the appropriate learning environment. B. What model would you choose if you wanted to teach in a group way? C. Present your activity in class. D. After you have seen others present and compare your work with them, highlight the strengths and weaknesses of your work. (Do not forget the reasons for the inference at all stages)		

SESSION 7

Title: Time (When are the students learning)

Subtitles:	time: 3 h	Teaching Method: Guided Problem / Exploration plan
▪ Definition of the time ▪ The importance of time in learning ▪ Students' differences in time of learning ▪ Time management in the learning of students ▪ The relationships between time of learning and conditions (context) ▪ Strengthen self-regulation in students through time management ▪ Learning everywhere and every time ▪ Life-long learning ▪ Evaluation of speed in students learning		
Exercise 1:	time: 1.5 h	Teaching Method: Problem-solving
Consider a situation that is shown by the film (30 minutes) and then in your groups be in dialogue and respond below questions: In the film, is the teacher paying attention to the students learning time? If your response is yes, which signs you detected? Does the teacher pay attention to learning time in student success? Why? If you have suggestions about the methods of the teacher regarding time of learning, explain them. Which condition could change your suggestions? (Other conditions or situation?)		
Exercise 2:	time: 1.5 h	Teaching Method: Problem-solving
Consider the following conditions:		

1- The classroom has 22 students in grade 4; 2- The variance between students is high and we have three groups (10 students are very high, 8 students are in the middle, and 4 students are at a lower level in academic achievement); 3- the time that teacher has is 1 hour; 4- a school located beside a large park.

For this situation, you should develop a program about teaching seedless plants. Use from things that you learn from this class.

SESSION 8

Title: Assessment (How is the students’ learning assessed)

Subtitles:	time: 4 h	Teaching Method: Lecturing/ inductive
▪ The nature of assessment ▪ Relationship between objectives and assessment ▪ Are the objectives only important? ▪ Two approaches to objectives: FFT & FOP ▪ Where can we assess students learning? ▪ When can wean assess students learning? ▪ Assessment tools ▪ Relationship between context and assessment tools		
Exercise 1:	time: 2 h	Teaching Method: Problem-solving
For the following situation, develop an assessment plan. "A school in the city's center has access to cultural and political places like cinema, Theatre, police, mosque, bookstores, etc. The topic that the teacher teaches is about the role of school in persuading people to use and visit cultural places". Based on this topic, A. Develop a plan for assessment of learning opportunities. B. What is the basis of your assessment plan? C. To have a comprehensive look at the topic, present your idea about looking at other dimensions. D. If students' perception was good but your assessment's result does not show them, how will your plan change?		

Findings

Descriptive Statistics

In the descriptive section, statistics on the age of students are shown in Table 2.

Table 2. Statistics on the age of students in the experimental and control groups.

Group	Number	Mean	Median	St. Deviation
Experimental	20	24.7	25	1.03
Control	20	24.4	24.5	1.39

Based on the information in Table 2, the mean age of the experimental group was 24.7±1.03 years and the control group was 24.4±1.39 years.

Inferential Statistics

Analysis of covariance (ANCOVA) represents a statistical technique that enables researchers to assess the influence of an independent variable on a dependent variable while controlling for the effects of covariates. This method proves particularly valuable in pretest-posttest control group designs, where it helps account for baseline differences between experimental conditions. In these schemes, a test is performed on the subjects before they are tested, and then the same test is performed

on them again after they are exposed to the experimental conditions. The control of the nuisance variables was done in two stages:

A. Before forming the groups, they were homogenized in terms of the influential variables of gender, field of study, and age.

B. Pre-test scores on TSES and TSRS were used as an auxiliary random variable.

Before the covariance analysis test, the most important assumptions were examined, which included three:

A. Existence of a linear relationship between the auxiliary random variable and the dependent variable, which was determined using the distribution diagram. The points around the regression line are scattered and there is a linear relationship between pre-test and post-test.

B. Normality: To test this hypothesis, the Kolmogorov-Smirnov (K-S) test was used.

The statistical rate of KS in the TSES variable ($Z=0.12$) with a significance level of $p=0.19$, and in the variable of SRTS ($Z=0.11$, $p=0.20$), indicates that each of the variables in the two groups has the same distribution.

Hypothesis1: CQLM has a positive effect on teaching self-efficacy of new teachers in elementary schools

Result of the Levene's Test is significant with a value of $F=1.77$ and degrees of freedom 1 and 38 at a $p=0.19$ level. Therefore, it can be said that this assumption [homogeneity of variances] is established between the variables. By examining these three assumptions and ensuring that they are established, analysis of covariance can be performed. The information required to investigate this hypothesis is given in Tables 3 and 4.

Table 3. Tests of between subject effects in CQLM on TSES.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared	Observed Power ^b
Corrected Model	4326.78 ^a	3	1442.26	88.60	.000	.88	1.00
Intercept	363.28	1	363.28	22.32	.000	.38	.99
GROUP	178.43	1	178.43	10.96	.002	.23	.89
TSES.PRE	1951.48	1	1951.48	119.89	.000	.77	1.00
GROUP * TSES.PRE	42.16	1	42.16	2.59	.116	.07	.35
Error	586	36	16.28				
Total	190281	40					
Corrected Total	4912.78	39					

a. R Squared = .881 (Adjusted R Squared = .871) b. Computed using alpha = .05

At the first line of Table 3 corrected model is located, which shows the estimate of the sum of the error squares regardless of the y-intercept (μm). It seems that with the small amount of sig, a suitable model has been obtained. One of ANCOVA's assumptions is the interaction between the pretest and the experiment effect (GROUP). This assumption is obtained by GROUP*TSES.PRE in the fifth line of the table, and the value of F in it should not be significant. The value of $F=2.59$ is not significant at the level $p<0.05$, which means that the regression slope of the dependent variable is not different at the independent variable levels; so ANCOVA can be run. Based on the data, the value of $F=10.96$ in the GROUP variable shows that the experiment intervention is significant and has positive effect on dependent variable (self-efficacy).

The Effect Size value for each of these variables can also be seen in the Partial Eta Squared column in the ANCOVA model. The greater the value of this column for each row, the greater its effect on the dependent variable. The value of the "Partial Eta Squared" is obtained by dividing the

changes of that factor by the total changes. Based on this rules, indicator of GROUP is 0.23 which has high observed power (0.89) and experimental variable is effective.

Table 4 shows the adjusted scores after neutralizing the pre-test effect from the post-test scores.

Table 4. Estimated Marginal Means.

Group of Subjects	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experiment	75.51 ^a	0.90	73.68	77.34
Control	60.53 ^a	0.91	58.70	63.36
a. Covariates appearing in the model are evaluated at the following values: Self-efficacy pretest = 55.03				

Data from Table 4 shows that the Mean of the experimental group 75.51±0.90 is higher than of the Mean of the control group (60.53±0.91).

Hypothesis2: CQLM has a positive effect on the relational trust of new teachers in elementary schools

Result of Levene’s Test is significant with a value of F=0.003 and degrees of freedom 1 and 38 at a p=0.96 level. Therefore, it can be said that this assumption [homogeneity of variances] is established between the variables. By examining these three assumptions and ensuring that they are established, analysis of covariance can be performed. The information required to investigate this hypothesis is given in Tables 5 and 6.

Table 5. Tests of between subject effects in CQLM on SRTS.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared	Observed Power ^b
Corrected Model	3672.76a	3	1224.26	39.16	.000	.76	1.00
Intercept	699.11	1	699.11	22.36	.000	.38	.99
GROUP	236.34	1	236.34	7.56	.000	.17	.76
SRTS.PRE	1494.16	1	1494.16	47.79	.000	.57	1.00
GROUP * SRTS.PRE	73.67	1	73.67	2.36	.13	.06	.32
Error	1125.61	36	31.27				
Total	190439	40					
Corrected Total	4798.37	39					
a. R Squared = .77 (Adjusted R Squared = .75) b. Computed using alpha = .05							

At the first line of Table 5 corrected model is located, which shows the estimate of the sum of the error squares regardless of the y-intercept (µm). It seems that with the small amount of sig, a suitable model has been obtained. One of ANCOVA’s assumptions is the interaction between the pretest and the experiment effect (GROUP). This assumption is obtained by GROUP*SRTS.PRE in the fifth line of the table, and the value of F in it should not be significant. The value of F=2.36 is not significant at the level p<0.05, which means that the regression slope of the dependent variable is not different at the independent variable levels; so ANCOVA can be run. Based on the data, the value of F=7.56 in the GROUP variable shows that the experiment intervention is significant and has positive effect on dependent variable (relational trust).

The Effect Size value for each of these variables can also be seen in the Partial Eta Squared column in the ANCOVA model. The greater the value of this column for each row, the greater its

effect on the dependent variable. The value of the "Partial Eta Squared" is obtained by dividing the changes of that factor by the total changes. Based on this rules, PES of GROUP is 0.17 which has high observed power (1) and experimental variable is effective.

Table 6 shows the adjusted scores after neutralizing the pre-test effect from the post-test scores.

Table 6. Estimated Marginal Means.

Group of Subjects	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experiment	74.74 ^a	1.31	72.08	77.40
Control	60.80 ^a	1.27	58.22	63.38
a. Covariates appearing in the model are evaluated at the following values: Self-regulatory pretest = 54.3500.				

Data from Table 6 shows that the mean of the experiment group 74.74±1.31 is higher than mean of the control group (60.80±1.27).

Hypothesis3: CQLM has a positive effect on students’ learning outcomes of new teachers in elementary schools

Result of the Levene’s Test is significant with a value of F=2.14 and degrees of freedom 1 and 38 at a p=0.15 level. Therefore, it can be said that this assumption [homogeneity of variances] is established between the variables. By examining these three assumptions and ensuring that they are established, analysis of covariance can be performed. The information required to investigate this hypothesis is given in Tables 7 and 8.

Table 7. Tests of between subject effects in CQLM on SLO.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared	Observed Power ^b
Corrected Model	24.91 ^a	3	8.30	56	.000	.82	1.00
Intercept	1.77	1	1.77	11.93	.001	.25	.92
GROUP	.09	1	.09	.60	.442	.02	.12
SLO.PRE	24.03	1	24.03	162.02	.000	.82	1.00
GROUP * SLO.PRE	.08	1	.08	.56	.46	.02	.11
Error	5.34	36	.15				
Total	12560.08	40					
Corrected Total	30.25	39					
a. R Squared = .82 (Adjusted R Squared = .81) b. Computed using alpha = .05							

One of ANCOVA’s assumptions is the interaction between the pretest and the experiment effect (GROUP). This assumption is obtained by GROUP*SLO.PRE in the fifth line of the table, and the value of F in it should not be significant. The value of F=0.56 is not significant at the level p<0.05, which means that the regression slope of the dependent variable is not different at the independent variable levels; so ANCOVA can be run. Based on the data, the value of F=0.60 in the GROUP variable shows that the experiment intervention isn’t significant and hasn’t positive effect on dependent variable (Students’ Learning Outcomes). Therefore, CQLM in this research doesn’t positive effect on SLO.

Table 8 shows the adjusted scores after neutralizing the pre-test effect from the post-test scores.

Table 8. Estimated Marginal Means.

Group of Subjects	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experiment	17.73 ^a	0.90	17.55	17.90
Control	17.65 ^a	0.89	17.47	17.83
a. Covariates appearing in the model are evaluated at the following values: Academic Achievement- pretest = 17.25				

Data from Table 8 shows that mean of experiment group 17.73±0.90 is higher than of mean of the control group (17.65±0.89).

Discussion

This study examined the impact of the Collective Quantum Learning Model (CQLM) on three key outcomes: (1) teaching self-efficacy, (2) relational trust among novice elementary school teachers, and (3) student learning achievement. The research employed a pretest-posttest control group design, with 20 early-career teachers participating in the experimental intervention. Teachers in the treatment group received 48 hours of CQLM workshop training, while control group participants continued with standard professional development activities.

The analysis revealed statistically significant differences in Teacher Self-Efficacy Scale (TSES) scores between the experimental and control groups, indicating that the intervention effectively enhanced participants’ teaching self-efficacy. Self-efficacy as a motivating factor in our educational system is influenced by several factors (Amoozegar et al., 2024), in which the role of teaching method is of great importance. Student-based teaching methods can develop and enhance many skills in learners, including self-efficacy. In fact, given the crucial role of self-efficacy judgments in students’ inner motivation and academic achievement, the teacher should increase learners’ sense of self-efficacy and improve their level of performance with the help of learners in class division tasks and activities. In general, the teaching method that a student is taught during a course of study affects his/her self-efficacy (Ince, 2023). The CQLM in several ways affected the self-efficacy of new teachers teaching. First, the teaching method was based on a collaborative and participatory approach, and new teachers were monitored, supported, and evaluated by each other. Second, performance assignments were analyzed collaboratively and call for high levels of cognition. In the early meetings, new teachers had difficulty presenting assignments, but the course feedback system was designed to grow. Third, because the approach of the course was interpretive, holistic, and communicative, a deeper understanding of learning took place, and they could have taught more successfully. Success in teaching enhanced students’ sense of self-efficacy and motivation. However, these findings contradict the study by Afacan and Gürel (2019), who argued that the duration of the research might have been insufficient to observe measurable shifts in self-efficacy levels among novice educators. Their study attributed the absence of significant differences between pre-test and post-test scores to this potential limitation. Comparing the results of the present study with (Afacan & Gürel, 2019) research, it can be said that the present study lasted 48 hours and their research lasted 16 hours. In other words, the point mentioned by them, that their courses were short and they could not affect their self-efficacy was considered in the present study and by tripled the training time, it was able to affect self-efficacy.

The second hypothesis of the research included the effect of CQLM on new teacher relational trust. Indeed, trust is the foundation of life. Among the specific non-educational outcomes that teachers should foster is the development of students’ self-confidence as well as trust in other students. This requires teachers to position themselves as trustworthy figures. Failure to fulfill this role leads to teacher distrust and, consequently, to the failure to realize students’ trust (Kurnianingsih et al., 2012). The term trust is defined by both historical and socio-cultural contexts and is therefore.

However, within the same cultural context, when we consider the equivalent meanings of what and whom to trust, the collected data becomes more complete (Westjohn et al., 2022). Studies on an individual concept are Relational trust is a level of trust that is earned by an individual based on the competence and behavior of others to act fairly, ethically, and predictably (Adams, 2014), and students with higher levels of this type of trust are more motivated to perform better academically (Robinson, 2022). The results of this study showed that the collective quantum learning model had an effect on the relational trust of new teachers. Although no research was found to investigate this relationship, some studies such as (Delgarm et al., 2022) stated that building trust is one of the main categories of quantum management in an attempt to present a quantum leadership model in Iranian secondary schools. Relational trust is defined as a relative confidence that another person or entity will not act in ways that lead to negative consequences. In the school setting, this confidence can lead to attachment to its agents, space, and processes. At higher levels, relational trust makes students and teachers feel competent (meaning the ability of one party to fulfill their commitments), trustworthy (meaning the reliability of an individual or group based on past performance), and honest (meaning the willingness to maintain ethical standards, rather than to achieve school goals).

The third hypothesis of this study examined the influence of the CQLM on the academic performance of elementary school students taught by new teachers. Academic success is often measured through summative evaluations, which align with predefined learning outcomes. Learning processes encompass the activities students engage in to meet educational objectives, whereas learning outcomes represent the competencies they acquire through these experiences. These outcomes reflect various dimensions of human development, including cognitive knowledge, practical skills, emotional and social growth, physical abilities, and attitudinal changes (Verplanken & Orbell, 2022). Learning outcomes are defined as explicit descriptions of the knowledge, skills, and competencies learners should demonstrate upon completing a course (Goff et al., 2015). Goff et al. (2015) emphasize that well-articulated outcomes enhance educational transparency, align course objectives with external standards, foster learner-centered instruction, and encourage self-directed learning by enabling students to monitor their progress. The findings of this study align with research by Setiawan (2023) and Arif et al. (2023), indicating that the CQLM did not significantly improve learning outcomes, with no notable differences observed between experimental and control groups. This contrasts with studies such as Sujatmika et al. (2018), which reported positive effects of quantum learning methodologies. The discrepancy suggests that the CQLM's impact on learning outcomes may be indirect or require extended timeframes to manifest fully.

This study was conducted to provide a new perspective on teacher education. As a key element and a reflective practitioner in the education system, the teacher must be properly educated to provide appropriate instruction for students. The main goal of the Quantum Learning Model (QLM) is to realize the individual as a whole. It is argued that this approach, which is mostly used in language teaching, is important for inspiring learners, influencing learning outcomes, and addressing every detail in the classroom. Quantum learning, which is considered suitable for learners of all age groups and styles, is based on the classroom environment, teaching methods, interactions, and student activities.

The results of this study showed that, in general, the QLM course has been effective and has yielded positive outcomes. The new teachers requested the continuation of the course and believed it would be more effective if extended. Adapting the course to professional development needs, the innovative method of course implementation, the deliberate selection of course content, and its evolutionary approach contributed to a proper understanding of learning. Although this course positively affected teacher self-efficacy and relational trust among new teachers, no significant effect was observed on their students' learning outcomes.

Conclusion

The Iranian teacher training system is in transition from traditional to modern. It has been less than a decade since the teacher education system became an academic system. However, much of the

content, teaching methods, and policies are still traditionally implemented. Formative and summative assessment methods are traditionally performed. Despite trying to get through this stage, there is still a long way to go. Courses such as CQLM both increased student participation and conflict of interest, and made it clear that other methods could be taught. Learning is a science and can be managed. This aspect of course effectiveness (changing attitudes towards learning and teaching) is the most important part. If the teacher changes his/her attitude towards learning, he/she will set goals, and choose appropriate strategies. Students participating in this course are expected to have the necessary motivation to disseminate the achievements of the course. Based on the results of this research, the following suggestions are presented.

1. Quantum learning is a new method in the Iranian education system. It is recommended that this method be used by more professors to increase its effectiveness.
2. Teaching teacher training in the field of QL can help spread this method.
3. The effect of QLM on other cognitive and psychological variables can be investigated by other researchers.
4. This method is expected to be used in other universities and fields of study so that comparisons can be made to determine how effective it is.
5. This research was conducted in the context of Iranian society, its implementation in other countries and systems can provide a better basis for comparison.

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