

Assessing The Impact Of Collaborative Learning Strategies On Pre-Service Teachers' Teamwork, Communication, And Metacognitive Abilities: A Mixed-Methods Study

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ABSTRACT

Conventional teaching methods, characterized by one-way education and emphasis on rote memory, have proven to be ineffective for student learning. In contrast, collaborative learning strategies have gained prominence in educational environments due to their ability to foster engaging and enduring learning experiences while enhancing teamwork, communication, and metacognitive skills. This study aimed to investigate the Collaborative learning strategies to enhance pre-service teachers' teamwork, communication, and metacognitive abilities. A mixed-methods approach was employed, with a pre-test conducted in the first semester and a post-test in the fourth semester, involving 46 participating pre-service teachers. The study spread across from first semester to fourth semester, about two years' time. During pre-service orientation, students were exposed to various collaborative learning strategies such as group discussions, project work, and seminar presentations, group activities, peer feedback, teacher feedback etc. The findings revealed that collaborative learning enhanced teamwork, communication, and metacognition among pre-service teachers. Further the pre-service teachers were motivated to incorporate collaborative learning into their teaching practices due to positive experiences and recognition of its potential benefits for instruction and student academic progress. The study also identified potential barriers and proposed feasible alternatives to facilitate the integration of collaborative learning into pre-service teacher training programs. This study underscores the importance of integrating collaborative teaching and learning approaches into teacher education programs, as they have transformative potential for improving learning outcomes and fostering the development of essential skills. Institutions can contribute to better equipping pre-service teachers by enhancing their proficiency in collaborative teaching and learning methodologies.

Keywords: Collaborative learning, teamwork, communication, metacognition effective teaching, pre-service teachers.

Introduction

Traditional teaching strategies that emphasis rote memory and one-way education have been found to be counterproductive for learners recently in India, as evidenced by NEP 2020 which identifies the significance of Collaboration and communication in learning. Due to its capacity to encourage more interesting, long-lasting, and deep learning experiences while also encouraging teamwork, communication, and metacognitive skills, collaborative learning approach has grown in favor of teaching and learning process. A more dynamic and interactive teaching approach that successfully assists students in acquiring and applying new information is made possible by collaborative learning (Dillenbourg, 1999; Goodsell et al. 1992; Bruffee, 1984; Johnson, Johnson, & Holubec, 1994; Webb, & Palincsar, 1996; Kim et al. 2013; and Cañabate et al. 2017). The theoretical underpinnings of social constructivism, which holds that knowledge is co-constructed through students' active engagement and social interactions within their learning environment, provide a strong foundation for

collaborative learning (Vygotsky, & Cole, 1978). And further supported by Cobb & Bowers, 1999; Dillenbourg 1999; and Wertsch 1985). Piaget, & Inhelder, (1969), proposed a constructivist theory of learning, which holds that learners actively construct their own understanding of the world through collaboration with others and the manipulation of objects in their environment. Further the Dewey theory which focuses on group projects and hands-on experiences as fundamental aspects of effective learning (Dewey, 1916) form the theoretical framework for this study.

According to research, collaborative learning provides several advantages, including strengthening students' motivation, engagement, and learning outcomes as well as encouraging teamwork, communication, and metacognition (Johnson & Johnson, 2014; Dillenbourg, 1999; Stahl, 2006). Additionally, it has been discovered that collaborative learning is especially beneficial for pre-service teachers, who gain from the chance to practice instructional skills, engage in reflective conversation, and get peer evaluation. (Boud, & Lee, 2005; Zeichner & Liston, 2013; Slavin, 1980).

Despite the potential benefits of collaborative learning, its incorporation into programmes for pre-service teachers is still restricted and faces several difficulties. (Vogt & Rogalla, 2009). By analyzing its effects on pre-service teachers' readiness to employ these strategies in the classroom, the current study seeks to supplement to the literature on collaborative learning in pre-service teacher education. While several research have examined the effectiveness of collaborative learning, relatively little focus has been placed on how it impacts pre-service teachers' ability to use these strategies effectively. Additionally, neither pre-service teachers' perceptions of collaborative learning's relevance to their teaching practice nor its potential for transformation have been extensively investigated. This study aims to bridge this gap by investigating the following research questions:

Research Questions:

1. How do pre-service teachers perceive and experience collaborative learning in comparison to traditional teaching methods?
2. What is the impact of collaborative learning on the teamwork, communication, and metacognitive abilities of pre-service teachers?

Literature review

A. Understanding Collaborative Learning

Collaborative learning is a pedagogical approach that emphasizes the significance of teamwork, communication, metacognitive abilities and social skills, (Louvet et al. 2017) and shared responsibility for learning outcomes. The traditional educational model, which emphasizes individual success, might not be sufficient to develop the critical thinking, problem-solving, and communication skills necessary in today's culture. Students have the chance to interact with other viewpoints, form social bonds, and find a common goal through collaborative learning. (Bruffee, 1984). The foundational components of collaborative learning are constructive interdependence, individual accountability, social interaction, peer or group learning, active engagement, shared responsibility, mutual engagement, active participation, negotiation, shared knowledge, feedback, and the creation of a common learning objective. (Bosworth, & Hamilton, 1994; Dillenbourg, 1999; Johnson et al., 2014; Vygotsky, 1978).

B. Collaborative Learning Strategies

To operationalize collaborative learning, it is essential to have clear learning goals, active participation, timely feedback, appropriate instructional approaches, and effective monitoring and evaluation of student interactions (Johnson & Johnson, 2008). Various strategies have been proposed, including group projects, peer editing, and discussion groups, as well as think-pair-share, jigsaw methods (Johnson & Johnson, 2008), problem-solving tasks, cooperative games, project-based learning, and group discussions, have been suggested to promote collaborative learning (Bosser, 1988). Additionally, Johnson and Johnson (2008), also identify collaborative learning techniques like peer teaching, collaborative writing, role-playing, debate, case studies, simulation games, and online collaboration using digital tools and platforms.

The effective implementation of collaborative learning in educational contexts, according to Bosworth and Hamilton (2016), depends on the right application of strategies. In their investigation of the fundamental principles and practical methods of collaborative learning, the authors emphasized the significance of precise learning objectives, active engagement, and timely feedback in fostering successful collaborative learning. However, Manickam et al., (2020) suggest that Facebook can also facilitate collaborative learning in higher education institutions, with proper guidance, and taking into account factors such as intention, interactivity, and engagement to promote student-teacher collaboration. Johnson and Johnson (1987) provide practical guidance for teachers on implementing cooperative, competitive, and individualistic learning approaches in the classroom based on social psychology and classroom practice, offering strategies for selecting, implementing, and evaluating them to improve students' achievement, attitudes, and social skills.

C. Collaborative Learning and Teamwork

Students' capacities for teamwork can be improved through collaborative learning. Collaborative learning structures, as opposed to competitive or individualistic ones, were found by Roseth, Johnson, and Johnson (2008) to be connected with more pleasant social connections and better academic performance. Johnson and Johnson (2003) contend that by putting an emphasis on shared goals, mutual support, and constructive interdependence, collaboration fosters social skills. The effectiveness of collaborative learning in building social skills and knowledge acquisition, when properly assisted, is further supported by Kirschner et al., (2006). According to Slavin (1980), cooperative learning can improve students' social skills by giving them opportunities for positive dependency, face-to-face interaction, self-reliance, and group processing. The overall results highlight the significance of encouraging shared objectives, mutual support, and constructive interdependence in the classroom and show that collaborative learning can be a useful strategy for enhancing collaboration abilities among students. (Webb, 2009; Gillies & Boyle, 2010; King, 1990).

D. Collaborative Learning and Communication

Students' social skills can be improved through collaborative learning by developing their communication, cooperation, and conflict resolution skills. Kagan and Kagan (1994) argue that through structured group work, students can develop important social skills, such as communication, leadership, and conflict resolution, while also gaining a deeper understanding of the subject matter. Collaboration Learning structures, as opposed to competitive or individualistic ones, promote pleasant social connections and higher academic outcomes, according to studies by Roseth et al., (2008) and Slavin (1980). Through shared goals, mutual support, and constructive interdependence, collaborative learning environments, according to Johnson and Johnson (2003), foster effective peer interactions. These environments can also enhance individual accountability and responsibility.

According to Kirschner et al., (2006), collaborative learning practices that are properly facilitated can be effective in promoting social skills and knowledge acquisition. According to Webb (2009), teachers can promote collaborative discussion through leading by example, promoting group accountability, and providing opportunity for students to reflect on their collaborative actions. Gillies and Boyle (2010) emphasize that for collaborative learning to be successful, teachers must give rigorous planning and management. These results imply that, when carefully planned and guided by teachers, collaborative learning might be a useful strategy for enhancing students' social skills and academic performance.

E. Collaborative Learning and Metacognitive abilities

Multiple advantages of collaborative learning have been demonstrated, including greater metacognitive skills, improved critical thinking, and higher motivation. (Laal & Ghodsi, 2012). According to Järvelä et al. (2021), collaborative learning enhances metacognitive abilities by allowing students to take into account both their own and their peers' perspectives. This will raise academic accomplishment and cultivate lifelong learning capabilities. Promoting self-regulation in science instruction through the use of metacognitive strategies in cooperative learning contexts can result in greater comprehension and enhanced academic performance (Schraw et al., 2006). Improvements in metacognitive knowledge and regulation, including better learning process planning, monitoring, and evaluation, have been linked to reciprocal peer tutoring. (De Backer et al., 2012). Collaborative learning allows students to learn from one another's knowledge and pedagogical methods, which improves their comprehension and capacity to control metacognitive processes. (Dinsmore et al., 2008). Effective group structures can help students better comprehend and regulate both their own and their peers' learning processes, thereby strengthening their metacognitive skills. Examples of these structures include collaborative learning, peer tutoring, and project-based learning. (De Wever & Strijbos, 2021).

Research Methodology

The current study employed a mixed-methods research design to investigate the impact of collaborative learning experiences on pre-service teachers. Teamwork, communication, and metacognition are dependent variables and collaborative learning intervention is the independent variable. The quantitative component involved a 45-item Likert scale questionnaire administered to 46 pre-service teachers concerning the pre and post intervention study, to research on the impact collaborative learning experiences on teamwork, communication, and metacognition. The questionnaire instrument was developed by the researchers by consulting experts from the field, conducted pilot test, and underwent reliability testing, yielding a Cronbach's alpha coefficient of 0.97, which indicated a high level of internal consistency.

The various collaborative learning activities implemented over four semesters include brainstorming sessions, discussion, project-based work, group tasks and activities, peer feedback, and group presentation. Prior to the start of the collaborative learning intervention, the pre-service teachers received two weeks of instruction and demonstration on the principles and strategies of collaborative learning. The participants were organized into 10 groups of 4-5 members, with rotational compositions for each activity. This facilitated diverse interactions through discussions, writing tasks, and topical presentations while collaborating with different peers, fostering

a dynamic learning environment for the pre-service teachers' professional development. The pretest and post test data were evaluated using paired sample t-test.

The qualitative component of the study involved researcher's reflective diary or journal and semi-structured interviews with 15 pre-service teachers throughout the four-semester period. This qualitative data was collected to gain a deeper understanding of the participants' lived experiences with collaborative learning and their perceptions regarding the applicability of these strategies to their future teaching practice.

The mixed-methods approach allowed the researchers to triangulate the quantitative survey data with the rich, contextual insights gained from the interviews and teacher observations. The methodological design of the study aims to answer the research questions, which centered on exploring the impact of collaborative learning on pre-service teachers' teamwork, communication skills and metacognitive dimensions; investigating the relationship between their experiences and readiness to use collaborative techniques; and identifying potential challenges and solutions for integrating collaborative learning into pre-service teacher education programs.

Data Analysis and Interpretation

The data that was collected for the research can be broadly categorized as that which relates to the collaborative learning and the data shows the transformation in the teamwork, communication skills and metacognitive dimensions of the pre-service teachers. The analysis includes both quantitative and qualitative methods used for the research.

A. Quantitative Analysis

Quantitative analysis involves the systematic examination of numerical data using statistical methods to identify patterns, relationships, and trends. It typically includes the collection of measurable data, which can be analyzed using various statistical techniques such as regression, correlation, and hypothesis testing. This type of analysis provides objective results that can be used to make informed decisions, predict outcomes, and validate hypotheses. Quantitative analysis is widely used in fields such as economics, psychology, sociology, and education to derive meaningful insights from large datasets.

a) Analysis of collaborative learning experience

The study aims to know if the students were exposed to collaborative learning atmosphere earlier in their education career. Also, there was a need to know if they sincerely participated in the collaborative learning exposure and whether there was a change in their opinion after the course and if they would use collaborative learning in their future career. The below chart shows the average score of the students prior to collaborative learning, during the collaborative learning exposure, and the opinion after the collaborative learning.

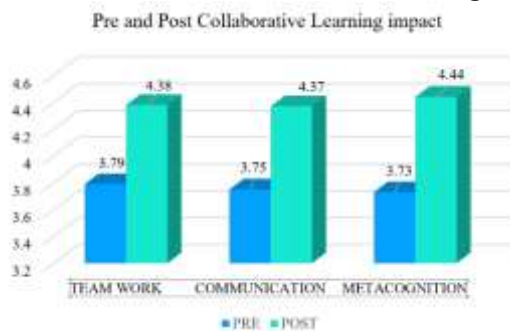


As can be seen from the chart, the students were considerably exposed to collaborative learning before but it was not intentional, rather informal. This interventional study was initiated to help the students deliberately involve in the various dimensions of collaborative learning so that they will enquire into the need to use these strategies in the future. After the intervention, there was a

change in their attitude from 3.8 to 4.5 in the scale. They all tended to totally agree to importance of collaborative learning methods in their teaching career.

b) Analysis of impact of Collaborative Learning

The interventional collaborative learning clearly indicates the impact on teamwork, communication, and metacognition and the below depicts it. As can be seen from the chart, the students showed remarkable increase on all the three dependable variables, teamwork, communication, and metacognition. This shows a significant impact by the use of collaborative learning intervention on pre-service students. Teamwork saw an increase of 0.59, communication with 0.62, and metacognition had the maximum impact with an increase of 0.71.



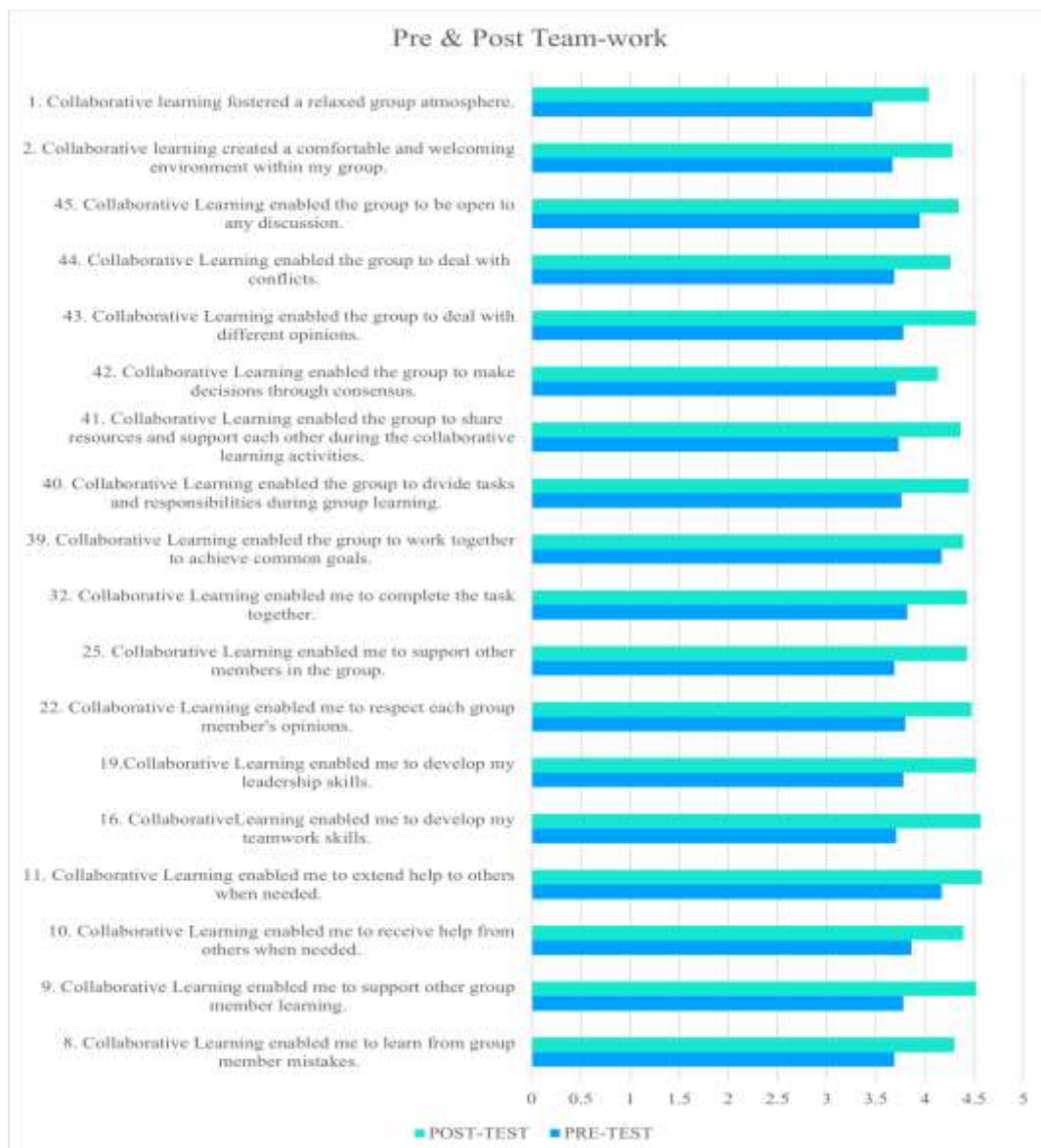
The item wise analyses of all the three variables are discussed in the following.

i) Teamwork

Paired sample t-test was conducted to find the significance in the increase of teamwork as impacted by collaborative learning intervention.

Teamwork: Paired Samples t-test						
Measure	Test	Mean	Std. Deviation	df	t	p
Teamwork	Pre	3.7907	.1685	17	-16.056	.000
	Post	4.3878	.14611			

When we compare the pre-test and post-test, there is a significant difference in the scores for pre-test (M = 3.7907, SD = .1685) and score for post-test (M = 4.3878, SD = .14611); $t(46) = -16.056$, and $p=0.000$. The probability value being 0.000 is significant at 5% level, as it can be observed that the value of post-test is greater than the value of pre-test. This is a clear inference that collaborative learning has impacted teamwork of the pre-service teachers significantly.



The data demonstrates a clear positive shift in the participants' attitudes and experiences towards collaborative learning's influence on teamwork skills. The post-test scores show a marked improvement across the majority of the teamwork-focused items compared to the pre-test.

The most substantial increase of 0.86 in Item 16 was observed, which shows that collaborative learning enabled individual learning in the teamwork as a whole. Additionally, noteworthy improvements were seen in Items 9, 19, and 25 that showed an increase of 0.74 and Item 43 with an increase of 0.73. These items were related to having an opportunity to support other group members in learning, develop leadership skills, help group

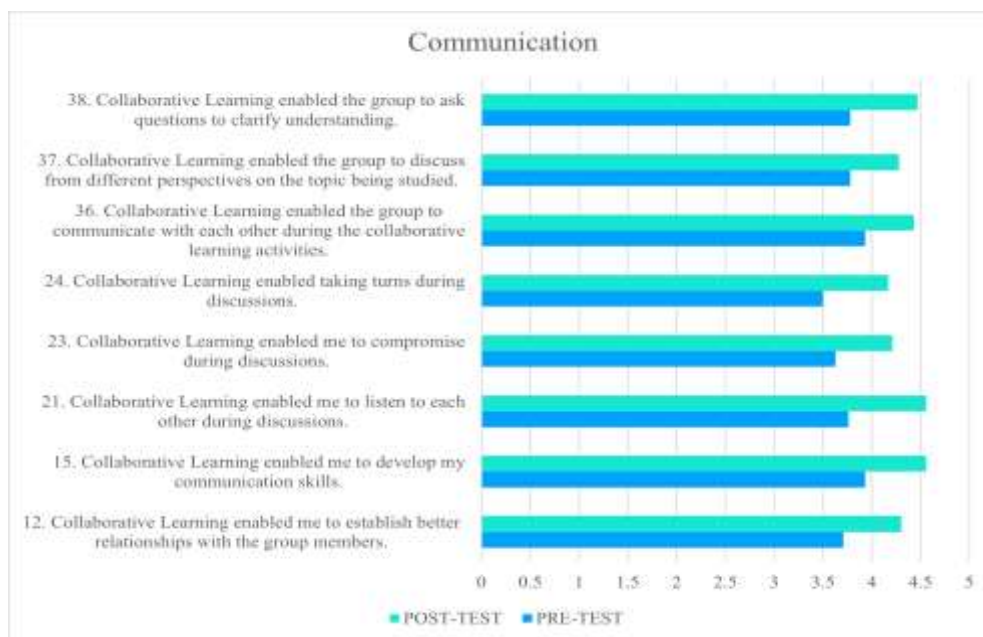
members socially, and deal with different opinions. The least increase of 0.22 was in Item 39 which had to do with achieving common goals, and this is understood because there could be different goals and there can be some who are good at working individually. The data reveals enhanced perceptions of one's own capacity to complete tasks together as represented by Item 32 with an increase of 0.61. Overall, the comparative analysis of the pre-test and post-test data provides strong evidence that the collaborative learning interventions had a measurable positive impact on the pre-service teachers' teamwork-related knowledge, skills, and dispositions. These findings underscore the potential of collaborative learning approaches to cultivate essential teamwork capabilities among future educators.

ii) Communication

Paired sample t-test was conducted to find the significance in the increase of communication as impacted by collaborative learning intervention.

Communication: Paired Samples t-test						
Measure	Test	Mean	Std. Deviation	df	t	p
Communication	Pre	3.7525	.14400	7	-17.388	.000
	Post	4.3725	.15323			

When we compare the pre-test and post-test, there is a significant difference in the scores for pre-test (M = 3.7525, SD = .14400) and score for post-test (M = 4.3725, SD = .15323); $t(46) = -17.388$, and $p=0.000$. The probability value being 0.000 is significant at 5% level, as it can be observed that the value of post-test is greater than the value of pre-test. This is a clear inference that collaborative learning has impacted communication of the pre-service teachers significantly.



Pre-test scores indicated moderate communication skills prior to the interventions. However, post-test results demonstrated substantial increases across all communication-focused items, suggesting collaborative learning effectively developed these abilities. The largest gains occurred in group-level communication which fostered active listening as represented in Item 21 with an increase of 0.8. Items 15, 24, and 38 also showed a considerable increase of 0.63, 0.67, and 0.69 respectively. These items had to do with developing communication skills, cooperation in taking decisions, and clarification of doubts. Meaningful improvements also emerged in Items 12, 23, 36, and 37 with an increase of 0.59, 0.58, 0.5, and 0.5 respectively. They show that there was enhanced relationship within the group members, willingness to compromise during discussions, enhanced communication, and helped get different perspectives on the given topic.

These findings indicate collaborative learning facilitated growth at both collective and individual levels. The consistently higher post-test scores provide strong evidence that collaborative learning had a substantive positive impact on enhancing pre-service teachers' communication knowledge, skills, and dispositions. This suggests incorporating collaborative strategies into teacher education can effectively cultivate essential communication competencies.

iii) Metacognition

Paired sample T-test was conducted to find the significance in the increase of metacognition as impacted by collaborative learning intervention.

Metacognition: Paired Samples t-test						
Measure	Test	Mean	Std. Deviation	df	t	p
Metacognition	Pre	3.73	.29935	18	-10.583	.000
	Post	4.44	.08422			

When we compare the pre-test and post-test, there is a significant difference in the scores for pre-test (M = 3.73, SD = .29935) and score for post-test (M = 4.44, SD = .08422); $t(46) = -10.583$, and $p=0.000$. The probability value being 0.000 is significant at 5% level, as it can be observed that the value of post-test is greater than the value of pre-test. This is a clear inference that collaborative learning has impacted metacognition of the pre-service teachers significantly.



The quantitative data analysis revealed significant improvements in pre-service teachers' metacognitive abilities following their engagement in collaborative learning experiences.

The post-test scores were notably higher compared to the pre-test across numerous metacognition-focused items on the survey. Item numbers 5, 13, 14, 17, and 18 showed the maximum increase in the post-test with an increase of 0.94, 0.95, 0.98, 0.91, and 0.96. The items indicate self-understanding of the subject, confidence in the ability to learn, self-esteem, problem solving skills, critical thinking skills. There was considerable impact

in Items 4 and 20 which have an increase of 0.8 and 0.87 respectively. These show an improved understanding of course material, and they were able to evaluate their learning skills. Other improvements that can be seen are evident through Items 7, 27, and 33 all of which have an increase of 0.72 and they evidence that the participants have had different perspectives, gained new ideas, and were able to set specific goals for learning. Besides the above mentioned the chart shows all the other aspects related to metacognition which are boosted through collaborative learning.

These consistently higher post-test scores across the metacognition domain provide robust evidence that the collaborative learning interventions had a significant positive impact on enhancing the pre-service teachers' metacognitive knowledge, skills, and self-regulatory capacities. These findings underscore the potential of collaborative learning approaches to cultivate essential metacognitive competencies among future educators.

B. Qualitative Analysis

Qualitative analysis involves the systematic examination and interpretation of non-numerical data, such as text, images, or observations, to uncover underlying meanings, themes, and patterns. It emphasizes understanding the context, perspectives, and subjective experiences of individuals or groups being studied.

a) Semi-structured Interview

The qualitative component of the study involved semi-structured interviews with 15 pre-service teachers at the end of the research. Below is the analysis:

How has collaborative learning fostered your communication, cooperation, and metacognition skills?

The participants claimed that collaborative learning has aided in their ability to become more open to one another. They resisted speaking at first and found group discussions and activities time-consuming during collaborative learning. But as the group learning proceeded, they started to open up to one another and began to communicate more freely. As they had to engage in brain-storming and discussions on the subject, clear up any confusion, come up with ideas, etc., the method also assisted them in improving their speaking abilities. As a result, individuals improved in their communication skills and confidence to speak. While interacting with groups, participants had the ability to watch and learn from their peers. Also, they evaluated and assessed what they think and feel as well as those of others. The group was guided by the researcher who distributed responsibilities and assigned tasks to the participants. Each participant was accountable for carrying out the task, project, or activity through the end. Participants' ability to organize and complete tasks strengthened due to the fact it employed this strategy, as well as fostered teamwork.

Can you identify any difficulties or obstacles in integrating collaborative learning into pre-service teacher education? What workable solutions can you offer for them?

Collaborative learning environments thrive on active participation and meaningful interaction among team members. Effective team coordination is paramount to ensure seamless collaboration and facilitate the learning process. A breakdown in communication can potentially hinder teamwork and impede learning progress. Additionally, the judicious dissemination of responsibilities is crucial, as there may be instances where some pre-service teachers contribute less to the collaborative effort. However, when these three factors – participation, communication, and equitable distribution of responsibilities – are carefully managed, the learning experience becomes remarkably enriching and expeditious.

How do you perceive the applicability of collaborative learning to your teaching practice and its potential transformative effects?

Having been exposed to different collaborative learning projects, tasks and activities, they said that they have acquired the knowledge of what is collaborative learning and what different techniques and strategies, tasks and activities can be adopted based on the environment, concept, and level of the students. They felt that this approach has a greater benefit when compared to the lecture method. As the learners are bound to be involved in the learning activities, create an environment that is learner centered and create a situation where all learners think critically, evaluate others, themselves, and the work. Furthermore, it creates a sense of community and supports social connection among learners which in turn boost motivation and a sense of belonging in the group. It was evident that they wanted to use collaborative learning strategy for meaningful learning.

b) Teacher's reflective journal

The researcher's observations, as documented in the teacher's diary, provide valuable insights into the implementation of collaborative learning among the pre-service teachers. Initially, the researcher noted that the adoption of collaborative learning strategies was challenging for the students and researcher. However, over the course of the intervention, the researcher observed a marked shift in the participants' attitudes and behaviors. Through continued exposure and experience, they demonstrated increased enjoyment and better coordination in their collaborative work. The researcher noted that the tasks were completed in a shorter timeframe, with greater ease, and yielding higher-quality outputs compared to individual efforts.

These observations suggest that while the initial implementation of collaborative learning may have encountered some resistance or difficulties, the sustained engagement and practice led to a positive transformation in the pre-service teachers' receptiveness and proficiency in collaborative work. The researcher's insights highlight the importance of providing adequate support and opportunities for pre-service teachers to develop the necessary skills and mindset for effectively utilizing collaborative learning strategies in their future classrooms. The researcher astutely acknowledges the significance of shared responsibility as a potential drawback in collaborative learning environments. Instances may arise where group members are absent, thereby hindering their ability to contribute to the collective endeavor, ultimately impacting the group's overall performance. This observation underscores the criticality of consistent and equitable participation from all team members to ensure the seamless execution of collaborative tasks and the realization of desired learning outcomes.

The qualitative data from the teacher's diary, coupled with the quantitative findings, offer a comprehensive understanding of the impact of collaborative learning on pre-service teachers' development, both in terms of their academic outcomes and their evolving perceptions and attitudes towards this pedagogical approach.

Research findings and conclusion

Peers' close association enable critical evaluation of peer opinions, ideas, and suggestions, leading to reflective knowledge and awareness of individual learning. The findings in relation to the research questions are:

1. Working in a group promotes coordination ability, negotiation skills, respecting other's opinions, empathizing with others, and observation skills, all contributing to a better learning outcome.
2. The study shows that pre-service teachers, as they have engaged and experienced in numerous collaborative learning, are better equipped to implement these strategies in their future classroom in a contextualized way.
3. The study gives the insight that collaborative learning enhanced the teamwork, communication, and metacognitive abilities of pre-service teachers, as collaborative learning has the potential for development in the areas of group decision-making and fostering a positive atmosphere.

Overall, the research indicates that collaborative learning is a useful strategy for meeting learning goals and enhancing crucial abilities in pre-service teacher education. This study offers insights to teacher education institutions on the potential benefits of providing various collaborative learning experiences aimed at enhancing the effectiveness of pre-service teachers in their future classroom teaching.

The methodological approach of the study, which restricted data collection to only one group and only gave this group the opportunity to engage in collaborative learning, places limitations on the study. Future studies should think about using a two-group experimental design with a larger sample size to address this limitation. This study is conducted with female pre-service teachers as participants; however, the results might as well be applicable to the male pre-service teachers also.

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