UNIVERSITY OF EDUCATION, WINNEBA

COMPARATIVE EFFECT OF COLLABORATIVE PEER AND VIDEO-BASED MICROTEACHING MODELS ON SELECTED FEMALE PRESERVICE TEACHERS' SCIENCE TEACHING EFFICACY

LYDIA AWORTWE

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A thesis submitted to the School of Graduate Studies in partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy (Science Education)

Department of Science Education
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DECLARATION

STUDENT'S DECLARATION

I, Lydia Awortwe, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature: …………………..……………

Date: ……………………………………

SUPERVISORS' DECLARATION

We hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

Professor Ruby Hanson (Principal Supervisor)

Signature: …………………………

Date: ………………………………

Professor Charles Kwesi Koomson (Co-Supervisor)

Signature: …………………………

Date: ………………………………

DEDICATION

This thesis is dedicated to the Almighty, Mr. Samuel and Mrs. Peggy Awortwe (parents), my siblings, Jezreel Araba Nyaw and Gilgal Eliyah Asankomah Nyaw (daughters), and Sampson Nyaw (husband).

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I am deeply grateful to Prof. Ruby Hanson and Prof. Charles Kwesi Koomson for their dedicated guidance and unwavering commitment throughout the writing of this thesis. Their invaluable insights and expert supervision greatly enhanced the quality of this study. They not only provided constructive feedback but also inspired me to think critically and work independently. Their mentorship has been instrumental in shaping my academic growth, and I sincerely appreciate the generous investment of their time and expertise in supporting this research.

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ABBREVIATIONS

STEBI-B: Science Teaching Efficacy Belief Instrument

PCPM: Perception of Collaborative Peer Microteaching Model

ABSTRACT

This study compared the effectiveness of the collaborative peer and video-based microteaching models in enhancing the science teaching efficacy of selected Ghanaian female preservice teachers. A comparative research design with purposive (criterion-based) sampling was used to select two intact classes comprising fifty-six (56) second-year Early Grade preservice teachers from the Presbyterian Women's College of Education, Aburi. Participants were assigned to two treatment groups: collaborative peer microteaching and video-based microteaching, with twenty-eight (28) participants in each group. Over a period of six weeks, participants engaged in their respective microteaching sessions. Data was collected using the Science Teaching Efficacy Beliefs Instrument (STEBI-B), the Perception of the Collaborative Peer Microteaching Model (PCPM) questionnaire, and a focus group interview. The STEBI-B was administered as a pre-intervention and post-intervention assessment to measure science teaching efficacy before and after the interventions. Paired-sample t-tests showed significant improvements in STEBI-B scores for both the collaborative peer group ($t(27) = -3.167$, $p = 0.004 < .05$) and the video-based group ($t(27) = -7.906$, $p = 0.000 < .05$), with the larger t-value indicating that the video-based microteaching model was comparatively more effective. An analysis of covariance (ANCOVA) further confirmed that when the collaborative peer and video-based microteaching groups' pre-intervention STEBI-B assessments are controlled, the video-based microteaching was comparatively more effective in enhancing female preservice teachers' levels of science teaching efficacy. A two-way ANCOVA also revealed that age, prior teaching experiences, and their interaction had no statistically significant effect on participants' STEBI-B scores. Additionally, responses from the PCPM questionnaire and focus group interviews indicated that participants generally perceived both microteaching models as effective in enhancing their science teaching efficacy.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter comprises the background to the study, statement of the problem, purpose of the study, research objectives, research questions, significance of the study, delimitations, limitations and organization of the study.

1.1 Background to the Study

The preparation of preservice teachers is a critical component of educational systems worldwide, particularly in the context of science education, where the need for effective teaching is paramount. Science education plays a very important role in developing the critical thinking and problem-solving skills necessary for students to navigate and contribute to an increasingly scientific and technological world. In promoting science education, especially in basic school classrooms, the quality of science teacher education programs should be prioritized.

Teacher education programs, particularly in science education play a pivotal role in preparing preservice teachers for the complexities of classroom teaching and learning of science (Appleton, 2006). Training preservice teachers to not only acquire the requisite science content knowledge and pedagogical skills but to develop confidence in their ability to teach science effectively and positively impact students learning outcomes in the subject is very important (Kartal & Dilek, 2021).

The belief or confidence preservice teachers have in their ability to teach science effectively and positively impact students learning outcomes which constitutes their science teaching efficacy have been found to play a very influential role in their instructional practices, classroom management strategies, and directly impacts students' performances in science subjects (Kartal & Dilek, 2021).

Science teaching efficacy, as derived from Bandura's (1997) concept of self-efficacy, comprises two unique sets of beliefs: personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE). PSTE refers to a teacher's belief in their own ability to teach science successfully; while STOE pertains to their belief that effective teaching can lead to student learning, regardless of external factors (Bleicher, 2011)

Existing literature, spanning over two decades, on science teaching efficacy and its impact on preservice teachers' instructional practices and students learning outcomes in science have consistently shown that preservice teachers with high levels of science teaching efficacy were more likely to implement effective instructional practices crucial for successful science teaching. They were more likely to demonstrate better classroom management, and foster higher student engagements and achievements in science (Velthuis et al., 2015).

Bleicher and Lindgren (2015) in a study that explored the influence of perceived learning environment and teacher perceptions on success in science learning and preservice teachers' science teaching efficacy found that preservice teachers who reported higher levels of science teaching efficacy were more likely to engage their students in inquiry-based learning, use diverse teaching methods, and integrate technology into their lessons. These teachers were also more confident in their ability to make science accessible and engaging to all students, fostering a positive learning environment.

Bleicher and Lindgren (2015) conversely reported that preservice teachers with low levels of science teaching efficacy were less inclined to adopt inquiry-based approaches or experiment with varied instructional strategies. They lacked the confidence to integrate technology in their science lessons and struggled to adapt their lessons to meet students' differing needs. The limited instructional flexibility among the low efficacious teachers contributed to lower student engagements and hindered the development of deep scientific understanding among their learners.

Again, Adomako and Peprah (2018) in a study that explored the relationship between Ghanaian preservice teachers' science teaching efficacy and their instructional practices, reported a strong correlation between preservice teachers' levels of science teaching efficacy and their ability to utilize diverse instructional strategies. Preservice teachers with high levels of science teaching efficacy were found to be more effective in differentiating their science instruction to accommodate the diverse learning needs of their students. These teachers were also more adept at integrating technology in their science lessons.

In contrast, Adomako and Peprah (2018) found that preservice teachers with low levels of science teaching efficacy often relied on traditional, teacher-centered instructional methods and were less likely to adjust their teaching to suit learners' differing learning styles or incorporate digital tools in their science lessons. The low efficacious teachers often lacked confidence in managing students' diversity and struggled with implementing innovative instructional approaches.

Apart from its influence on instructional practices, preservice teachers' science teaching efficacy has also been noted to significantly influence their classroom management strategies and teacher-student interactions (Klassen & Chiu, 2010). For example, Cheng and Lam (2018) in a study that investigated the role of science teaching efficacy in preservice teachers' classroom management practices reported that preservice teachers with high levels of science teaching efficacy exhibited more proactive classroom management techniques, such as establishing clear expectations and using positive reinforcement strategies. These teachers were also better prepared at managing students' behaviour during science lessons.

Cheng and Lam (2018) conversely found that low efficacious preservice teachers, as part of their classroom management strategies, mostly relied on reactive approaches, such as reprimands or punitive measures and often struggled to maintain a well-managed classroom environment. Their lack of confidence in teaching science appeared to hinder their ability to implement effective classroom management techniques.

Again, Zientek et al. (2021) in a study that explored the relationship between preservice teachers' science teaching efficacy, classroom management and students' science learning outcomes, found that preservice teachers with higher levels of science teaching efficacy were more likely to establish clear expectations, use positive reinforcements, and effectively handle disruptions. These teachers were more likely to foster higher levels of students' engagements through hands-on learning activities and group works.

Zientek et al. (2021) conversely reported that preservice teachers with lower levels of science teaching efficacy often struggled to maintain classroom order, relied more on teacher-centered instructional strategies and demonstrated limited use of interactive or student-centered strategies. As a result, their students were generally less engaged and showed lower achievements in science learning tasks.

Additionally, Guskey and Passaro (2021) in a study that explored the links between teacher beliefs and classroom outcomes reported that preservice teachers with high levels of science teaching efficacy believed more strongly in their ability to make science interesting and accessible to their learners, and as a result, they engaged in more positive interactions with their learners. The researchers further noted that the positive teacher-student interactions led the creation of a classroom climate where students felt safe to ask questions and expressed their thoughts.

Guskey and Passaro (2021) also reported that preservice teachers with very low science teaching efficacy were more likely to struggle with students' engagement and may unintentionally reinforce negative classroom dynamics due to uncertainty or lack of confidence in handling science content and activities. Similarly, Bursal (2017) noted that low efficacious teachers were more likely to experience anxiety and stress in their classrooms. These teachers, as a result, were more likely to struggle with managing their science classrooms effectively.

Many studies have also reported a positive correlation between preservice teachers' levels of science teaching efficacy and students' achievements in science. For example, in a study that examined the impact of preservice teachers' science teaching efficacy on students' academic achievements in junior high school science, Mensah and Oteng (2021) reported that students taught by preservice teachers with high levels of science teaching efficacy performed better in science assessments as compared to those taught by teachers with low science teaching efficacy.

In a study on the effect of science teaching self-efficacy on student outcomes in middle school science, Gunning and Mensah (2022) found that students taught by teachers with high science teaching efficacy performed better in standardized science tests and demonstrated greater interest in science subjects. The study noted that teachers' confidence in their teaching abilities translated into more effective instruction, which in turn led to better student outcomes in science.

Similarly, Bautista et al. (2022) in a study that analyzed the effects of science teaching efficacy on student engagement and learning outcomes in STEM found that teachers with high levels of science teaching efficacy were more successful in implementing engaging and interactive science lessons, leading to improved students' performances and interests in STEM subjects. Conversely, in a study that explored the role of teacher confidence and instructional practices on students' achievement in science, Davis (2015) found that when teachers lack confidence in their science teaching abilities, they were less likely to use innovative and effective teaching methods, and this resulted in poor students' performances in science subjects.

In addition to influencing preservice teachers' instructional practices, classroom management strategies, and students' learning outcomes in science, science teaching efficacy has also been shown to have a long-term impact on preservice teachers' success in teaching science even after exiting teacher training institutions. For example, Hoy et al. (2014) in a longitudinal study that tracked preservice teachers from their teacher education programs into their first few years of teaching reported that preservice teachers with higher levels of science teaching efficacy during their training were found to be more successful in their early teaching careers. They reported higher levels of job satisfaction, were more likely to stay in the teaching profession, and consistently achieved better student outcomes in science.

Similarly, Mansfield and Woods-McConney (2016) in a study that examined the long-term impact of science teaching efficacy on teacher retention and success found that preservice teachers with high levels of science teaching efficacy were more resilient in the face of classroom challenges and less likely to leave the profession. These teachers continued to develop their instructional skills, further enhancing their success in teaching science over time.

Research has shown that many Ghanaian preservice teachers have low teaching efficacy, particularly towards the teaching of science subjects. Osei-Akoto and Owusu (2017) in a study that investigated the impact of secondary school science education on preservice teachers' efficacy found that many preservice teachers in Ghana entered teacher training institutions with a weak foundation in science and this they attributed to inadequate exposure to quality science education at the primary and secondary levels. They indicated that preservice teachers who had negative experiences with science education in their formative years often carried these perceptions into their teacher training education.

In a related study, Akyeampong and Mettle (2017) found that many preservice teachers in Ghana have had negative experiences with science education in their earlier schooling. These experiences, such as difficulties in understanding scientific concepts and poor performance in science subjects, contributed to a lingering fear and lack of confidence in teaching science

In a study on the challenges in developing science teaching efficacy among preservice teachers in Ghana, Kwame and Ayim (2023) noted that factors such as limited exposure to more robust science teacher preparation programs, lack of access to quality science teaching materials, and insufficient opportunities for practical science teaching experiences contributed to low levels of science teaching efficacy among preservice teachers in Ghana.

Additionally, Owusu et al. (2019) in a study that explored preservice teachers' confidence in teaching science from a Ghanaian perspective found that many preservice teachers in Ghana often felt inadequately prepared in science content and this affected their confidence and ability to effectively teach science. They found that the lack of adequate science content knowledge among some Ghanaian preservice teachers resulted in their anxiety and low self-efficacy, especially when they were required to teach science.

Further, in a study on the impact of practical teaching experience on preservice teachers' self-efficacy in science teaching in Ghana, Yeboah (2020) found that many preservice teachers in Ghana often have insufficient opportunities to engage in hands-on, practical teaching experiences during their training. This lack of exposure to real classroom environments prevented them from developing the necessary skills and confidence to teach science effectively, contributing to low science teaching efficacy.

Opoku-Asare et al. (2020) in a study that analyzed the quality of Ghanaian teacher education programs reported that teacher education programs in Ghana often lacked sufficient practical components which were crucial for building science teaching efficacy. The focus on theoretical knowledge without adequate hands-on experiences in science teaching methods left preservice teachers feeling unprepared to teach science effectively.

Research on gender differences in science teaching efficacy among Ghanaian preservice teachers have consistently indicated a significant gap in science teaching efficacy between male and female preservice teachers in Ghana. Ghanaian female preservice teachers have been found to generally report lower levels of science teaching efficacy as compared to their male counterparts (Mensah & Okyere, 2017).

Agyemang et al. (2022) in a study on cultural and societal influences on gender differences in science teaching efficacy among preservice teachers in Ghana found that societal norms that discourage females from pursuing science-related careers are deeply entrenched in the Ghanaian culture. These norms contributed to the lower science teaching efficacy reported by female preservice teachers, who often perceive science as incompatible with their gender roles. Mensah (2013) in a similar study found that many Ghanaian female teachers often perceive science as a male-dominated field, resulting in anxiety and reluctance to engage in science teaching.

Apart from the cultural and gender-stereotypes, Amankwah and Tawiah (2020) in a study that investigated the impact of teacher education programs on science teaching efficacy among Ghanaian preservice teachers from a gender perspective found that male preservice teachers generally benefited more from science teacher education programs than their female peers. The study indicated that male preservice teachers tend to participate more actively in practical science teaching sessions, which enhanced their confidence and efficacy. In contrast, female preservice teachers often feel intimidated in these settings, leading to lower participation and, consequently, lower efficacy.

Amankwah et al. (2017) in a study that examined preservice teacher preparation in Ghana found that both male and female preservice teachers in Ghana often felt inadequately prepared to teach science and this reflected in their low self-efficacy towards teaching the subject. Inadequate exposure to practical science teaching opportunities during training exacerbates this issue, particularly for females who may already have low confidence in their science abilities.

In the studies that reported gender differences in science teaching efficacy among Ghanaian preservice teachers, the need for targeted interventions that could effectively develop the science teaching efficacy of preservice teachers, particularly female preservice teachers were consistently recommended. Microteaching is one of such interventions. Microteaching, provides a controlled and supportive environment where preservice teachers, particularly female preservice teachers, can practice, reflect, and refine their teaching skills, thereby boosting their teaching efficacy (Mba & Njoku, 2022).

In a study on addressing gender imbalances in teacher education through microteaching from a Nigerian perspective, Mba and Njoku (2022) found that microteaching allowed for targeted feedback which addressed the specific needs of female preservice teachers who might lack confidence in teaching science. They found that female preservice teachers engaged in microteaching received constructive feedback in a supportive environment and this feedback mechanism enabled them to improve on their teaching skills and build confidence in their teaching skills.

Microteaching allows for the repetition of teaching practice, which is essential for skill mastery. Ochonogor (2011) in a study that explored the role of microteaching in enhancing science teaching skills in preservice teacher education indicated that female preservice teachers who may initially struggle with science teaching can use repeated practice sessions in microteaching to build competence and confidence gradually. Microteaching was found to be effective in developing the science teaching efficacy of female preservice teachers by providing them with multiple opportunities to practice and perfect their science teaching techniques.

Microteaching encourages reflective practice, which is crucial for personal and professional growth. According to Adofo and Arhin (2019), female preservice teachers who engage in microteaching sessions have opportunities to reflect on their teaching experiences in a non-threatening environment, and this helps them identify their strengths and areas for improvement. Reflective practice through microteaching was found to be effective in helping female preservice teachers to develop confidence in their science teaching abilities.

Additionally, Amoako and Owusu (2021) in a study that sought to reduce anxiety in female preservice teachers through microteaching found that the controlled environment of microteaching enabled female preservice teachers to see their mistakes as learning opportunities which helped to build their confidence. Microteaching, as they noted reduces the anxiety and fear that female preservice teachers might feel when teaching in front of a class, particularly in subjects like science where they might feel less competent.

Among the several microteaching models, literature is replete with studies on the collaborative peer and video-based microteaching models. These two microteaching models have separately been studied extensively for their effectiveness in developing the science teaching efficacy of preservice teachers, particularly female preservice teachers (Savan & Lee, 2015). For example, Baffoe and Ayiku (2021) in a study that examined collaborative peer microteaching and its implications for preservice teacher education reported that engaging female preservice teachers in collaborative peer microteaching sessions helped reduce feelings of isolation and inferiority often linked to gender-based stereotypes. By working together, sharing experiences, and supporting one another, the female preservice teachers gained confidence, improved their science teaching strategies, and became more comfortable with teaching science subjects. This ultimately enhanced their science teaching efficacy. Baffoe and Ayiku (2021) in their study emphasized that peer collaboration in microteaching environments fostered a sense of community among preservice teachers and this was essential for building confidence and teaching efficacy.

Similar to the collaborative peer microteaching model, the video-based microteaching model has shown significant potential in reducing gender disparities in science teaching efficacy among preservice teachers (Antwi & Adjei, 2023). By allowing preservice teachers, particularly female preservice teachers to review and reflect on recordings of their teaching, this microteaching model supports the development of both teaching skills and efficacy (Gomez et al., 2021). Recent research indicates that video-based microteaching positively influences the science teaching efficacy of female preservice teachers, contributing to narrowing the gender gap (Antwi & Adjei, 2023).

A review of literature on the collaborative peer and video-based microteaching models revealed that whilst there is substantial research on how each of the two microteaching models affects the science teaching skills and efficacy of preservice teachers, there is however limited literature specifically focused on the comparative effectiveness of the two microteaching models in developing the science teaching efficacy of preservice teachers, particularly female preservice teachers.

This study will, therefore, provide a comparative analysis of the collaborative peer and video-based microteaching models, highlighting their strengths and limitations in developing the science teaching efficacy of selected female preservice teachers in Ghana. Since this direct comparison is relatively underexplored in existing literature, the findings would offer new perspectives on how these two microteaching models can be effectively integrated into teacher education programs in Ghana to maximize their benefits.

Additionally, although literature is replete with studies on microteaching and its effectiveness in developing the science teaching efficacy of preservice teachers in general, there is limited literature specifically focused on female preservice teachers in Ghana. This study therefore sought to bridge this gap in literature by focusing specifically on how the collaborative peer and video-based microteaching can be used to develop the science teaching efficacy of selected female preservice teachers in Ghana, thereby adding a gender and context-specific dimension to existing literature.

1.2 Statement of the Problem

Preservice teachers' science teaching efficacy, which describes the belief or confidence preservice teachers have in their ability to teach science effectively and positively influence students learning outcomes, has been found to be very influential in their instructional practices, classroom management strategies and directly impacts student performance in science subjects (Kartel & Dilek, 2021).

High levels of science teaching efficacy among preservice teachers have been associated with more innovative science instructional practices, increased teacher motivation, a positive classroom environment, increased teacher persistence and improved students' learning outcomes in science subjects (Klassen et al., 2011). Low levels of science teaching efficacy have conversely been associated with the lack of instructional innovation, negative classroom climate and poor students learning outcomes in science subjects (Davis, 2015).

Many empirical studies have reported a strong correlation between preservice teachers' levels of science teaching efficacy and students learning outcomes in science subjects. For example, in a study on the effect of science teaching self-efficacy on student outcomes in middle school science, Gunning and Mensah (2022) found that students taught by teachers with high levels of science teaching efficacy performed better on standardized science tests and demonstrated greater interests in science subjects as compared to those taught by teachers with low science teaching efficacy. The study found that teachers' confidence in their teaching abilities translated into more effective instruction, which in turn led to better student outcomes in science.

Similarly, Bleicher (2011) in a study that examined the science teaching efficacy and outcome expectancy beliefs of preservice elementary teachers noted that higher science teaching efficacy among preservice teachers led to more effective instructional delivery, which positively impacted students' engagement and understanding of scientific concepts. In a related study, Kartal and Dilek (2021) reported that preservice teachers with high levels of science teaching efficacy were more likely to implement student-centered teaching strategies, resulting in improved student achievement in science.

Conversely, Davis (2015) in a study that examined the impact of teacher self-efficacy on students' achievements in science found that when science teachers lack confidence in their teaching abilities, student performance in science subjects tends to be lower, as these teachers are less likely to employ innovative and effective teaching strategies. Similarly, Palmer (2011) reported that preservice teachers with low science teaching efficacy often avoid inquiry-based instruction, limiting students' opportunities for active engagement and deeper understanding. In another study, Mulholland and Wallace (2012) observed that low self-efficacy among preservice teachers led to less effective classroom management and reduced student participation, ultimately affecting science learning outcomes.

Research has shown that many Ghanaian preservice teachers exhibit low teaching efficacy, particularly towards the teaching of science subjects. The low science teaching efficacy among Ghanaian preservice teachers have been found to be influenced by a combination of factors such as the lack of confidence in subject knowledge, limited practical teaching experiences, societal and gender stereotypes, insufficient training in teaching methods and negative past experiences with science (Kwame & Ayim, 2023).

Studies on gender differences in science teaching efficacy among preservice teachers in Ghana have consistently indicated a significant gap in science teaching efficacy between male and female preservice teachers in Ghana. Comparatively, more female preservice teachers than males have been found to exhibit lower science teaching efficacy (Aboagye & Yawson, 2018).

For example, in a study on gendered perceptions and science teaching efficacy, with a specific focus on examining the challenges of Ghanaian female preservice teachers, Siaw and Donkor (2020) reported that the Ghanaian society often held gendered views that science is a male-dominated field and these gender stereotypes are often internalized by female preservice teachers, resulting in a lack of confidence in their abilities to teach science effectively. Apart from gender and societal stereotypes, limited practical science teaching experiences and negative science experiences is noted to contribute to the low science teaching efficacy among female preservice teachers in Ghana.

Similarly, Amankwah and Tawiah (2020) in a study that investigated the impact of teacher education programs on science teaching efficacy among Ghanaian preservice teachers from a gender perspective found that male preservice teachers generally benefitted more from science teacher education programs than their female peers. The study noted that male preservice teachers tend to participate more actively in practical science teaching sessions, which enhanced their confidence and efficacy. In contrast, female preservice teachers often felt intimidated in these settings, leading to lower participation and, consequently, lower efficacy.

Many studies have reported the effectiveness of microteaching in addressing gender disparities in science teaching efficacy among preservice teachers. By providing opportunities for repeated practice and reflection, combined with constructive feedback from peers and instructors, Aderibigbe et al. (2020) found that microteaching was beneficial to female preservice teachers as it helped them reinforce their strengths and systematically addressed weaknesses in their teaching practice, leading to increased teaching efficacy. They noted that the reflection and feedback components of microteaching were crucial in promoting self-awareness and self-regulation among female preservice teachers who engaged in microteaching sessions.

Baffoe and Ayiku (2021) in a study found that peer collaboration in microteaching environments fostered a sense of community, and for female preservice teachers, this was particularly helpful as it mitigated feelings of isolation and inferiority stemming from gender-based stereotypes. They also found that through peer support in microteaching, female preservice teachers shared experiences and learnt from each other, this enabled them to build confidence in their teaching abilities.

The collaborative peer and video-based microteaching models are two microteaching models that have separately been studied extensively for their effectiveness in enhancing the science teaching efficacy of preservice teachers. Although literature is replete with studies on the two microteaching models, very few studies have specifically focused on comparing the models in terms of their effectiveness in enhancing the science teaching efficacy of preservice teachers, particularly female preservice teachers.

This study was therefore undertaken to address this gap by examining the comparative effectiveness of the collaborative peer microteaching and video-based microteaching models in developing the science teaching efficacy of selected Ghanaian female preservice teachers. By focusing on female preservice teachers within the Ghanaian context, this study sought to contribute to the existing body of literature by introducing a gender- and context-specific perspective to the discourse on science teaching efficacy and microteaching practices.

1.3 Purpose of the Study

This study was conducted purposely to investigate the comparative effectiveness of the collaborative peer and video-based microteaching models in developing the science teaching efficacy of selected female preservice teachers in Ghana.

1.4 Research Objectives

The specific objectives that guided this study were to:

i. assess female preservice teachers' levels of science teaching efficacy before and after engaging in collaborative peer microteaching sessions.

ii. examine female preservice teachers' levels of science teaching efficacy before after participating in video-based microteaching sessions.

iii. compare the mean science teaching efficacy levels of female preservice teachers engaged in collaborative peer microteaching sessions with those engaged in video-based microteaching sessions.

iv. determine the influence of demographic factors such as age and prior teaching experiences on female preservice teachers' science teaching efficacy.

v. examine female preservice teachers' perceptions of the collaborative peer microteaching model.

vi. explore female preservice teachers' perceptions and experiences with the video-based microteaching model.

1.5 Research Questions

The study sought to address the following research questions:

i. What are the levels of female preservice teachers' science teaching efficacy before and after engaging in collaborative peer microteaching sessions?

ii. What are the levels of female preservice teachers' science teaching efficacy before and after participating in video-based microteaching sessions?

iii. What are the mean science teaching efficacy levels of female preservice teachers engaged in collaborative peer microteaching as compared with those engaged in video-based microteaching?

iv. What influence do the demographic factors such as age and prior teaching experiences have on female preservice teachers' science teaching efficacy?

v. What are female preservice teachers' perceptions regarding the collaborative peer microteaching model?

vi. What are female preservice teachers' perceptions and experiences with the video-based microteaching model?

1.6 Significance of the Study

Even though literature is replete with studies on the effectiveness of microteaching models in developing the science teaching efficacy of preservice teachers, studies that specifically focus on Ghanaian female preservice teachers are quite limited. This study would fill the gap in existing literature by providing empirical evidence on the effectiveness of the collaborative peer and video-based microteaching models in developing the science teaching efficacy of selected female preservice teachers in Ghana.

In Ghana, female teachers often face unique challenges, including societal biases and limited access to resources, which can undermine their confidence and effectiveness in teaching science. By focusing on female preservice teachers, this current study highlights the need to empower women in science education, ensuring they are adequately prepared and confident to inspire future generations in science disciplines.

By identifying the microteaching model-collaborative peer or video-based microteaching model- most effective in addressing the peculiar needs and challenges faced by Ghanaian female preservice teachers that hinder the development of their science teaching efficacy, the findings of this study will provide lecturers and tutors who train female preservice teachers with evidence-base insights they can use to refine their instructional strategies and tailor their professional development activities to meet the specific needs of female preservice teachers and enhance their science teaching skills and competency.

This study's findings have practical implications for teacher education policies and practices in Ghana. Education policymakers and teacher training institutions can use the insights to design more effective and inclusive programs that address the specific needs of female preservice teachers. Enhancing the science teaching efficacy of female preservice teachers is likely to improve their classroom performance and inspire greater interest in science among their students. This, in turn, could contribute to closing gender gaps in science education, supporting national development goals, and fostering a more equitable education system.

Finally, this study will serve as a useful reference material for researchers who would want to conduct similar studies in different subject areas and across different regions in Africa and beyond.

1.7 Delimitations of the Study

Since female preservice teachers have in many studies been reported to have low science teaching efficacy as compared to their male peers, the study focused exclusively on developing the science teaching efficacy of female preservice teachers selected from the Presbyterian Women's' College of Education, Aburi.

The study was delimited to the comparative analysis of two specific microteaching models: collaborative peer microteaching and video-based microteaching models. Other microteaching models were not considered in this study. The study also specifically focused on developing the science teaching efficacy of selected female preservice teachers and did not take into account the female preservice teachers' general teaching efficacy towards other subject areas.

Further, the Science Teaching Efficacy Belief instrument (STEBI-B) was used as the primary tool for measuring the female preservice teachers' science teaching efficacy. Other instruments or methods of assessment of the efficacy of female preservice teachers towards the teaching of science subjects were not used. The findings of this study were only limited to the aspects of science teaching efficacy measured by the STEBI-B instrument.

Finally, the impact of the two microteaching models on the science teaching efficacy of the selected female preservice teachers was assessed within a specific period, which is the second semester of the 2023/2024 academic year when the study was conducted. The study only measured the immediate impacts of the two microteaching models on the science teaching efficacy of the female preservice teachers and did not account for the long-term changes in the female preservice teachers' science teaching efficacy due to the impact of the two microteaching models.

1.8 Limitations

Since the study was conducted in a single female teacher training institution, the findings may not be representative of other institutions in Ghana or beyond. The unique characteristics of the institution, such as its curriculum, resources, or student population, may limit the generalizability of the study's findings to a wider population of preservice teachers. The study's exclusive focus on selected Ghanaian female preservice teachers, potentially excludes insights into how male preservice teachers might respond to the same interventions and this limits the generalizability of the study's findings across gender.

Also, the assessment of changes in female preservice teachers' science teaching efficacy using the Science Teaching Efficacy Belief instrument (STEBI-B) could introduce self-reported bias. Efficacy beliefs are inherently subjective and rely on self-reporting, which may not fully capture the actual teaching skills or improvements observed during microteaching sessions. Participants might overestimate or underestimate their confidence in their teaching skills. To mitigate this, the participants were made to respond to the questionnaire items anonymously in order to encourage more honest and accurate self-assessments.

1.9 Operational Definition of Terms

Preservice teachers: Students enrolled into teacher education programs, receiving training to become certified teachers.

Science Teaching Efficacy: Belief preservice teachers have in their ability to teach science effectively and positively impact students learning outcomes in science.

Personal Science Teaching Efficacy: Teacher's belief in their own ability to teach science successfully.

Science Teaching Outcome Expectancy: Teacher's belief that effective teaching can lead to student learning, regardless of external factors.

Collaborative Peer Microteaching: A microteaching practice where preservice teachers work together in small groups to plan a short lesson, teach, critique lessons and reteach.

Video-based Microteaching: A microteaching practice where preservice teachers plan and teach short lessons, record themselves delivering the lessons for review and analysis of their teaching performance before re-teaching the lesson.

1.10 Organization of the Study

The study was organized into five chapters. Chapter one which was the introduction to the study comprised the background to the study, statement of the problem, purpose of the study, research objectives, research questions, significance of the study, delimitations and limitations of the study.

Chapter two comprised an elucidation of the theoretical framework underpinning science teaching efficacy and microteaching models in teacher education in Ghana. It also included a conceptual and empirical review on science teaching efficacy and microteaching models and their relevance in female preservice teacher education. Chapter three comprised the research paradigm, research design, population, sample and sampling techniques, instrumentation, data collection procedure and analysis. Chapter four dealt with the analysis and interpretation of data. The summary of key findings, conclusion, recommendations and suggestions for further studies were presented in Chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

Literature relevant to this study was reviewed in this chapter under three subsections: theoretical review, conceptual review and empirical review. The chapter begins with an elucidation of the theoretical frameworks underpinning science teaching efficacy and microteaching models in preservice teacher education. This is followed by a detailed conceptual review of literature on science teaching efficacy and its relevance in preservice teacher, specifically female preservice teacher education in Ghana, comparative analysis of the collaborative peer and video-based microteaching and their relevance in preservice teacher education in Ghana. Empirical literature related to this study was also reviewed in this chapter.

2.1 Theoretical Review

2.1.1 Social Cognitive Theory (Bandura, 1986)

The Social Cognitive Theory (SCT) is a theory developed by Albert Bandura in 1986 as an evolution of his earlier work on the Social Learning Theory (SLT). The SCT posits that human behaviour and learning are shaped by the dynamic interaction between personal factors (such as beliefs and attitudes), environmental influences, and behaviour itself, in a process referred to as reciprocal determinism (Bandura, 2012).

The SCT asserts that an individual's self-beliefs (personal factors) can shape their decisions and actions (behaviour), which, in turn, can modify their surroundings and affect how others perceive them. Conversely, changes in the environment or the behaviors of others can alter one's beliefs and subsequent actions. This interplay suggests that learning is an active, reciprocal process, rather than a passive one, reflecting the continuous exchange between individuals and their environments. (Schunk & DiBenedetto, 2020).

Bandura's Social Cognitive Theory (SCT) provides a solid theoretical foundation for this study which investigates the comparative effectiveness of the collaborative peer and video-based microteaching in developing the science teaching efficacy of selected Ghanaian preservice teachers. The principle of reciprocal determinism on which the SCT hinges highlights the interaction between personal beliefs, behaviors, and environmental influences, which together shape learning and development (Bandura, 1986).

This principle offers a valuable perspective on how the interaction between personal beliefs (self-efficacy), teaching behaviors (microteaching), and environmental influences (peer collaboration or video feedback) work together to create competent, confident science educators. It provides valuable insights into how preservice teachers' beliefs about their ability to teach science (self-efficacy) evolve through microteaching experiences and is particularly useful for examining how preservice teachers develop science teaching efficacy through active participation, observation, and reflection in collaborative and video-based microteaching environments.

The principle of observational learning, a component of the SCT, is central to this study. Observational learning, as explained by Bandura (1986) is the process by which individuals learn new behaviours, skills, or attitudes by observing others, rather than through direct experience. The principle of observational learning played a crucial role in both the collaborative peer and video-based microteaching models employed in this study, as female preservice teachers not only engaged in active teaching but also observed their peers teaching the same or similar science lessons. Through the observations, the female preservice teachers learnt new teaching strategies, classroom management techniques, and effective ways of engaging students (Amobi, 2005).

Watching peers successfully execute a task builds vicarious experiences, a key source of self-efficacy according to Bandura (1997). When preservice teachers see their peers handle challenges or succeed in science teaching, they are more likely to believe in their own capacity to teach effectively. The peer interaction in this model provides an immediate opportunity for observational learning, as participants can ask questions, provide feedback, and reflect on each other's teaching performances.

Video-based microteaching relies heavily on observational learning, female preservice teachers in this study recorded their lessons and reviewed them individually. This process enabled them to observe their teaching from a third-person viewpoint, which helped them critically assess and refine their teaching techniques. Additionally, by watching the recorded lessons of others, female preservice teachers in this study gained insights from both the strengths and weaknesses of their peers. Bandura (1997) highlights that self-reflection and observing oneself in action are effective ways to boost self-efficacy, making video-based microteaching a valuable tool for observational learning.

In addition to the principle of reciprocal determinism and observational learning, self-efficacy, is another key component of the SCT that serves as a critical theoretical framework for this study. Self-efficacy- the belief in one's ability to perform tasks successfully- shapes how individuals approach challenges, set goals, and handle setbacks (Lent et al., 2017). Self-efficacy according to Bandura (2012) is not simply about knowing what to do, but about believing in one's ability to do it effectively. Self-efficacy beliefs according to the SCT are fundamental to individuals' choices, persistence, and resilience, influencing their ability to succeed in various tasks, especially in educational settings.

In this study, science teaching efficacy is conceptualized as a subset of the broader construct of self-efficacy. Within the context of preservice teacher education, particularly for female preservice teachers in Ghana, science teaching efficacy plays a critical role in shaping their confidence and effectiveness in the classroom. As noted by Palmer (2011), the level of science teaching efficacy held by preservice teachers significantly influences student engagement, motivation, and academic achievement in science.

Bandura (1997) outlined four primary sources of self-efficacy: mastery experiences, vicarious experiences, social persuasion, and physiological and emotional states. These sources provide a foundation for evaluating the collaborative peer and video-based microteaching models, as each model interacts with these sources in distinct ways.

Mastery experiences, according to Bandura (1997), are the most direct and impactful way to enhance self-efficacy because they involve successfully completing a task firsthand. In the collaborative peer microteaching model, preservice teachers build mastery by actively teaching in front of their peers. The supportive and secure environment enables them to try out various teaching strategies, learn from their mistakes, and refine their skills through practice. With repeated teaching opportunities, their confidence and ability to teach science effectively steadily increase.

Adding to the mastery experiences, Bandura (1997) identified that vicarious experiences derived from observing others' successes and failures can influence one's belief in their own abilities. In collaborative peer microteaching, preservice teachers observe their peers teaching, which helps them learn alternative strategies and approaches to teaching science. In video-based microteaching, vicarious learning is heightened as teachers watch recordings of their own teaching and that of others. They can observe teaching methods, assess their effectiveness, and adjust their own teaching practices accordingly. This ability to reflect on performance through video offers a powerful form of vicarious learning that may surpass in-the-moment observation during peer microteaching.

Feedback and encouragement from others, which Bandura (1997) termed social persuasion, significantly influence self-efficacy. In both models, preservice teachers receive feedback from peers and instructors. In collaborative peer microteaching, immediate feedback during teaching sessions provides real-time insight into teaching performance, helping to build confidence. Video-based microteaching, on the other hand, allows for more detailed feedback, as the preservice teachers can review their performance multiple times, providing a deeper reflection and understanding of their strengths and areas for improvement. Both forms of microteaching allow for the social persuasion that enhances self-efficacy, but in different ways: collaborative peer microteaching emphasizes immediate, interactive feedback, while video-based microteaching supports delayed, reflective feedback.

In addition to the mastery experiences, vicarious experiences and social persuasion, Bandura (1997) noted that physiological and emotional states which constitutes emotional responses such as stress, anxiety, or fatigue can affect an individual's belief in their ability to succeed. In the supportive environment of peer microteaching, as employed in this study, stress is often mitigated, as the setting is designed to foster growth and development rather than to critique.

In video-based microteaching, however, watching oneself teach can evoke emotions such as anxiety or discomfort. However, repeated viewing of video recordings can help teachers manage these emotional responses and reduce anxiety over time, contributing to increased self-efficacy. The collaborative peer and video-based microteaching models employed in this study draws on all the key sources of self-efficacy: mastery experiences, vicarious learning, social persuasion, and emotional regulation in distinct ways, making SCT a fitting framework for evaluating their effectiveness in developing the science teaching efficacy of selected Ghanaian female preservice teachers, as was the focus of this study.

2.1.2 Constructivist Learning Theory

The constructivist theory of learning originates from the work of early cognitive theorists like Jean Piaget and Lev Vygotsky. The theory can be traced to Piaget's studies on cognitive development in the 1930s and Vygotsky's work on social constructivism in the 1920's and 1930's. Vygotsky's work emphasized the role of social interaction and cultural context in learning. Among these theorists, Jean Piaget is widely regarded as a foundational figure in the development of the constructivist learning theory. Piaget's research on cognitive development provided a basis for understanding how learners actively construct knowledge through interaction with their environment. His work emphasized that individuals build knowledge through stages of cognitive development as they assimilate and accommodate new experiences (Piaget, 1973).

Piaget in his studies argued that learning is an active process, where learners build on their prior knowledge by interacting with their environment. He highlighted the importance of active and experiential learning, where individuals form cognitive schemas through their experiences and interactions (Piaget, 1973)

Lev Vygotsky's work on social constructivism significantly shaped the development of the constructivist learning theory. His concept of social constructivism introduced the idea that learning is fundamentally a social process, occurring through interaction with more knowledgeable individuals, such as teachers, peers, or mentors (Vygotsky, 1978). He highlighted the importance of social interaction, culture, and language in shaping cognitive growth.

The constructivist learning theory posits that learning is an active, constructive process where learners engage with new information, interpret it, and integrate it into their existing knowledge structures. Rather than passively receiving information, constructivism asserts that in a learning process, learners are involved in actively constructing meaning through experiences, inquiry, and problem-solving (Schunk, 2012).

The constructivist theory of learning emphasizes that learners construct knowledge rather than simply acquiring it. Knowledge construction, according to the theory, occurs through interactions with the environment, experimentation, and the application of prior knowledge to new contexts (Bruning et al., 2011). Each learner's understanding is shaped by their unique background and experiences, making knowledge subjective and diverse (Fosnot, 2013).

Social constructivism, as developed by Vygotsky complements the constructivist theory of learning by emphasizing the importance of collaboration in learning and proposing that social interactions and cultural context play a crucial role in shaping the learning process. According to social constructivism, when learners engage with their peers, they exchange ideas and the process of negotiating meaning to these ideas contribute to a deeper, shared understanding (Mercer, 2018).

Central to Vygotsky's social constructivism is the Zone of Proximal Development (ZPD), which describes the differences between what learners can do on their own and what they can achieve with assistance. Scaffolding involves offering the right level of support to help learners advance through the ZPD, gradually enabling them to complete tasks independently (Moll, 2014). Scaffolding plays a critical role in facilitating the learning process within constructivist frameworks.

The constructivist theory of learning stresses the importance of reflection in learning. Learners, according to the theory engage in a critical reflection on their experiences, assess their actions, and draw insights that will enhance their understanding and performance. Reflection is crucial for learners to adjust their strategies and behavior in future learning situations (Kolb & Kolb, 2017).

Elements of the two microteaching models: collaborative peer and video-based microteaching models, used in this study closely align with constructivist principles, particularly those related to learning as a social, interactive process. Constructivism, grounded in the works of theorists like Vygotsky, posits that learning occurs most effectively when individuals interact with others in a meaningful way, exchanging ideas and reflecting on their experiences within a social context (Vygotsky, 1978). In the collaborative peer microteaching model, as used in this study, female preservice teachers engaged in teaching and learning activities with their peers, creating a dynamic environment where knowledge is co-constructed rather than passively absorbed.

In collaborative peer microteaching, preservice teachers through their microteaching sessions can actively experiment with different teaching strategies, interact with peers, receive immediate feedback and reflect on their teaching practices. Through this, collaborative peer microteaching fosters an environment of social constructivism and aligns with Vygotsky (1978) argument that learning occurs through social interaction and collaborative dialogue.

Vygotsky's concept of the "zone of proximal development" (ZPD) suggests that learners can achieve higher levels of understanding through guided collaboration with more knowledgeable peers or mentors (Moll, 2014). In collaborative peer microteaching, preservice teachers work together to improve their teaching skills, supporting each other's learning through dialogue, critique, and reflection. This collaborative engagement fosters the development of teaching efficacy as it encourages deeper exploration of teaching strategies and problem-solving methods.

Collaborative peer microteaching fosters critical reflection and mutual learning, both key elements of constructivist education. As preservice teachers critique their peers' teaching and receive feedback on their own, they gain a deeper understanding of effective science teaching, which in turn enhances their self-efficacy. By working collectively, they build a shared body of knowledge that benefits all members of the group (Johnson & Johnson, 2018).

By providing preservice teachers with opportunities to record and critically analyze videos of their teaching practices, video-based microteaching model also employed in this study strongly reflects constructivist principles, particularly those related to reflective learning and self-assessment. Constructivism emphasizes that learners actively construct knowledge by engaging with their experiences, reflecting on them, and integrating new insights into their existing frameworks of understanding (Schunk, 2012).

In video-based microteaching, preservice teachers can review recordings of their teaching practices and observe their teaching from a third-person perspective. This reflective process helps them identify their strengths and areas for improvement, aligning with constructivism's focus on learning through personal experience and self-guided inquiry.

Additionally, video-based microteaching promotes self-assessment by allowing preservice teachers to evaluate their instructional methods and student interactions. Reflection through video review encourages a deeper engagement with the learning process, as teachers can analyze both successful strategies and mistakes in real time (Gaudin & Chaliès, 2015). This iterative cycle of teaching, reflection, and adjustment facilitates continuous improvement and enhances the preservice teachers' science teaching efficacy. Constructivist theory, with its focus on active learning, social interaction, reflection, and scaffolding, provides a strong foundation for understanding how both collaborative peer and video-based microteaching models contribute to the development of science teaching efficacy in preservice teachers.

2.1.3 Experiential Learning Theory

Experiential Learning Theory (ELT) was developed by David Kolb in the 1980s. The ELT was built on the foundational work of influential theorists like John Dewey, Kurt Lewin, and Jean Piaget. Kolb's ELT posits that learning is a process in which knowledge is formed through the transformation of experience (Kolb, 1984).

Central to the ELT is the idea that learning is cyclical, involving the interaction of four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). This cycle enables learners to continuously learn by reflecting on their experiences, drawing conclusions, and applying their insights to new situations.

John Dewey’s impact on ELT comes from his emphasis on experience in education, advocating for learning grounded in real-world experiences that promote reflective thought (Dewey, 1933). Kurt Lewin contributed through his work on group dynamics and the role of feedback in learning, which is evident in Kolb's learning cycle. Jean Piaget influenced Kolb by demonstrating how learners build new knowledge through interactions with their environment and by integrating new information into their pre-existing cognitive structures (Kolb, 1984).

Kolb proposed four stages in his experiential model of learning and these stages comprised:

1. Concrete Experience- Engaging in a new experience or situation, or a reinterpretation of existing experience in the light of new concepts.
2. Reflective Observation- Observing and reflecting on that experience in the light of existing knowledge.
3. Abstract Conceptualization- Drawing conclusions and formulating theories based on reflections. Reflection gives rise to a new idea, or a modification of an existing abstract concept
4. Active Experimentation- Applying new knowledge to real-world scenarios to see how it works in practice.

A diagram of Kolb’s Learning Cycle model with its four distinct phases is shown as Figure 1.

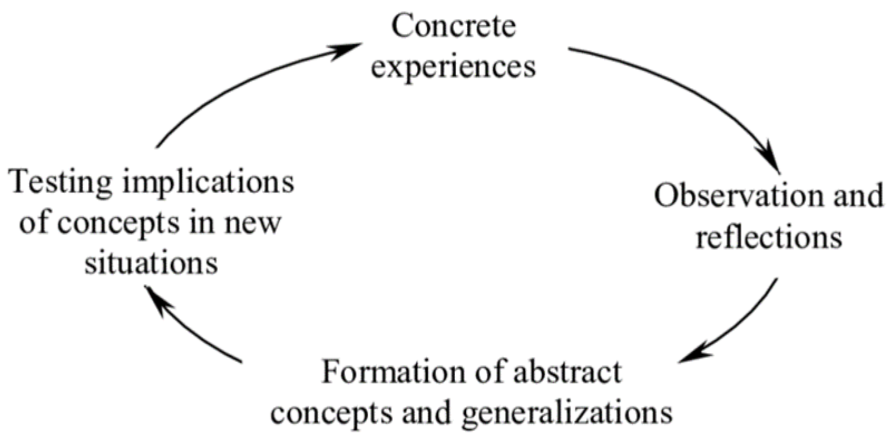

Figure 1: Kolb's Learning Cycle with its Four Distinct Phases

From Figure 1, Kolb's Experiential Learning Theory (ELT) provides a robust framework for examining how collaborative peer and video-based microteaching models support the development of science teaching efficacy among preservice teachers, especially within the Ghanaian context.

The collaborative peer and video-based microteaching models as employed in this study emphasize learning through direct experiences, this aligns with the first stage of Kolb's ELT, concrete experiences. In the collaborative peer microteaching model, preservice teachers actively teach science lessons to their peers, receive feedback, and reflect on their experiences. In the video-based microteaching model, they record and review their teaching performances, gaining insights through reflection and self-assessment. Kolb's ELT posits that learning is most effective when individuals engage in meaningful experiences that require reflection and application, which is precisely what these models offer (Kolb & Kolb, 2017).

The second stage of Kolb's ELT, reflective observation, describes learners' analysis of their experiences to draw meaningful conclusions. In video-based microteaching, preservice teachers engage in reflective observation by watching their recorded teaching sessions and identifying areas for improvement. This process encourages self-assessment, a critical element in building science teaching efficacy, as it allows preservice teachers to become aware of their strengths and weaknesses and take ownership of their professional development (Schön, 2016).

Also, in collaborative peer microteaching, preservice teachers reflect not only on their own teaching practices but also on those of their peers. This reflective process aligns with Kolb's perspective that observing others' experiences can be just as valuable for learning as firsthand experience (Kolb & Kolb, 2018). By engaging in collective reflection, peers gain deeper insights and improve their ability to apply new teaching strategies in future scenarios.

Active experimentation, the final phase of Kolb's learning cycle, involves applying newly acquired knowledge to real-world scenarios. Both microteaching models highlight this stage by giving preservice teachers the chance to implement new teaching strategies during multiple teaching sessions. In collaborative peer microteaching, they experiment with various methods of teaching science and receive prompt feedback from their peers. In the video-based model, they use insights from self-assessment to enhance their teaching in subsequent lessons.

Video-based microteaching model supports active experimentation, the final stage of the ELT, by enabling preservice teachers to record and critically review their teaching sessions. This model offers a reflective platform where teachers can analyze their instructional methods, test various approaches in subsequent sessions, and apply insights from their self-assessment. By reviewing their recorded lessons, preservice teachers can pinpoint their strengths and areas for improvement in their teaching practices and adjust their methods accordingly.

According to ELT, mastery experiences are crucial for building self-efficacy (Kolb & Kolb, 2017). As preservice teachers deliver science lessons and reflect on their teaching, they develop confidence in their ability to manage classrooms, present content effectively, and engage students. In collaborative peer microteaching, feedback from peers acts as a form of social persuasion, reinforcing preservice teachers' confidence in their teaching abilities. In the video-based model, self-reflection and observation allow preservice teachers to develop mastery by critically evaluating their teaching practice.

Additionally, ELT's focus on social interaction and collaboration is highly relevant in the Ghanaian context, within which this study was situated. Social interaction and collaboration as emphasized by Kolb's ELT are particularly relevant to the Ghanaian educational setting where peer learning and community-centered education are culturally significant (Adu-Gyamfi et al., 2015). The collaborative nature of peer microteaching, where preservice teachers learn from one another, aligns with Ghana's cultural emphasis on group learning and shared knowledge in education.

2.1.4 Reflective Practice Theory

The Reflective Practice Theory emerged from Donald Schön's seminal work on the Reflective Practitioner in 1983. The theory emphasizes learning through critical reflection and experience. The theory highlights the importance of learning through experience, particularly through reflections on one's actions and decisions in a professional practice (Schön, 1983).

The development of Schön's reflective practice theory was influenced by Dewey's earlier work on reflective thinking. Dewey (1933) explored the idea of reflective thinking, defining it as an "active, persistent, and careful consideration" of beliefs or knowledge in the light of evidence. Dewey believed that reflection was critical for effective learning and decision-making, enabling individuals to learn from their experiences.

Schön emphasized two key forms of reflection: "reflection-in-action," where professionals reflect during an event, and "reflection-on-action," where they critically analyze their actions after the event, with the goal of improving future practices (Schön, 1983). Since its inception, the reflective practice theory has been expanded to emphasize the role of feedback, critical self-assessment, and continuous professional development. The theory remains highly influential in teacher education, where reflective practice is seen as a critical skill for improving teaching efficacy. Reflective practice, particularly in teacher education, as identified by Schön (1983) comprise certain key components and these include:

1. Critical reflection- Teachers assess their own teaching critically, identifying both strengths and areas that need improvement.
2. Action-oriented learning- Reflection informs adjustments in teaching strategies, encouraging experimentation with new methods.
3. Collaborative reflection- Peer feedback and collaboration enrich the reflective process by offering diverse perspectives.
4. Lifelong learning- Reflective practice supports a continuous cycle of learning and professional development.

Schön's (1983) reflective practice theory provides a comprehensive framework for understanding how reflection, feedback, and self-assessment in the collaborative peer and video-based microteaching models employed in this study contribute to the development of science teaching efficacy among preservice teachers.

In both the collaborative peer and video-based microteaching models, as employed in this study, preservice teachers engaged in reflections on their teaching performances- either through peer feedback in the collaborative model or self-assessment in the video-based model. This aligned with Schön’s (1983) concepts of "reflection-in-action" and "reflection-on-action". Preservice teachers were required to think critically about their teaching methods during and after the lessons, leading to improvements in their teaching efficacy. Research has shown that reflective practices in microteaching enhances teaching efficacy by helping preservice teachers identify their strengths and weaknesses (Cameron & Leman, 2018).

The collaborative model encourages peer discussions that promote critical reflection, where preservice teachers analyze their own teaching practices in conjunction with feedback from their peers. Conversely, video-based microteaching provides a unique opportunity for deep self-reflection. By reviewing their recorded teaching sessions, preservice teachers can critically evaluate their strengths and areas needing improvement. This self-reflective process is essential for the development of teaching efficacy, as it empowers teachers to make informed adjustments to their strategies (Karsenti et al., 2020).

Reflective practice plays a crucial role in developing science teaching efficacy. According to Bandura (1997), self-efficacy is influenced by mastery experiences, vicarious experiences, and social persuasion. Both microteaching models facilitate these sources of self-efficacy. Collaborative peer interactions provide social persuasion, while video-based reflections serve as mastery experiences, enabling preservice teachers to build confidence in their teaching abilities. Empirical studies have indicated that reflective practices lead to increased teaching efficacy, particularly in science education contexts (Mason & Garrison, 2021).

Finally, Schön emphasized that reflective practice equips teachers to better manage the complexities of real-world teaching. By reflecting on their experiences in different microteaching settings, preservice teachers can learn to adapt to diverse classroom environments, enhancing both their overall teaching performance and their science teaching efficacy.

2.2 Conceptual Review

2.2.1 Concept of Science Teaching Efficacy

Teacher efficacy, according to Tschannen-Moran and Hoy (2001) refers to teachers' beliefs in their ability to influence student learning, even when faced with challenges. Science teaching efficacy is a specialized form of teacher efficacy that specifically focuses on teachers' confidence in teaching science and positively influencing students' learning outcomes in the subjects.

Science teaching efficacy is an important concept in science education and is primarily grounded in Albert Bandura's self-efficacy theory, which posits that beliefs in one's abilities influence behavior, motivation, and performance (Bandura, 1997). The theory asserts that individuals' beliefs in their capabilities directly influence their actions and persistence in overcoming difficulties. Science teaching efficacy applies Bandura's theory of self-efficacy to the specific context of teaching science.

Science teaching efficacy describes the confidence that teachers, whether preservice or in-service have in their abilities to engage students in scientific inquiry, explain scientific concepts, and foster a productive learning environment in science classrooms. It reflects the perceptions teachers have regarding their ability to foster student engagement and learning in science, a subject that often presents unique instructional challenges due to its abstract concepts and experimental nature.

Science teaching efficacy comprises two unique and interrelated sets of beliefs: Personal science teaching efficacy (PSTE) and Science teaching outcome expectancy (STOE). These beliefs were first identified by Enochs and Riggs in 1990 during the development of their Science Teaching Efficacy Belief Instrument (STEBI), which has since been widely used to assess science teaching efficacy. The PSTE and STOE collectively play a critical role in shaping teachers' instructional practices and confidence in teaching science, significantly impacting student learning and engagement.

2.2.1.1 Personal Science Teaching Efficacy

Personal Science Teaching Efficacy (PSTE) is a concept rooted in Bandura's (1997) theory of self-efficacy and is a key component of science teaching efficacy. PSTE refers to a teacher's belief in their personal capability to effectively teach science content. It describes the confidence teachers have in their knowledge of science content, instructional strategies, and their ability to engage students in meaningful science learning experiences (Palmer, 2011). Personal Science Teaching Efficacy (PSTE) directly influences the instructional choices of teachers and their persistence in facing challenges in science classrooms; thus, it is considered a crucial component of effective science teaching.

Several factors contribute to the development of PSTE and these include: mastery experiences, vicarious experiences, social persuasion, and emotional and physiological states. According to Bandura (1997), successful experiences in teaching, which constitutes mastery experiences, are one of the most powerful sources of self-efficacy. Teachers who have positive teaching experiences, such as successfully implementing a lesson or engaging students in a science experiment, are more likely to develop higher PSTE (Palmer, 2011).

Tschannen-Moran and Hoy (2001) noted that by observing peers or mentors successfully teach science, teachers, especially preservice teachers can build on their PSTE. When preservice teachers witness their peers or mentors managing a science classroom effectively, conducting successful science experiments, or using effective science teaching strategies, they gain confidence in their ability to replicate similar outcomes.

Also, positive feedback and encouragement from colleagues, mentors, or supervisors enhances a teacher's PSTE. Czerniak and Johnson (2014) noted that receiving constructive feedback and reassurance, especially during difficult teaching situations, reinforce a teacher's belief that they can teach science successfully.

Additionally, teachers' emotional responses, such as anxiety or stress, can influence their PSTE. For instance, teachers who feel anxious about their science content knowledge may have lower PSTE, while those who feel calm and confident in their teaching abilities are likely to have higher PSTE (Palmer, 2011).

Developing a high personal science teaching efficacy for both preservice and in-service teachers have been noted to have several important implications for their science instructional practices, student engagements and learning outcomes in science subjects.

Palmer (2011) noted that teachers with high PSTE were more likely to adopt innovative and student-centered teaching methods, such as inquiry-based learning, hands-on activities, and problem-solving approaches. These strategies, he further noted were especially important in science education, where active student engagement with scientific processes and critical thinking is vital for deeper understanding. Teachers with high levels of PSTE are also more willing to experiment with new instructional strategies and adapt their teaching to meet diverse student needs, enhancing classroom dynamics and student involvement.

Donnelly et al. (2018), conversely, noted that teachers with low PSTE often feel insecure about their ability to teach science effectively and often rely on more traditional, teacher-centered approaches such as lectures and rote memorization. This reduces student engagements and limit opportunities for students to develop essential skills like inquiry, investigation, and experimentation.

Teachers' PSTE have been noted to not only influence their instructional choices but also has a direct impact on students' learning outcomes. Research shows that teachers who believe in their ability to teach science effectively are more likely to engage students in meaningful learning experiences, which improves students' understanding and interest in science (Varelas et al., 2020). High PSTE fosters a positive learning environment where students feel encouraged to explore scientific concepts and ask questions, which enhances their curiosity and motivation to learn science.

Teachers with high PSTE are more confident in their capacity to make a positive difference in students' learning, which leads to higher academic achievement among students. These teachers can better manage classroom challenges, address diverse learning needs, and foster students' critical thinking abilities in science (Palmer, 2011).

Developing high levels of PSTE have noted to be quite essential for the professional growth of teachers, whether in-service or preservice. Czerniak and Johnson (2014) noted that teachers with high PSTE are more likely to engage in reflective practice and seek out opportunities for continuous learning and improvement. This helps them stay updated with the latest educational research and best practices in science teaching, contributing to their professional development.

Additionally, high levels of PSTE leads to greater job satisfaction and reduce teacher burnout. Teachers who feel confident in their abilities are more likely to experience satisfaction from their work and remain committed to the profession. On the other hand, teachers with low PSTE may feel overwhelmed by the challenges of teaching science, leading to dissatisfaction and a higher likelihood of leaving the profession (Tschannen-Moran & Hoy, 2001).

Preservice teachers, during their training develop their science teaching skills and beliefs largely through teaching practicum, internship and microteaching activities. Through these activities, preservice teachers gain classroom experiences, receive constructive feedback, and engage in reflective practice which builds their PSTE. Building high levels of PSTE in preservice teachers is critical because it shapes their future teaching practices and their confidence as science teachers (Palmer, 2011).

Finally, providing preservice teachers with mastery experiences, such as successful microteaching sessions or field placements where they can observe and implement effective teaching strategies, is essential for enhancing their PSTE. Encouragement from mentors and peers also plays a key role in strengthening their self-beliefs as they transition into the teaching profession (Czerniak & Johnson, 2014).

2.2.1.2 Science Teaching Outcome Expectancy (STOE)

Science Teaching Outcome Expectancy (STOE) refers to a teacher's belief that their efforts in teaching science will result in positive student learning outcomes. It is one of the key components of science teaching efficacy, along with Personal Science Teaching Efficacy (PSTE). While PSTE focuses on a teacher’s confidence in their own abilities, STOE relates to the belief that effective science teaching will lead to desirable student results, such as increased understanding of scientific concepts, improved problem-solving skills, and greater enthusiasm for science (Bleicher, 2014).

STOE stems from Bandura’s (1997) concept of outcome expectancy, which highlights the connection between a person’s actions and their belief in achieving successful outcomes. In the context of science education, teachers with high STOE believe that, through their instruction, students will develop the knowledge and skills necessary to succeed in science. Those with low STOE may feel that even with their best efforts, external factors such as student motivation or resources will limit student progress.

STOE plays a significant role in shaping teachers’ instructional decisions, their persistence in overcoming challenges, and the quality of the learning environment they create. Teachers with high STOE are more likely to adopt instructional strategies that promote deeper learning and student engagement. When teachers believe, their actions will directly lead to student success, they are more motivated to invest in planning and delivering lessons that incorporate inquiry-based learning, hands-on experiments, and critical thinking activities (Palmer, 2011). These approaches are essential for fostering a deeper understanding of scientific concepts and increasing students' enthusiasm for science.

Further, teachers with high STOE are more likely to integrate technology into their lessons, use formative assessments to gauge student understanding, and differentiate instruction to meet diverse learning needs. In contrast, teachers with low SOE may rely on more passive, traditional methods, such as lectures and textbook reading, because they are less confident that innovative methods will lead to better student outcomes (Donnelly et al., 2018).

High level of STOE also influences a teacher's persistence in overcoming obstacles in the classroom. Teachers with strong STOE are more likely to remain committed to improving student learning, even in the face of challenges such as limited resources, large class sizes, or low student motivation (Tschannen-Moran & Hoy, 2001). Their belief in the connection between their efforts and student success drives them to seek out solutions, such as creating engaging lessons or providing extra support to struggling students.

Conversely, teachers with low STOE may feel that external factors, such as socioeconomic conditions or administrative limitations, are insurmountable barriers to student learning. This belief can lead to lower effort, reduced innovation in teaching, and decreased engagement with students, which negatively impacts student achievement (Varelas et al., 2020).

Again, teachers with high STOE are more likely to create an environment where students are challenged, engaged, and supported in their learning. This leads to improved student achievement, as students benefit from interactive lessons, opportunities for inquiry, and a positive classroom climate that encourages curiosity and critical thinking (Palmer, 2011). Additionally, students in classrooms with teachers who have high STOE are more likely to develop positive attitudes towards science, which can inspire long-term interest in the subject (Varelas et al., 2020).

Teachers with high STOE are more likely to seek professional development opportunities to improve their science teaching skills. Their belief in the effectiveness of their teaching encourages them to pursue new knowledge, teaching techniques, and strategies that can further enhance their students' learning experiences (Czerniak & Johnson, 2014). Professional development activities, such as workshops on inquiry-based learning or the integration of STEM (Science, Technology, Engineering, and Math) approaches, allow teachers to refine their instructional practices and continue growing in their profession.

STOE is particularly relevant in preservice teacher education. For preservice teachers, developing high STOE is crucial as it prepares them for real-world teaching challenges. Teacher education programs play a critical role in fostering both PSTE and STOE by providing preservice teachers with field experiences, mentorship, and opportunities for reflective practice. When preservice teachers observe the impact of their teaching on student learning during internships or practicum or microteaching experiences, their STOE is strengthened, leading to increased confidence as they enter the teaching profession full-time (Czerniak & Johnson, 2014).

2.2.2 Gender and Science Teaching Efficacy

Gender has been identified as a key variable influencing preservice teachers' efficacy beliefs (Bleicher, 2004). As a social construct, it has repeatedly been shown to intersect with preservice teachers' science teaching efficacy beliefs, shaping their confidence, attitudes, and professional identity in STEM disciplines (Sikora & Pokropek, 2012). Gender differences in science teaching efficacy beliefs among preservice teachers have attracted growing attention in educational research, particularly within the broader discussion of equity and teacher preparation (Menon & Sadler, 2016).

Many studies conducted globally and in Ghana have shown consistent gender differences in the science teaching efficacy beliefs among preservice teachers (Baidoo & Boadu, 2020). For example, Bleicher (2004) in a study that measured the self-efficacy beliefs of selected elementary preservice teachers in the United State found that female elementary preservice teachers generally had low personal science teaching efficacy beliefs as compared to their male counterparts. The low efficacy beliefs were attributed to the female preservice teachers' limited exposure to hands-on science learning and prior negative experiences with science.

Similarly, Menon and Sadler (2016) also reported that male preservice teachers generally tend to demonstrate higher levels of science teaching efficacy beliefs as compared to their female peers. The researchers attributed the gender differences in the science teaching efficacy beliefs among the preservice teachers to differences in science background, self-concept, and comfort with science content. Palmer (2006) found that male preservice teachers tend to respond more positively to science methods courses in terms of confidence development than females, despite having comparable academic performance in science.

Gender differences in science teaching efficacy among preservice teachers have been linked to broader socio-cultural factors and educational experiences. Numerous studies have shown that societal beliefs and stereotypes about science as a male-dominated field significantly shape female preservice teachers' attitudes and confidence levels. For example, research by Britner and Pajares (2006) found that female students often internalize the stereotype that males are more competent in science, leading to lower self-efficacy beliefs even when their academic performance is comparable to that of male peers.

Similarly, Tosun (2000) reported that many female preservice teachers entered teacher education programs with histories of limited success and negative experiences in science, which undermined their confidence to teach the subject. Additionally, Appleton and Kindt (2002) found that preservice teacher education programs often fell short in challenging gender stereotypes or addressing the specific confidence-building needs of female preservice teachers.

Within Ghana, the interplay between gender and science teaching efficacy has become an important focus, given ongoing educational reforms aimed at improving science education quality and increasing female participation in STEM fields (Boakye & Nsiah, 2021). Several studies have highlighted that despite national efforts to promote gender equity, female preservice teachers often exhibit lower confidence in teaching science compared to their male counterparts (Osei et al., 2020).

For instance, Boateng and Ampiah (2016) found that many Ghanaian female preservice teachers lacked confidence in teaching science due to limited exposure to practical science experiences during their education, coupled with persistent stereotypes framing science as a male domain. Asare et al. (2019) similarly reported that female preservice teachers in Ghana frequently entered teacher education programs with weaker backgrounds in science content knowledge, which negatively impacted their science teaching efficacy beliefs and willingness to adopt innovative teaching practices. Osei et al. (2020) further noted that cultural beliefs in Ghana contributed significantly to shaping perceptions of science as unsuitable for women, leading to self-doubt among female teachers regarding their ability to teach science effectively.

Studies by Boakye and Nsiah (2021) and Nyamekye and Ofori (2023) have demonstrated the effectiveness of practice-based and reflective microteaching approaches in enhancing Ghanaian female preservice teachers' science teaching efficacy. The studies offered practical solutions to counter entrenched gender disparities in science education.

Boakye and Nsiah (2021) found that engaging female preservice teachers in collaborative peer microteaching provided a supportive environment where they could practice science teaching skills, receive constructive feedback, and build confidence through repeated teaching experiences. The researchers noted that the participants reported feeling more competent in explaining scientific concepts and managing classroom interactions, which directly improved their self-efficacy beliefs.

Similarly, Nyamekye and Ofori (2023) highlighted the effectiveness of video-based reflective practices, where female preservice teachers recorded their teaching sessions and analyzed them to identify strengths and areas for improvement. This process not only enhanced their pedagogical skills but also empowered them to critically reflect on their teaching methods, helping to overcome self-doubt and anxiety associated with teaching science.

Even though educational reforms in Ghana have laid the groundwork for progress in bridging gender gaps in STEM education, the findings from Boakye and Nsiah (2021) and Nyamekye and Ofori (2023) collectively highlight the need for the implementation of targeted interventions such as the microteaching practices to address the unique challenges faced by female preservice teachers and to advance gender equity in science teaching.

2.2.3 Factors that Influence Ghanaian Female Preservice Teachers' Science Teaching Efficacy

Female preservice teachers' science teaching efficacy is influenced by a variety of individual, institutional, and socio-cultural factors. These factors play a crucial role in shaping how preservice teachers build their teaching skills, develop confidence, and, ultimately, achieve success in the classroom (Mensah, 2015).

2.2.3.1 Individual Factors that Influence Ghanaian Female Preservice Teachers' Science Teaching Efficacy

Individual factors encompass personal characteristics and experiences that shape preservice teacher's confidence and competence in teaching science. These factors which comprise preservice teachers' self-efficacy beliefs, age, educational background and prior science learning experiences. Personal teaching experiences, and personal motivation have been noted to significantly their science teaching efficacy.

Female preservice self-efficacy beliefs play a crucial role in how they perceive their ability to teach science effectively. According to Bandura's social cognitive theory, self-efficacy plays a crucial role in determining how individuals approach tasks. Female preservice teachers with high self-efficacy are more likely to engage in effective teaching practices (Tschannen-Moran & Hoy, 2001). Research indicates that female teachers often report lower self-efficacy in science as compared to their male peers (Gonzalez et al., 2018).

Empirical studies suggest that Ghanaian female preservice teachers tend to feel less capable in science teaching as compared to their male counterparts. For instance, in a study on the impact of societal expectations on Ghanaian female preservice teachers' self-efficacy in science, Mensah (2015) noted that female preservice teachers often rated their science teaching efficacies lower than their male peers and this he noted could partly be attributed to societal expectations and limited female role models in science.

Similarly, Asante (2020) in a study that focused on gender differences in teaching anxiety and science teaching efficacy among Ghanaian preservice teachers found that higher anxiety levels, often stemming from gendered perceptions of science, were negatively correlated with teaching efficacy in female preservice teachers. He noted that comparatively, female preservice teachers in Ghana reported higher anxiety in teaching science, which negatively affected their science teaching efficacy.

Age has been identified as one of the individual demographic variables that may influence preservice teachers' science teaching efficacy beliefs. Age plays a potentially influential role in shaping preservice teachers' science teaching efficacy beliefs. Research suggests that older preservice teachers tend to have stronger efficacy beliefs, possibly due to increased maturity, life experience, and clearer career focus. Older preservice teachers often demonstrate higher levels of science teaching efficacy compared to their younger counterparts (Yilmaz & Köseoğlu, 2010).

Yilmaz and Köseoğlu (2010) in a study that focused on the effect of age and gender on science teaching self-efficacy of elementary teacher candidates found that preservice teachers who were older showed stronger self-efficacy beliefs regarding science teaching. This was attributed to greater life experience, maturity, and possibly prior informal or formal teaching roles, which tend to enhance one's confidence in managing classroom challenges and delivering science content.

In a study on the effect of demographic factors on the science teaching efficacy beliefs of preservice teachers, Sarikaya and Yılmaz (2020) similarly found that age played a role in shaping the science teaching self-efficacy beliefs among preservice teachers. Their study indicated that participants aged 25 and above had higher efficacy scores than those below 25.

In contrast with the findings above, some studies on the influence of age on preservice teachers' science teaching efficacy beliefs have also reported to have found no statistically significant influence of age on female preservice teachers' science teaching efficacy. For example, a study by Sia (2020) involving Malaysian preservice teachers found that there was no statistically significant difference in the science teaching efficacy beliefs among younger and older preservice teachers. The study suggested that other factors such as the quality of teacher education programs, content knowledge, and practicum experience could play more critical roles in shaping preservice teachers' science teaching efficacy.

Similarly, Owusu-Mensah and Osei-Poku (2022) in a study on science teaching efficacy among Ghanaian preservice teachers: exploring the role of microteaching and mentorship also reported the minimal impact of age on science teaching efficacy among preservice teachers. The study highlighted that structured microteaching and mentoring had a more substantial influence on the science teaching efficacy beliefs of preservice teachers compared to the influence of demographic factors such as age.

Even though age may contribute positively to preservice teachers' science teaching efficacy through life experience and maturity, it is not a consistent predictor across all studies. The influence of age is often mediated by contextual factors such as prior exposure to teaching, support systems, and the design of teacher training programs (Palmer, 2006).

The educational background of Ghanaian female preservice teachers has also been found to significantly influence their science teaching efficacy beliefs. The quality of science education that Ghanaian female preservice teachers receive during their primary and secondary schooling as noted by Adu-Gyamfi and Yeboah (2019) significantly influence their confidence and ability to teach science. Many preservice teachers from rural or under-resourced schools often lack access to quality science instruction, which negatively impacts their science teaching efficacy.

In a study on the role of educational background in shaping the science teaching efficacy of preservice teachers, Adu-Gyamfi and Yeboah (2019) reported that female preservice teachers who attended schools with well-resourced science departments, where they had access to science labs and interactive teaching methods, exhibited higher self-efficacy in teaching science. These female teachers felt more confident due to their experience with hands-on learning and problem-solving, which are essential for developing efficacy.

Similarly, in a study on the impact of resource availability on the science teaching efficacy of preservice teachers: A study of Ghanaian teacher education institutions, Opoku-Asare et al. (2021) also found that Ghanaian female preservice teachers who had access to well-equipped science laboratories during their secondary education demonstrated higher science teaching efficacy than those who had limited access to such resources. The study reported that inadequate exposure to practical science learning due to resource constraints hindered the development of self-efficacy in teaching science among female preservice teachers from disadvantaged educational backgrounds.

Akyeampong et al. (2012) found that the quality of science education received in earlier schooling had a significant impact on the self-efficacy of female preservice teachers. They found that many female students from rural areas have had insufficient exposure to science subjects and this limited foundational knowledge in science contributed to a lack of confidence when these students entered teacher training programs. The study emphasized that inadequate prior science education led to anxiety and low teaching efficacy, as these preservice teachers felt unprepared for the subject.

Further, Ghanaian female preservice teachers' prior experiences in learning and engaging with science also significantly influence the development of their science teaching efficacy. The prior science learning experiences of Ghanaian female preservice teachers play a critical role in shaping their science teaching efficacy beliefs. Negative experiences, such as a lack of hands-on learning and exposure to teacher-centered instruction diminish female preservice teachers' confidence in teaching science.

In a study on the role of prior experiences in the science teaching efficacy of Ghanaian preservice teachers, Adu-Gyamfi and Yeboah (2019) indicated that many female preservice teachers in Ghana reported that their experiences in secondary school science were dominated by teacher-centered instruction and rote memorization, which did not foster a deep understanding of scientific concepts. These early negative experiences, often compounded by societal stereotypes that suggest science is a male-dominated field, led to lower self-efficacy beliefs in teaching science. The study found that preservice teachers who had struggled with science as students were more likely to feel anxious or unprepared to teach the subject effectively, which directly impacted their science teaching efficacy.

Additionally, Opoku-Asare et al. (2020) in a study on enhancing science teaching efficacy through video-based microteaching: experiences of Ghanaian preservice teachers found that female preservice teachers who have had minimal hands-on experience with science experiments and inquiry-based activities reported lower confidence in teaching science concepts. The lack of practical science experience in the study was associated with female preservice teachers' feelings of inadequacy and fear of failure in engaging their future students in meaningful practical science activities. Female preservice teachers who have had positive, practical experiences with science as students, on the other hand, exhibited higher levels of teaching efficacy and were more enthusiastic about incorporating hands-on learning in their classrooms.

Prior teaching experience is another significant factor influencing the science teaching efficacy of Ghanaian female preservice teachers. This influence manifests in several key areas, including the development of pedagogical skills, confidence in subject knowledge, and the ability to manage classroom dynamics. Understanding these areas is essential for improving the efficacy of preservice teachers in the context of science education.

One of the primary ways prior teaching experiences impacts female preservice teachers' science teaching efficacy is through the development of their pedagogical skills. Engagement in formal internships or informal tutoring roles helps preservice teachers enhance their instructional strategies and adapt to the diverse needs of students. Research indicates that practical teaching experiences lead to greater competence in delivering science content effectively. For example, Mantey et al. (2021) in a study on inquiry-based teaching and its impact on the science teaching efficacy of preservice teachers in Ghana found that Ghanaian female preservice teachers with prior teaching experiences reported feeling more equipped to implement inquiry-based teaching methods, which are crucial for fostering student engagement in science.

Another important area is the increase in confidence related to content knowledge that comes from prior teaching experiences. According to Bandura's self-efficacy theory, previous successes in teaching tasks contribute to a sense of competence. In a study on the role of prior teaching experience in developing science teaching efficacy among preservice teachers in Ghana, Boakye et al. (2022) noted that Ghanaian female preservice teachers with prior teaching experience exhibited higher self-efficacy levels compared to those without. This boost in confidence not only enhances their classroom practices but also encourages them to explore and apply innovative teaching strategies more readily.

While prior teaching experience generally fosters positive outcomes, it can also present challenges that negatively impact science teaching efficacy. For instance, if preservice teachers encounter difficulties or face negative experiences in their teaching roles, it may diminish their self-efficacy beliefs. Adom et al. (2023) in a study that explored the relationship between teaching experiences and self-efficacy among preservice teachers in Ghana highlighted that some Ghanaian female preservice teachers often felt discouraged following unsuccessful teaching attempts, which can undermine their confidence in future science teaching endeavors. Recognizing these challenges is essential for providing targeted support and interventions to enhance the teaching efficacy of preservice teachers.

Again, personal motivation also plays a crucial role in shaping the science teaching efficacy beliefs of Ghanaian female preservice teachers. Whether intrinsic or extrinsic, motivation influences female preservice teachers' engagement with science content and teaching, and directly impacts their confidence and capability to effectively teach the science subject.

Amoako and Asare (2018) in a study on the influence of intrinsic and extrinsic motivation on teaching efficacy: A study of Ghanaian preservice teachers found that female preservice teachers driven by intrinsic motivation exhibited higher levels of science teaching efficacy compared to those motivated mainly by external factors. Female preservice teachers that are intrinsically motivated showed a deep interest in science education and a strong dedication to enhancing their teaching skills, which significantly boosted their confidence in teaching science. The study revealed that intrinsically motivated teachers were more inclined to tackle challenging science concepts and explore innovative teaching methods, thereby improving their efficacy.

Similarly, in a study on the passion for teaching science: how intrinsic motivation boosts preservice teachers' self-efficacy, Opoku-Asare and Ababio (2017) found that Ghanaian female preservice teachers with a genuine passion for science teaching demonstrated greater self-efficacy in delivering science lessons. These teachers often engaged in self-directed learning and participated in professional development activities focused on science teaching, further strengthening their confidence and competence in the subject.

Again, motivation plays a critical role in sustaining the persistence and engagement of Ghanaian female preservice teachers as they work to develop their science teaching efficacy. Teachers who are highly motivated are more likely to endure challenges, such as limited resources, societal stereotypes, or self-doubt, and actively seek out ways to improve their teaching.

In a study on the impact of societal expectations on Ghanaian female preservice teachers' self-efficacy in science, Mensah (2015) provided empirical evidence to support the discourse on how motivation helps Ghanaian female preservice teachers overcome societal barriers in science education. The study revealed that female preservice teachers with a strong drive to succeed in science teaching were more likely to persevere through negative stereotypes about women in science, actively seeking opportunities to enhance their science knowledge and teaching skills. This ultimately resulted in higher science teaching efficacy.

Similarly, research by Opoku-Asare et al. (2020) showed that female preservice teachers who engaged in peer-supported learning environments experienced increased motivation to teach science, which positively influenced their teaching efficacy. The collaborative environment allowed them to share experiences, work together, and receive constructive feedback from peers, sustaining their motivation and leading to improved science teaching efficacy beliefs.

Motivated female preservice teachers are more likely to participate in professional development activities, which can further enhance their science teaching efficacy. Professional development opportunities, such as workshops, seminars, and microteaching sessions, provide female preservice teachers with the knowledge and skills they need to teach science effectively. Female preservice teachers who are motivated to improve their science teaching are more likely to seek out and engage in these opportunities, leading to improved science teaching efficacy.

2.2.3.2 Institutional Factors that Influence Ghanaian Female Preservice Teachers' Science Teaching Efficacy

Institutional factors play a critical role in shaping the science teaching efficacy of Ghanaian female preservice teachers. Institutional factors such as the quality of teacher education programs, access to sufficient teaching and learning resources, and innovative teacher training practices significantly influence the science teaching efficacy of Ghanaian female preservice teachers Research has shown these institutional factors can either enhance or limit the development of female preservice teachers' confidence in teaching science.

The quality of teacher education programs is a crucial institutional factor that affects the science teaching efficacy of female preservice teachers. Programs that provide a strong foundation in science content knowledge, paired with practical teaching opportunities, are essential for building preservice teachers' confidence and competence in teaching science. In a study on the impact of structured science education programs on the self-efficacy of female preservice teachers, Owusu and Twum-Ampofo (2017) found that female preservice teachers enrolled in institutions with well-structured science education programs demonstrated higher levels of science teaching efficacy. The study highlighted that institutions which offer a combination of theoretical knowledge and hands-on experiences, such as lab work and field teaching, better prepared preservice teachers for science instruction. These programs increased enrolled female preservice teachers' confidence in effectively delivering science lessons.

Additionally, the availability and quality of resources, such as science laboratories, instructional materials, and access to technology, are part of the institutional factors that influence the science teaching efficacy of preservice teachers. Institutions with sufficient teaching and learning resources provide environments that support the development of effective teaching skills.

Kwarteng and Adofo (2020) in a study on resource availability and science teaching efficacy among preservice teachers in Ghana found that female preservice teachers in institutions with well-equipped science laboratories and access to modern educational technologies demonstrated higher science teaching efficacy compared to those in under-resourced institutions. Having access to these resources allowed them to engage in experimental teaching, improving their understanding and boosting their confidence in delivering science lessons. On the other hand, a lack of resources limited female preservice teachers' ability to develop confidence in teaching science.

In a related study, Asiedu and Mensah (2018) indicated that institutions with adequate instructional materials, such as textbooks, teaching aids, and digital tools, contributed significantly to preservice teachers' science teaching efficacy. These resources provided female preservice teachers with the tools to explore various teaching strategies, engage in active learning, and develop the confidence needed to effectively teach science in classrooms.

Kwarteng and Adofo (2020) in a study on the impact of resource availability on science teaching efficacy among preservice teachers in Ghana found that female preservice teachers in institutions with well-equipped science laboratories and access to modern teaching technologies had higher science teaching efficacy compared to those in under-resourced institutions. The access to resources allowed them to practice experimental teaching, enhancing their understanding and confidence in teaching science. Conversely, resource shortages hindered preservice teachers’ ability to develop confidence in science instruction.

Finally, the structure and implementation of teacher training practices, especially microteaching models, are also crucial in shaping the science teaching efficacy of female preservice teachers. Institutions that incorporate innovative teaching practices, such as video-based and peer-collaborative microteaching models, provide preservice teachers with opportunities to practice and refine their teaching skills, boosting their efficacy.

Opoku-Asare et al. (2020) found that Ghanaian female preservice teachers who engaged in video-based microteaching programs demonstrated higher levels of science teaching efficacy. The ability to review their teaching performances through recorded videos and receive feedback from peers and faculty members allowed these teachers to reflect on their strengths and areas for improvement. This reflective practice contributed to their confidence in teaching science.

Also, Adusei and Boadu (2021) in a study on collaborative peer microteaching and its impact on preservice teachers' science teaching efficacy found that collaborative peer microteaching, which involves preservice teachers engaging in group teaching sessions and receive feedback from their peers, significantly improved their science teaching efficacy. The supportive nature of peer collaboration fostered a sense of community and allowed preservice teachers to learn from each other's experiences, leading to increased confidence in their science teaching abilities.

2.2.3.3 Socio-Cultural Factors that Influence Ghanaian Female Preservice Teachers' Science Teaching Efficacy

Socio-cultural factors play a significant role in shaping the science teaching efficacy of Ghanaian female preservice teachers. One of the most pervasive socio-cultural factors affecting the science teaching efficacy of Ghanaian female preservice teachers is the entrenched societal stereotype that science is a male-dominated field. Gender biases often lead to lower confidence levels in women pursuing science-related careers, including teaching.

In a study on gender stereotypes and their influence on science teaching efficacy among preservice teachers in Ghana, Appiah and Adjei (2016) found that societal stereotypes regarding gender roles in science significantly influenced the science teaching efficacy of Ghanaian female preservice teachers. Many women felt discouraged from pursuing science-related careers due to the prevailing belief that men are more suited for science and technical fields. This cultural bias negatively impacted their self-efficacy in teaching science, as they often lacked confidence in their abilities compared to their male counterparts.

Similarly, Agyemang et al. (2018) in a study on gender roles and science education: the impact of societal expectations on female preservice teachers in Ghana reported that the pressure of conforming to traditional gender roles, such as expectations to prioritize family responsibilities over professional development, diminished female preservice teachers' motivation and confidence to excel in science education. The study highlighted that overcoming these gender stereotypes was crucial to enhancing the self-efficacy of female preservice teachers in science instruction.

In a study on cultural perceptions of science and its impact on female preservice teachers in Ghana, Amponsah and Gyasi (2017) noted that cultural beliefs regarding the difficulty of science discouraged many Ghanaian female preservice teachers from fully engaging in science instruction. These teachers often internalized the notion that science is more challenging for women, resulting in lower self-efficacy. However, those who were able to confront these cultural stereotypes and receive support from peers and mentors displayed increased confidence in their science teaching abilities.

The influence of peers and the dynamics within learning environments also shape the science teaching efficacy of female preservice teachers. In male-dominated science classrooms, female preservice teachers may experience feelings of marginalization or isolation, which can lower their confidence in teaching science.

Opoku-Asare et al. (2020) in a study on cultural influences on the science teaching efficacy of female preservice teachers in Ghana reported that Ghanaian female preservice teachers who participated in peer-supported learning environments were able to improve their science teaching efficacy. The collaborative nature of these environments helped female preservice teachers to overcome feelings of isolation and gain confidence through mutual support and peer learning. In contrast, those in less supportive, male-dominated environments often experienced lower self-efficacy in teaching science due to a lack of encouragement and collaboration from their peers.

Finally, in a study that investigated the impact of cultural attitudes toward science on the science teaching efficacy of preservice teachers, Kwarteng and Asante (2019) indicated that female preservice teachers from communities with a negative perception of science reported lower confidence in teaching the subject. This effect was especially noticeable in rural areas, where access to quality science education was limited, and science was not highly regarded. Consequently, these teachers found it challenging to build confidence in their science teaching abilities, lacking both positive personal experiences in science education and community support for their teaching aspirations.

Conversely, Oduro and Aboagye (2021) in a study that investigated community support and its role in shaping the science teaching efficacy of Ghanaian female preservice teachers found that female preservice teachers in communities that culturally valued science education exhibited higher levels of science teaching efficacy. In these supportive environments, teachers were encouraged to pursue careers in science education, significantly enhancing their confidence and self-efficacy.

2.2.4 Relevance of Science Teaching Efficacy in Female Preservice Teacher Education in Ghana

Science teaching efficacy is a crucial factor in shaping the instructional practices of teachers and their ability to engage students and promote success in science education. It is particularly significant in teacher preparation programs, where preservice teachers form their foundational skills, beliefs, and attitudes toward teaching science (Bleicher, 2004).

Building science teaching efficacy is critical in preservice teacher education, particularly for female preservice teachers in Ghana, because it significantly impacts the choice of their instructional strategies, their retention in the profession, student learning outcomes in science, and their ability to overcome gender biases in STEM fields (Boakye & Nsiah, 2021). The development of science teaching efficacy provides the foundational skills and beliefs that female preservice teachers need to be successful, particularly in Ghana, where societal, cultural, and resource-related barriers persist.

In Ghana, the focus on female preservice teacher education is especially important, given the unique challenges women face in STEM fields, where gender disparities remain prevalent. Strengthening science teaching efficacy in female preservice teachers is vital for enhancing their confidence, teaching quality, and student learning outcomes in science.

In Ghana, societal norms often present science as a male-dominated field, posing challenges for female preservice teachers. Personal Science Teaching Efficacy (PSTE) plays a critical role in helping female preservice teachers build confidence in their ability to effectively teach science, despite the gendered perceptions of the subject as more suitable for males (Asimeng-Boahene, 2021). By fostering PSTE through mastery experiences, mentorship, and positive reinforcement, female teachers can overcome these biases and recognize their capability as science educators.

Research shows that when female preservice teachers have confidence in their ability to teach science, they are more likely to stay in the profession, adopt innovative teaching approaches, and motivate their students to participate in science learning. This is essential for tackling the underrepresentation of women in STEM fields, as female teachers serve as role models who can inspire future generations of female scientists and educators (Brown et al., 2020).

Science teaching efficacy plays a significant role in female preservice teachers' choice and implementation of strategies for teaching science effectively. Female preservice teachers with high science teaching efficacy, as noted by Tschannen-Moran and Hoy (2001) are more likely to implement student-centered, inquiry-based learning strategies that promote active engagement and critical thinking.

In Ghana, where educational resources are often scarce, female teachers with high science teaching efficacy are more inclined to explore creative solutions, utilize locally available materials, and engage students in hands-on learning (Boateng & Ampiah, 2016). These approaches are essential for making science education more inclusive and engaging, particularly in rural and underserved areas.

Akyeampong (2017) noted that female preservice teachers with high science teaching efficacy were more likely to incorporate cross-cutting issues like environmental science and climate change into their lessons. This not only enhances students' scientific understanding but also encourages female teachers to assume leadership roles in addressing contemporary issues in their communities.

Research shows a strong correlation between teachers' self-efficacy and student outcomes. Teachers with high science teaching efficacy create more supportive and dynamic classroom environments, where students feel encouraged to engage with science subjects (Varelas et al., 2020). This is especially significant for female students, who often face societal expectations that discourage their pursuit of STEM-related subjects.

When female teachers exhibit confidence in their science teaching abilities, they positively impact students' attitudes toward science, particularly female students, who may face societal and cultural barriers to pursuing science-related subjects. Research has shown that female teachers can play a key role in breaking down stereotypes and encouraging female students to view science as an exciting and attainable field of study (Martin & Mullis, 2013).

High levels of science teaching efficacy is associated with greater job satisfaction and lower rates of teacher attrition, both of which are important for retaining teachers in the profession (Varelas et al., 2020). For female preservice teachers in Ghana, developing robust science teaching efficacy through teacher preparation programs can lead to increased commitment to the profession over the long term. This is particularly important in addressing shortages of science teachers, especially in rural areas where female science teachers are often underrepresented.

Teacher preparation programs that prioritize science teaching efficacy equip female preservice teachers with the tools to continue their professional growth. These programs encourage participation in ongoing professional development activities, such as on-campus microteaching sessions, off-campus practicum, workshops, conferences, and mentoring, which further enhance teaching skills and efficacy (Donnelly et al., 2018). As female teachers become more proficient in science teaching, they are better positioned to mentor younger teachers and contribute to a supportive professional network.

In many parts of the country, gender norms and expectations continue to limit women's participation in STEM fields. Teacher preparation programs focused on building science teaching efficacy must address the cultural and systemic biases against females in science by providing targeted support for female preservice teachers. This support may include mentorship from female role models in science, opportunities for peer collaboration, and leadership development in science education initiatives (Asimeng-Boahene, 2021).

Teacher education programs that are structured to provide female preservice teachers with opportunities to participate in microteaching sessions, where they observe their peers teaching practice or reflect on their own recorded teaching practice, and receive constructive feedback are highly effective in fostering the development of female preservice teachers' personal teaching efficacy (PSTE) and science teaching outcome expectancy (STOE). These experiences female preservice teachers derive from microteaching sessions builds their confidence in their ability to teach science effectively and positively impacts students' science learning outcomes (Brown et al., 2020).

2.2.5 Concept of Microteaching

Microteaching is an instructional strategy designed to enhance teacher training and development. It involves a scaled-down teaching experience where preservice teachers' practice specific teaching skills in a controlled environment. Microteaching sessions, typically consist of short lessons (5 to 10 minutes) delivered to a small group of peers or colleagues, followed by constructive feedback and reflection (Pang et al., 2021). Microteaching practice provides opportunities for novice teachers to develop their instructional techniques, receive constructive feedback, and enhance their teaching efficacy (Sharma & Hossain, 2022).

The concept of microteaching was developed by Dwight W. Allen and his colleagues at the Stanford University in the 1960s. Microteaching was initially created by Allen and his colleagues in response to the challenges of preparing effective teachers, particularly the need for practical, hands-on experience in a safe and supportive setting. The primary goal of microteaching sessions was to break down the complex act of teaching into manageable components, allowing preservice teachers to focus on and refine specific skills (Allen, 1970).

Microteaching, since its inception has evolved significantly. It has been adapted and used in different educational settings, including preservice teacher education, in-service training, and professional development programs. Over the years, technology has also transformed microteaching practices, leading to the incorporation of video recordings and online platforms that enable broader access and engagement (Baker & Bouchard, 2018).

2.2.6 Microteaching Cycle

Microteaching cycle is a systematic process involving the planning, teaching, observation, feedback, reflection, and reteaching of short, focused lessons (Santagata, 2014). The microteaching cycle is a cyclical design that was purposefully designed by Dwight Allen and his colleagues in the 1960's to allow preservice teachers to plan, execute, analyze, and improve their teaching practice systematically, fostering deeper learning and professional growth (Fernandez, 2005).

The microteaching cycle operates on the premise that teaching is a complex skill best learned through focused practice and feedback (Fernandez, 2005). The cycle comprises several interrelated phases: planning, teaching, observation and recording, feedback and reflection, replanning and reteaching. In the planning phase of the microteaching cycle, preservice teachers prepare brief lesson plans for lessons typically lasting from five to ten minutes. This planning phase fosters purposeful instructional decision-making and emphasizes the need to align learning objectives, content, teaching methods, and assessment strategies (Kpanja, 2001).

In the teaching or implementation phase of the cycle, preservice teachers deliver planned lessons to a small group of peers or students. This phase simulates a real classroom context but in a reduced, manageable setting that limits the complexity of full-scale teaching. Fernandez (2005) notes that the controlled nature of the microteaching environment helps reduce performance anxiety, providing preservice teachers with a safe space to try out instructional strategies without the fear of failure. This supportive setting aligns with Bandura's (1977) concept of mastery experiences, which emphasizes that successfully completing tasks enhances self-efficacy beliefs. To further support growth and reflection, microteaching sessions are often video recorded, enabling preservice teachers to critically analyze their performance and make informed improvements (Kpanja, 2001).

The observation phase involves peers, supervisors, or mentors observing the micro-lesson to evaluate the preservice teacher's instructional strategies. Observers focus on the targeted skill and provide objective, evidence-based assessments of teaching performance. Observation is typically guided by rubrics or checklists, and is sometimes accompanied by peer feedback protocols (Amobi, 2005). The importance of observation lies in its function as a foundation for subsequent feedback, which is integral to professional growth. Through observing others and being observed, preservice teachers also benefit from vicarious learning, an essential component of social learning theory.

The feedback phase is a very important phase in the microteaching cycle. In this phase, constructive, specific, and timely feedback allow preservice teachers to become aware of their teaching strengths and areas needing improvements. Research shows that effective feedback fosters reflection, challenges assumptions, and builds confidence when delivered in a supportive manner (Tillema, 2000). Peer feedback is particularly valuable, as it fosters collaboration and shared learning among preservice teachers, creating a supportive environment for professional growth (Amobi, 2005). When feedback is coupled with video review, as advocated by Kpanja (2001), it becomes even more impactful, allowing the preservice teachers to visually and objectively analyze their own teaching behavior.

After receiving feedback, preservice teachers move into the replanning phase, during which they revise their lesson plans, integrate the suggestions provided, and prepare to reteach. This iterative process embodies the principle that teaching is a dynamic cycle of planning, action, reflection, and ongoing improvement (Darling-Hammond et al., 2017).

The subsequent reteaching phase offers preservice teachers the chance to implement changes, address previous mistakes, and enhance their instructional performance. Recent research indicates that the cycle of repeated practice and refinement in microteaching fosters deeper professional learning and significantly contributes to the development of teaching efficacy (Boakye & Nsiah, 2021; Nyamekye & Ofori, 2023).

The reflection phase of the microteaching cycle consolidates the microteaching experience. Preservice teachers engage in critical self-reflection, considering what worked well, what could be improved, and how their learning can transfer to real classroom contexts (Amobi, 2005). Reflection is widely regarded as a critical component of professional development, promoting deeper insights into teaching practices and strengthening teachers' ability to engage in self-directed learning (Korthagen, 2017).

Finally, the re-feedback phase of the microteaching cycle provides preservice teachers with an additional round of feedback focused on the improvements they made and any remaining areas for development. This phase allows observers, peers, and mentors to acknowledge progress, reinforce effective practices, and offer further guidance for refinement. It serves as a crucial opportunity for consolidating learning and ensuring that new teaching strategies have been successfully integrated (Fernandez, 2005).

According to Fernandez (2005) and Korthagen (2017), repeated feedback not only enhances teaching skills but also boosts preservice teachers' confidence and self-efficacy, helping them internalize reflective habits that are essential for continuous professional growth. Empirical research has consistently validated the effectiveness of the microteaching cycle. Studies across diverse contexts have reported significant gains in preservice teachers' confidence, pedagogical skills, and classroom management abilities following participation in microteaching (Boakye & Nsiah, 2021).

Figure 2: The Microteaching Cycle

2.2.7 Microteaching Models

Microteaching is categorized into several distinct types with each type serving different purposes in teacher training. One prominent type is the video-based microteaching, which involves recording preservice teachers as they deliver lessons. This method allows preservice teachers to analyze recordings of their teaching practice critically and receive constructive feedback from peers and instructors. By watching their recorded sessions, preservice teachers can identify areas for improvement and refine their teaching strategies, making this an effective tool for professional development (Khalaf & Abdulwahed, 2021).

Another important type is collaborative peer microteaching, where groups of preservice teachers work together to plan, teach, and evaluate each other's lessons. This model encourages a supportive learning environment and promotes peer feedback, which is essential for fostering collaboration and enhancing teaching practices. Through this cooperative approach, preservice teachers develop not only their instructional skills but also their ability to provide and receive constructive criticism, which is crucial for their growth as educators (Kumar & Tiwari, 2023).

Additionally, simulated microteaching uses simulation technologies to create realistic teaching scenarios. This allows preservice teachers to practice their skills in a controlled environment without the pressures of real-time classroom settings. By engaging in simulated experiences, they can experiment with various teaching strategies, manage classroom dynamics, and develop confidence in their abilities. This type of microteaching is particularly beneficial for preparing teachers to handle the complexities of actual teaching situations (McClung & McClung, 2019).

Microteaching is very essential in preservice teacher education because it provides preservice teachers with opportunities to develop key pedagogical skills in a controlled environment. By focusing on specific teaching techniques such as lesson preparation and presentation strategies, questioning strategies and classroom management, preservice teachers can enhance their confidence and effectiveness in delivering lessons. This targeted approach allows them to refine their teaching abilities, which is crucial for building a successful teaching career (Khalaf & Abdulwahed, 2021).

Another significant and important feature of microteaching is the immediate feedback process. After presenting their lessons, preservice teachers receive constructive critiques from both peers and instructors. This feedback enables them to reflect on their performances and make necessary adjustments, fostering a culture of continuous improvement. The feedback preservice teachers receive not only enhances their teaching effectiveness but also promotes a growth mindset among them. It encourages preservice teachers to embrace learning and adaptation (Huang et al., 2023).

Microteaching also emphasizes the importance of reflection and self-evaluation in professional growth. Through the analysis of their teaching sessions and the considerations of feedback received, preservice teachers can identify both their strengths and areas that requires improvement. This reflective practice is vital for their ongoing development as educators, as it leads to more effective teaching strategies and better classroom management in the future (Davis et al., 2019).

Further, microteaching fosters collaboration among preservice teachers. Collaborative peer teaching allows candidates to work together in planning, teaching, and evaluating lessons, enhancing their teamwork and communication skills. This cooperative approach is essential for building a supportive learning environment, which positively impacts classroom dynamics. Additionally, microteaching encourages preservice teachers to experiment with various instructional strategies and adapt their methods to accommodate diverse learners, which is increasingly important in today's inclusive educational landscape (Cheng & Tsai, 2022).

2.2.7.1 Collaborative Peer Microteaching Model

The collaborative peer microteaching model is an instructional approach that engages preservice teachers in small groups where they collaboratively plan, deliver, observe, and critique micro-lessons. Unlike traditional microteaching, where feedback often comes solely from a supervising instructor, the collaborative peer model emphasizes mutual engagement and shared responsibility for learning and professional growth (Kumar & Tiwari, 2023).

Preservice teachers take turns assuming the role of teacher, student, and observer, which provides diverse perspectives on the teaching process. Through this cycle of planning, teaching, and constructive peer feedback, participants refine not only their pedagogical skills but also their communication, analytical thinking, and reflective practice (Amobi, 2005).

Central to the collaborative peer microteaching model is the belief that learning to teach is inherently social and benefits from interactive, dialogic processes. The model leverages peer feedback as a powerful learning tool, enabling preservice teachers to receive immediate, context-specific insights about their teaching performance (Nicol & MacFarlane-Dick, 2006). This feedback, when delivered constructively, helps preservice teachers identify strengths and areas for improvement, fostering a growth mindset and increasing teaching efficacy (Hattie & Timperley, 2007).

Additionally, working in collaborative groups nurtures a sense of professional community and reduces the anxiety often associated with practicing teaching in front of peers and supervisors (He & Yan, 2011). The origins of collaborative peer microteaching trace back to the broader concept of microteaching, developed in the 1960s at Stanford University by Dwight Allen and his colleagues as a response to the challenges of preparing teachers for real classroom complexities (Fernandez, 2010).

Initially focused on individual performance and supervisor feedback, microteaching aimed to simplify teaching practice by allowing preservice teachers to rehearse specific teaching skills in short lessons with small groups of peers (Fernandez, 2010). However, as educational research highlighted the importance of social interaction and cooperative learning, microteaching practices began evolving to incorporate more collaborative dimensions. This shift was grounded in theoretical frameworks such as Vygotsky's social constructivism, which posits that cognitive development is mediated through social interaction and shared activity (Vygotsky, 1978).

Over time, the collaborative peer microteaching model has gained prominence in teacher education programs worldwide, recognized for its potential to develop both pedagogical skills and professional dispositions. Studies have shown that collaborative microteaching enhances preservice teachers' confidence, teaching self-efficacy, and willingness to experiment with diverse instructional strategies (Amobi, 2005; Remesh, 2013).

In contexts such as science education, where teaching often involves complex demonstrations and hands-on activities, collaborative microteaching provides a safe and supportive environment for practicing instructional techniques and receiving feedback from peers who share similar learning goals (Santagata et al., 2007). As such, this model is increasingly viewed as an essential component of effective teacher preparation, promoting reflective practice and collaborative professionalism (Zeichner, 2012).

In the Ghanaian context, where challenges such as limited teaching resources, large class sizes, and gender disparities in science education persist, collaborative peer microteaching offers a promising approach for developing preservice teachers' skills and confidence. By engaging in peer teaching and feedback, female preservice teachers, in particular, can overcome apprehension about teaching science, build resilience, and cultivate a sense of competence critical for effective classroom practice (Boateng & Ampiah, 2016; Owusu et al., 2022). Moreover, integrating collaborative peer microteaching into teacher education aligns well with broader educational goals of fostering teamwork, professional dialogue, and continuous improvement, making it a relevant and impactful model for preparing future science educators in Ghana and beyond.

2.2.7.1.1 The Role of Collaborative Peer Microteaching Model in Developing Female Preservice Teachers' Science Teaching Efficacy

Collaborative peer microteaching plays a vital role in enhancing the science teaching efficacy of female preservice teachers by drawing on Bandura's self-efficacy framework, which comprises mastery experiences, vicarious experiences, verbal persuasion, and emotional states. Collaborative peer microteaching model provides numerous opportunities for mastery experiences, as female preservice teachers plan, teach, and refine their lessons. Studies suggest that female preservice teachers often enter teacher education programs with lower self-efficacy in science, influenced by societal stereotypes associating science with male dominance (Sharma & Hossain, 2022). By practicing and refining their skills in a supportive environment, female teachers enhance their self-efficacy through repeated mastery experiences.

In addition, vicarious experiences in collaborative peer microteaching, where female preservice teachers observe their peers teaching, are instrumental in developing science teaching efficacy. As female preservice teachers witness the success of their peers, they develop the belief that they too can teach science effectively. This peer modelling effect is especially impactful for those lacking confidence in teaching science. In a study on the impact of collaborative peer microteaching on teacher efficacy, Asare and Adjei (2022) found that female preservice teachers who engaged in collaborative peer microteaching showed significant gains in perceived science teaching abilities after learning from their peers' successes and challenges.

Feedback and reflection are other crucial components of collaborative peer microteaching. Female preservice teachers benefit from peer feedback, which reinforces their efforts and identifies areas for improvement in a supportive setting. Constructive criticism not only refines their teaching strategies but also boosts confidence. This iterative process of teaching, receiving feedback, and reflecting fosters continuous improvement in teaching efficacy. Additionally, reflective practice allows female preservice teachers to critically evaluate their strengths and weaknesses, addressing gender-related barriers to science teaching efficacy (Davis et al., 2019). This reflection helps them approach complex science concepts, manage classrooms more effectively, and refine instructional strategies.

Female preservice teachers often experience higher levels of anxiety in teaching science, which is a field that has historically been male-dominated. Collaborative peer microteaching helps alleviate this anxiety by providing a non-threatening and cooperative environment where participants feel comfortable practicing their teaching skills without the fear of failure or judgment.

In a study on the role of collaborative learning in enhancing teacher efficacy among preservice teachers, Alhassan and Agyemang (2023) found that female preservice teachers who participated in collaborative peer microteaching reported significantly lower levels of anxiety when teaching science topics, attributing this to the collaborative and supportive nature of the model. By working in small groups and sharing teaching experiences, female preservice teachers develop a sense of belonging and mutual support, which helps boost their confidence in their science teaching abilities.

Furthermore, the repetitive practice embedded in collaborative peer microteaching reinforces positive teaching behaviours and gradually reduces anxiety associated with teaching science. This is particularly important because female preservice teachers may face challenges relating to gender stereotypes or societal expectations that contribute to lower self-confidence in science teaching (Cheng & Tsai, 2022).

Through repeated practice in a safe environment, collaborative peer microteaching allows female preservice teachers to overcome these challenges, gradually building their science teaching efficacy over time.

Collaborative peer microteaching plays a critical role in improving the content knowledge and pedagogical skills of female preservice teachers in science education. The collaborative peer microteaching model encourages peer learning and this allows female preservice teachers to exchange ideas, share resources, and collaborate on lesson planning, which enhances their understanding of science content.

Pang et al. (2021) in a study that explored collaborative peer microteaching as a transformative pedagogy in teacher education found that female preservice teachers who participated in collaborative peer microteaching demonstrated significant gains in their content knowledge, particularly in areas where they initially lacked confidence. The collaborative environment fosters an open exchange of ideas, allowing female preservice teachers to clarify science concepts and develop more effective ways of teaching them.

In addition to content knowledge, collaborative peer microteaching helps female preservice teachers enhance their pedagogical skills, particularly in managing classrooms, engaging students, and using inquiry-based learning methods. Female preservice teachers often find inquiry-based teaching strategies, which are essential for effective science education, challenging to implement. However, through collaborative peer microteaching, they have the opportunity to practice these strategies repeatedly and receive feedback on their effectiveness. This practice allows them to refine their teaching approaches and improve student engagement in science lessons (Sharma & Hossain, 2022)

2.2.7.2 Video-based Microteaching Model

The video-based microteaching model is an instructional approach that integrates video technology into the traditional microteaching process, enabling preservice teachers to record, review, and analyze their teaching performances. In the video-based microteaching model, preservice teachers deliver short lessons that are captured on a video. Preservice teachers can watch the recordings of their microteaching practices, reflect on their performance, critically assess their own teaching performances, receive constructive feedback and make the necessary adjustments. Preservice teachers can repeatedly observe their teaching practices, identify areas of improvement, and refine their instructional skills (Khalaf & Abdulwahed, 2021).

The origins of video-based microteaching could be traced to the 1960s when traditional microteaching was first developed by Dwight Allen and his colleagues at Stanford University. Initially, microteaching involved live teaching sessions in front of a small group, followed by immediate feedback from peers and instructors (Allen, 1966). With the rapid advancement of video technology, the model was adapted to include video recordings in the 1970s, making it possible for teachers to watch and critically evaluate their own lessons. Over time, video-based microteaching became an essential component of teacher education programs, offering a more systematic and reflective approach to developing teaching skills.

Technological advancements such as digital video tools and online platforms in this 21st century have further enhanced the video-based microteaching model, making it more accessible and effective. Video recordings can now be easily shared with peers and mentors, allowing for detailed feedback and collaborative learning. As a result, video-based microteaching model has gained widespread adoption in teacher education, with numerous studies highlighting its benefits for improving teaching efficacy, particularly in science education (Pang et al., 2021).

Video-based microteaching model has proven especially relevant for female preservice teachers, who often face challenges in developing science teaching confidence due to societal and cultural stereotypes (Sharma & Hossain, 2022). Video-based microteaching allows female preservice teachers to repeatedly practice and reflect on their teaching performance, which contributes to higher teaching efficacy.

In the 21st century, technological advancements such as digital video tools and online platforms have further enhanced the video-based microteaching model, making it more accessible and effective. Video recordings can now be readily shared with peers and mentors via social media, allowing for detailed feedback and collaborative learning. The technological component of the video-based microteaching model has caused the model to gain widespread traction in preservice teacher education, with numerous studies highlighting its benefits for improving teaching efficacy, particularly in science education (Pang et al., 2021).

Video-based microteaching model has in recent times become especially relevant for female preservice teachers, who often face challenges in developing science teaching confidence due to societal and cultural stereotypes (Sharma & Hossain, 2022).

2.2.7.2.1 The Relevance of Video-Based Microteaching in Female Preservice Teacher Education in Ghana

Video-based microteaching has become highly relevant in the education of female preservice teachers in Ghana, especially in addressing the challenges of teaching science. By combining traditional microteaching with video technology, video-based microteaching enables preservice teachers to record, review, and reflect on their teaching performance. The model has been instrumental in boosting self-efficacy, refining teaching techniques, and promoting a more confident and reflective teaching mindset among female preservice teachers, particularly in science fields where gender disparities and stereotypes remain prevalent

Self-efficacy, as defined by Bandura (1997), refers to an individual's belief in their capability to execute behaviors necessary to produce specific performance attainments. The video-based microteaching model supports this concept by providing female preservice teachers with opportunities to engage in mastery experiences, one of the key sources of self-efficacy. In the context of Ghana, where female students often experience lower self-efficacy in science due to societal stereotypes, video-based microteaching can help mitigate these effects.

Research has shown that female preservice teachers who engage in video-based microteaching sessions demonstrate significant improvements in their self-efficacy regarding science teaching. For instance, in a study on enhancing teaching efficacy through video-based microteaching: perspectives of female preservice teachers in Ghana, Asare and Adjei (2022) found that Ghanaian female preservice teachers who participated in a video-based microteaching session developed more confidence in their ability to teach science concepts effectively. By repeatedly watching their recorded lessons, these female preservice teachers could critically evaluate their science teaching techniques, identify their strengths, and address their weaknesses, leading to increased self-confidence.

The collaborative nature of video-based microteaching allows for constructive feedback from peers and instructors, which is crucial for the development of teaching efficacy. During the feedback sessions, female preservice teachers can receive insights on their teaching strategies and classroom management techniques, which are essential for effective science teaching. For instance, in study on video-based microteaching: enhancing teaching skills in higher education, Khalaf and Abdulwahed (2021) emphasized that peer feedback in the video-based process helps preservice teachers refine their instructional methods and improve their teaching efficacy. This feedback mechanism is particularly beneficial for female preservice teachers in Ghana, where cultural norms may discourage them from seeking support and guidance.

Further, the peer learning aspect of video-based microteaching fosters a supportive environment that encourages female preservice teachers to share their experiences and teaching strategies. Kumar and Tiwari (2023) in a study on collaborative peer microteaching and its impact on teacher efficacy, highlighted that female preservice teachers who participate in collaborative video-based microteaching sessions not only improved their science teaching efficacy but also developed a sense of community and support among their peers. The collaborative learning experience, as embedded in the video-based microteaching model, is vital for female preservice teachers who may feel isolated in their pursuit of a career in science education, allowing them to gain confidence and expertise.

In Ghana, gender-related barriers often limit female preservice teachers' opportunities in science education, leading to feelings of inadequacy and self-doubt. Video-based microteaching model directly addresses these challenges by providing a platform for practice in a controlled environment. In a study on microteaching as a tool for enhancing teacher efficacy in higher education, Davis et al. (2019) noted that the controlled settings within which video-based microteaching is conducted allows female preservice teachers to experiment with their teaching methods without the pressures of real-time classroom settings. This practice enables them to build confidence in their abilities, making them more effective science educators.

Moreover, the iterative nature of video-based microteaching, where female preservice teachers have the opportunity to record, review, and re-record their teaching sessions, helps in solidifying their understanding of science concepts and teaching methods. In a study on microteaching as a tool for enhancing teacher efficacy in higher education, Sharma and Hossain (2022) found that the ability to self-evaluate through video recordings was particularly empowering for female preservice teachers, as it allowed them to address their unique challenges and work towards overcoming them. By providing multiple opportunities for reflection and improvement, video-based microteaching plays a crucial role in enhancing the science teaching efficacy of Ghanaian female preservice teachers.

Video-based microteaching model is highly relevant for developing the science teaching efficacy of Ghanaian female preservice teachers. By fostering reflective practices, providing constructive feedback, and creating a supportive learning environment, video-based microteaching addresses the specific challenges faced by female preservice teachers in science education, ultimately empowering these teachers to become more confident and effective science educators. As teacher education programs in Ghana continue to evolve, incorporating video-based microteaching model in teacher education programs can serve as a strategic approach to fostering female participation and success in science teaching.

2.2.8 Addressing Gender-Specific Challenges through Microteaching

Microteaching plays a crucial role in addressing the gender-specific challenges faced by Ghanaian female preservice teachers, particularly in the development of their science teaching efficacy. These gender-specific challenges often stem from deep-rooted societal norms, educational inequalities, and gender-based biases, which impact women's confidence and competence in teaching science.

In Ghana and many other societies, science is often perceived as a male-dominated field. Women are sometimes discouraged from pursuing science careers due to stereotypes that depict science as incompatible with traditional female roles (Asimeng-Boahene, 2021). This perception affects the self-efficacy of female preservice teachers, making them less confident in their abilities to teach science (Bandura, 2012).

Microteaching offers a controlled environment where female preservice teachers can engage in science teaching without fear of judgment or failure. Both the collaborative peer and video-based microteaching models provide female teachers with opportunities to teach science lessons, receive feedback, and make improvements in a supportive setting. As they practice and improve their skills, they build mastery experiences, which Bandura (1997) identifies as the most powerful source of self-efficacy. Mastery experiences help female preservice teachers to build confidence, gradually breaking down internalized gender stereotypes that limit their perception of their abilities.

Empirical studies show that microteaching can significantly enhance the science teaching efficacy of female teachers by providing repeated opportunities for successful teaching experiences. For instance, Zulu et al. (2020) in a study on enhancing science teaching efficacy through peer collaboration: insights from a microteaching intervention found that peer-supported microteaching interventions improved female preservice teachers' confidence and willingness to engage with science content, which they previously saw as too difficult or "male-oriented."

According to Asimeng-Boahene (2021), cultural norms in Ghana often deter women from actively engaging in science education, as science is frequently perceived as a challenging field for women. Female preservice teachers, therefore, face significant challenges in gaining the confidence and skills needed to teach science effectively, as societal expectations may make them feel unwelcome in the field.

Microteaching provides a supportive space where these cultural norms can be challenged. In the collaborative peer microteaching model, female preservice teachers are not only learners but also collaborators, working alongside their peers to refine their teaching. This peer-based support helps to alleviate feelings of isolation and discouragement that may stem from societal pressures. Vygotsky's (1978) social constructivist theory highlights the value of social interaction in learning. In collaborative microteaching, female preservice teachers build confidence through the exchange of ideas, observing the instructional strategies of peers, and engaging in joint problem-solving.

Dicke et al. (2019) in a study on reducing the gender gap in science teaching efficacy: the role of mastery experiences, emphasized the significance of supportive environments in teacher preparation programs. Their findings suggest that female preservice teachers who participate in collaborative learning settings, such as peer microteaching, are more likely to develop a stronger sense of efficacy than those without access to such support systems. The collaborative nature of microteaching, where female teachers engage in shared observation and reflection on both their own and others' teaching practices, helps them overcome the psychological barriers reinforced by cultural norms.

Further, video-based microteaching model provides a platform for female preservice teachers to engage in reflective learning by critically evaluating their own teaching practices and identifying areas for improvement. The process of reflection, as Schön (1983) describes, helps female preservice teachers gain insights into their teaching strategies, strengths, and areas requiring improvements. By reviewing their recorded teaching sessions, female teachers can recognize instances where stereotype threat may have affected their performance and consciously make adjustments. This self-assessment process in video-based microteaching empowers them to take charge of their learning, gradually boosting their confidence and mitigating the effects of stereotype threat (Dicke et al., 2019).

The collaborative aspect of microteaching effectively addresses the isolation that female preservice teachers often experience in the male-dominated field of science. Gender-specific challenges, such as feeling intimidated or overlooked, can be alleviated by creating a supportive community of collaboration among peers. Vygotsky's (1978) social constructivist theory emphasizes the importance of social interaction in learning, which is especially beneficial for female preservice teachers who may struggle with confidence in teaching science.

In collaborative peer microteaching, female teachers work closely with their peers, delivering lessons and receiving constructive feedback in a controlled and non-threatening environment. Through mutual observation and support, female preservice teachers gain vicarious experiences which are essential in building self-efficacy (Bandura, 1997). Peer collaboration fosters the exchange of ideas, collective problem-solving, and shared learning, all of which enhance female preservice teachers' confidence in their science teaching abilities. Zulu et al. (2020) in a study emphasized that peer support in microteaching significantly boosts teaching efficacy among female teachers, as it cultivates a more inclusive and supportive learning atmosphere.

Female preservice teachers frequently encounter emotional and psychological challenges, such as anxiety, self-doubt, and fear of failure in teaching science (Nurlu, 2015). These feelings are often reinforced by societal pressures that expect women to underperform in science-related subjects. The peer support systems inherent in both collaborative peer and video-based microteaching help alleviate these challenges by providing a supportive environment for trial, error, and growth.

The collaborative peer microteaching model enables female preservice teachers to receive immediate feedback and encouragement from their peers, helping to reduce feelings of isolation and fear. Similarly, the video-based model offers a reflective tool that allows them to privately assess their progress without the pressure of real-time evaluation. This reflective and gradual approach to learning is particularly advantageous for female preservice teachers, as it enables them to build their confidence and improve their science teaching skills at their own pace (Zulu et al., 2020).

Finally, collaborative peer microteaching fosters gender inclusivity by creating a space where male and female preservice teachers can collaborate in teaching science. Collaborative microteaching model encourages both genders to engage in dialogue, provide feedback, and reflect on their teaching practices together. Female preservice teachers benefit from participating alongside their male peers, helping to bridge the gender gap that is often present in science education (Zulu et al., 2020).

2.3 Empirical Review of Literature Related to the Study

2.3.1 Empirical Review of Literature on Collaborative Peer Microteaching Model and its Effect on Female Preservice Teachers' Science Teaching Efficacy

Several studies have been conducted in Ghana to investigate collaborative peer microteaching and its effect on Ghanaian preservice teachers' science teaching efficacy. For example, Osei et al. (2019) investigated the impact of collaborative peer microteaching on preservice teachers' pedagogical skills and self-efficacy in science. In the study, Osei et al. (2019) sought to examine the effect of collaborative microteaching on the pedagogical skills and science teaching efficacy of preservice teachers. The study was conducted at a Ghanaian college of education and employed a quasi-experimental design. The one hundred and twenty (120) participants involved in the study were split evenly into two groups namely the experimental and control groups.

Preservice teachers in the experimental group participated in collaborative peer microteaching activities that included lesson planning, teaching practice, and peer feedback whilst those in the control group received traditional instruction. The findings revealed that preservice teachers in the experimental group showed significant improvements in their pedagogical skills and science teaching efficacy as compared with those in the control group. The researchers highlighted that the collaborative nature of microteaching fostered a supportive learning environment, which allowed preservice teachers in the experimental group to enhance their confidence in teaching science.

The study also included qualitative data gathered from participant reflections, which indicated that preservice teachers felt more prepared and competent in their teaching abilities following the collaborative peer microteaching experience. Participants reported that engaging in peer feedback and observing their colleagues' teaching practices helped them to develop critical pedagogical skills such as lesson delivery, classroom management, and student engagement techniques.

Osei et al. (2019) in the study concluded that collaborative peer microteaching is an effective approach for developing pedagogical skills and self-efficacy among preservice teachers in science education, suggesting its potential integration into teacher education programs to enhance teaching effectiveness.

In a study on the impact of collaborative peer microteaching on preservice teachers' science teaching efficacy in Ghana, Amankwah and Amankwah (2019) investigated the impact of collaborative peer microteaching on the science teaching efficacy of preservice teachers in Ghana. The research was motivated by the need to enhance the pedagogical skills of preservice teachers, particularly in science education, where many lack confidence.

Amankwah and Amankwah (2019) in the study employed a quasi-experimental design involving 60 preservice teachers from a Ghanaian college of education, who were divided into experimental and control groups. The experimental group participated in collaborative peer microteaching sessions, where they taught lessons to their peers and received constructive feedback, while the control group engaged in traditional teaching methods.

The results of the study by Amankwah and Amankwah (2019) indicated a significant improvement in the science teaching efficacy of the preservice teachers who participated in collaborative peer microteaching compared to those in the control group. Preservice teachers in the experimental group reported increased confidence in their ability to teach science, as well as improved skills in lesson planning and classroom management. The feedback received from peers was identified as a crucial component of the learning process, enabling participants to reflect on their teaching practices and make necessary adjustments. The findings suggest that collaborative peer microteaching creates a supportive environment that fosters professional growth among preservice teachers.

Amankwah and Amankwah (2019) in their study concluded that collaborative peer microteaching is an effective instructional strategy for enhancing the science teaching efficacy of preservice teachers in Ghana. They recommended integrating this approach into teacher education programs to better prepare preservice teachers for the challenges of teaching science. The study highlighted the importance of fostering collaboration and peer support in teacher training, as these elements contribute significantly to building confidence and competence in science teaching.

Again, Osei and Owusu (2024) conducted a comparative study to assess the effectiveness of collaborative peer microteaching compared to traditional teaching methods in enhancing the science teaching efficacy of female preservice teachers in Ghana. The research aimed to address the persistent challenges in science education, particularly regarding the low self-efficacy levels among female preservice teachers.

The study employed a quasi-experimental design, involving a sample of 80 female preservice teachers from a teacher training institution in Ghana. Participants were divided into experimental and control groups. Preservice teachers in the experimental group engaged in collaborative peer microteaching whilst those in the control group received instruction through traditional lecture-based methods.

The study by Osei and Owusu (2024) also employed a mixed-methods approach, combining quantitative and qualitative data collection methods. For the quantitative aspect, the Science Teaching Efficacy Belief Instrument (STEBI) was administered to assess the participants' science teaching efficacy before and after the interventions. The qualitative component involved focus group discussions and interviews to gain insights into the participants' experiences and perceptions of the teaching methods. The duration of the study was six weeks, during which both groups underwent their respective instructional methods. Data analysis included statistical tests to compare the efficacy scores between the two groups and thematic analysis for qualitative responses.

Osei and Owusu (2024) found that preservice teachers in the experimental group that engaged in the collaborative peer microteaching significantly outperformed the traditional group in terms of self-efficacy scores post-intervention. Participants in the collaborative group reported greater confidence in their teaching abilities and a more positive attitude towards teaching science. Qualitative feedback highlighted the benefits of peer support, constructive feedback, and shared learning experiences, which contributed to their increased self-efficacy. Conversely, the traditional group expressed feelings of anxiety and uncertainty in their teaching capabilities, revealing the limitations of conventional instructional methods in fostering science teaching efficacy.

Osei and Owusu (2024) in their study concluded that compared to traditional instruction, collaborative peer microteaching is a more effective instructional approach for enhancing the science teaching efficacy of female preservice teachers in Ghana. The study emphasized the importance of creating a supportive learning environment that encourages collaboration and peer interaction to build confidence and teaching skills among preservice teachers. The researchers recommended incorporating collaborative microteaching into teacher education curricula to better prepare future educators for the challenges of teaching science effectively.

Further, Quansah and Osei (2020) conducted a study that investigated the effects of collaborative peer microteaching on the attitudes of female preservice teachers towards teaching science in Ghana. The study aimed to evaluate whether or not collaborative peer microteaching could foster a more positive attitude towards science teaching among female preservice teachers.

Using a mixed-methods research design, the study involved 60 female preservice teachers from a college of education in Ghana. Participants were divided into two groups: one group engaged in collaborative peer microteaching and the other group received conventional instruction.

Quansah and Osei (2020) in their study administered questionnaires to quantitatively measure changes in female preservice teachers' attitude before and after engaging the collaborative peer microteaching. Interviews were conducted for qualitative insights on preservice teachers' experiences with the collaborative peer microteaching. The quantitative data were analyzed using statistical techniques to assess the effectiveness of the collaborative approach, while thematic analysis was applied to the qualitative data to uncover deeper insights into the participants' experiences.

Quansah and Osei (2020) found a significant positive shift in the attitudes of female preservice teachers who participated in collaborative peer microteaching as compared to those in the traditional group. Participants in the collaborative group reported increased confidence, motivation, and enthusiasm towards teaching science. The peer feedback mechanism was highlighted as a critical factor in fostering a supportive learning environment, enabling preservice teachers to overcome anxiety and build their self-efficacy. Qualitative responses further emphasized the importance of collaboration in enhancing female preservice teachers' perception of teaching as a rewarding profession.

Quansah and Osei (2020) concluded that collaborative peer microteaching effectively promotes positive attitudes towards teaching science among female preservice teachers in Ghana. They advocate for the incorporation of collaborative microteaching practices into teacher education programs to empower female preservice teachers, enhance their confidence, and ultimately improve their effectiveness in teaching science. The study emphasizes the need for educational stakeholders to support innovative teaching methodologies that address the unique challenges faced by female preservice teachers in the Ghanaian context.

Additionally, Adjei and Mensah (2020) conducted a study to explore how collaborative peer microteaching can enhance the science teaching efficacy of Ghanaian female preservice teachers. The study addressed the challenges of low self-confidence and teaching anxiety that many female preservice teachers face when it comes to teaching science. The researchers aimed to determine whether participating in collaborative peer microteaching sessions could improve these teachers' efficacy in delivering science lessons, classroom management, and handling science content. A case study approach was used, focusing on 40 female preservice teachers from a teacher training college in Ghana, who participated in a series of collaborative peer microteaching sessions over a six-week period.

Adjei and Mensah (2020) found that the collaborative peer microteaching significantly enhanced the participants' teaching efficacy, especially in lesson planning and classroom management. Through peer interactions and feedback, the preservice teachers were able to refine their lesson plans and gain confidence in teaching complex science topics. The collaborative setting allowed participants to learn from each other, exchange ideas, and identify areas where they could improve. The immediate and constructive feedback they received from their peers enabled them to correct mistakes and adopt more effective teaching strategies. The researchers also noted that the female preservice teachers felt more comfortable and less anxious teaching in a peer-supported environment compared to their previous experiences.

One of the key findings of Adjei and Mensah (2020) in their study was the reduction in teaching anxiety among the participants. The female preservice teachers reported feeling more relaxed and confident during the peer microteaching sessions. The supportive nature of the feedback from their peers helped them overcome their fears of making mistakes in front of a classroom. The study also highlighted the importance of peer collaboration in fostering a sense of belonging and community among the preservice teachers. This sense of belonging motivated the participants to actively engage in the learning process and provided a safe space for them to experiment with new teaching techniques without fear of judgment.

Adjei and Mensah (2020) concluded that collaborative peer microteaching is a highly effective method for improving the science teaching efficacy of female preservice teachers in Ghana. The researchers recommended that teacher education programs integrate more collaborative peer microteaching sessions into their curricula to provide preservice teachers with opportunities to practice their teaching skills in a supportive, low-pressure environment. They also suggested further research into how this model could be combined with other teaching methods to enhance preservice teachers' overall professional development.

Again, Asare and Antwi (2018) conducted a study to investigate the impact of peer microteaching on the science teaching efficacy of Ghanaian female preservice teachers. The study aimed to address the problem of low teaching efficacy among female preservice teachers in science education, which is a critical issue in teacher training in Ghana. The researchers employed a quasi-experimental design, with 50 female preservice teachers randomly assigned to either a peer microteaching group or a control group. The participants in the peer microteaching group engaged in a series of collaborative microteaching sessions, where they taught science lessons and received feedback from their peers.

The findings of Asare and Antwi (2018) indicated a significant improvement in the science teaching efficacy of the female preservice teachers who participated in the peer microteaching sessions compared to the control group. The participants in the peer microteaching group showed marked improvements in key areas such as lesson planning, instructional delivery, and classroom management. Peer feedback was found to be an essential element in this process, as it allowed the participants to reflect on their teaching practices and make real-time adjustments to improve their performance. The study also revealed that collaborative peer microteaching helped reduce the participants' anxiety about teaching science, which further contributed to the increase in their teaching efficacy.

Asare and Antwi (2018) in their study observed that peer microteaching fostered a collaborative learning environment, where preservice teachers could learn from one another's strengths and weaknesses. The participants gained confidence not only from practicing their teaching skills but also from observing their peers and discussing teaching strategies collectively. This interactive approach to teacher training created a supportive atmosphere in which female preservice teachers felt comfortable experimenting with new teaching methods and receiving constructive criticism. The study highlighted that peer collaboration was crucial in enhancing the preservice teachers' self-efficacy in teaching science subjects, an area where they previously had low confidence.

Asare and Antwi (2018) concluded that peer microteaching is an effective pedagogical tool for developing the science teaching efficacy of female preservice teachers in Ghana. The study recommended incorporating peer microteaching as a regular component of teacher education programs, especially for female preservice teachers who tend to have lower self-efficacy in teaching science. By providing a platform for collaborative learning and reflective practice, peer microteaching helps preservice teachers build the confidence and skills necessary to teach science effectively. The researchers emphasized the importance of structured peer feedback and suggested that future studies could explore the long-term impact of peer microteaching on teaching efficacy after graduation.

Owusu and Addo (2016) also conducted a study to investigate the impact of collaborative peer microteaching on the science teaching efficacy of preservice teachers in Ghana. The study aimed to understand how this method could enhance the teaching confidence and classroom effectiveness of preservice teachers, particularly in handling science subjects. A total of 60 preservice teachers participated in the study, which was carried out over eight weeks. The researchers used a quasi-experimental design, dividing participants into a collaborative peer microteaching group and a control group that did not participate in microteaching. Both groups were assessed on their science teaching efficacy before and after the intervention.

Owusu and Addo (2016) in their study found that preservice teachers who engaged in collaborative peer microteaching showed significant improvements in their science teaching efficacy compared to the control group. Specifically, the participants in the collaborative peer group demonstrated increased confidence in delivering science lessons, managing classrooms, and effectively engaging students in scientific discussions. The peer feedback received during microteaching sessions played a critical role in helping participants refine their teaching techniques and address areas of weakness. Through observing and critiquing each other's lessons, the preservice teachers were able to implement new teaching strategies and improve their instructional delivery.

Owusu and Addo (2016) also reported that collaborative peer microteaching helped reduce the anxiety preservice teachers typically experience when teaching science. The supportive nature of the peer group allowed participants to practice teaching in a low-pressure environment, where they could make mistakes and learn from them without the fear of being judged. This contributed to a positive feedback loop, where preservice teachers gained mastery over science content and pedagogical skills, further boosting their confidence. The interactive discussions and collective reflections fostered a sense of community among the participants, encouraging continuous learning and mutual support.

Owusu and Addo (2016) concluded that collaborative peer microteaching is an effective tool for improving the science teaching efficacy of preservice teachers. They recommended its integration into teacher education programs, particularly for preservice teachers who struggle with confidence in teaching science subjects. The study emphasized that peer microteaching not only enhances pedagogical skills but also helps preservice teachers develop a deeper understanding of science content, making them more effective in the classroom. The researchers suggested further studies to explore how this model could be combined with other teaching approaches, such as video-based microteaching, to maximize its impact on preservice teacher development.

Finally, Abu and Nkrumah (2021) investigated the role of collaborative peer microteaching in enhancing the pedagogical skills of female preservice science teachers in Ghana. The study was motivated by the challenges faced by female preservice teachers in developing effective teaching practices and their overall confidence in teaching science subjects. Using a mixed-methods approach, the researchers selected a sample of 60 female preservice teachers from a teacher training college. The participants were divided into two groups: one that engaged in collaborative peer microteaching and a control group that followed traditional teaching methods. The researchers aimed to assess the impact of collaborative peer microteaching on the participants' pedagogical skills and self-efficacy.

Abu and Nkrumah (2021) found that female preservice teachers who participated in collaborative peer microteaching significantly improved their pedagogical skills compared to those in the control group. The interactive nature of collaborative microteaching allowed participants to engage in practical teaching experiences, receive constructive feedback from peers, and reflect on their teaching practices. These elements fostered a supportive learning environment where female preservice teachers could experiment with different instructional strategies, enhancing their overall teaching abilities. Participants reported feeling more confident and prepared to handle classroom challenges after the microteaching sessions.

Qualitative data collected through interviews and focus group discussions provided deeper insights into the participants' experiences with the collaborative peer microteaching. Many female preservice teachers expressed that the collaborative approach helped them develop critical thinking and problem-solving skills. They highlighted the importance of peer support in alleviating anxiety associated with teaching and emphasized that the feedback received during the microteaching sessions was instrumental in refining their pedagogical techniques. The study also pointed out that collaborative peer microteaching facilitated a sense of community among the participants, which contributed to a positive learning experience.

In conclusion, Abu and Nkrumah (2021) emphasized the effectiveness of collaborative peer microteaching as a pedagogical strategy for enhancing the skills of female preservice science teachers in Ghana. The study advocates for the integration of collaborative learning approaches in teacher education programs to better prepare preservice teachers for the challenges of the teaching profession. By fostering collaboration and providing opportunities for feedback, teacher training institutions can significantly contribute to improving the quality of science education in Ghana, particularly for female preservice teachers

Collaborative peer microteaching is a valuable approach for enhancing the science teaching efficacy of Ghanaian female preservice teachers. The empirical evidence from the studies reviewed above underscores the importance of fostering a collaborative learning environment that encourages peer interaction and feedback, since these are critical in building the science teaching efficacy of female preservice teachers in Ghana.

2.3.2 Empirical Review of Literature on Video-based Microteaching Model and its Effect on Female Preservice Teachers' Science Teaching Efficacy

Video-based microteaching is an innovative instructional strategy that utilizes recorded teaching sessions to enhance preservice teachers' skills and self-efficacy in teaching science. By allowing preservice teachers to observe and reflect on their teaching practices, video-based microteaching have been found to lead to improved pedagogical skills and greater confidence in teaching science subjects. Several studies have been conducted in Ghana to investigate the video-based microteaching model and its effect on Ghanaian preservice teachers' science teaching efficacy

For example, Adjei and Opoku (2021) explored the perceptions of female preservice teachers regarding video-based microteaching as a method for developing their science teaching efficacy. The study aimed to understand how female preservice teachers perceived the effectiveness of video-based microteaching in enhancing their confidence and competence in teaching science subjects. The study was conducted in Ghana and employed a qualitative research design, utilizing focus group discussions and interviews with 30 female preservice teachers enrolled in a teacher training institution.

Adjei and Opoku (2021) found that female preservice teachers who participated in the study generally held positive perceptions of video-based microteaching. Many of the female preservice teachers appreciated the opportunity to observe their own teaching practices through recorded sessions. They reported that this self-observation enabled them to identify areas for improvement and develop a better understanding of their instructional strategies. Participants noted that viewing their videos allowed them to reflect on their classroom management techniques, lesson delivery, and student engagement, leading to increased self-awareness and growth in their teaching efficacy.

The study highlighted the role of peer feedback in the video-based microteaching process. Female preservice teachers emphasized the importance of receiving constructive criticism from their peers after viewing the videos. This collaborative aspect not only fostered a supportive learning environment but also encouraged participants to adopt diverse teaching strategies and improve their pedagogical skills. The ability to engage in discussions about their teaching practices further contributed to their overall confidence in teaching science.

In conclusion, Adjei and Opoku (2021) found that video-based microteaching serves as an effective tool for enhancing the science teaching efficacy of female preservice teachers. The study emphasized the significance of self-reflection and peer feedback in the development of teaching skills and confidence. The researchers recommend that teacher education programs incorporate video-based microteaching strategies to better prepare preservice teachers for the challenges of teaching in the classroom, ultimately contributing to improved science education outcomes in Ghana.

Again, Asante and Ampadu (2022) conducted a study to evaluate the effectiveness of video-based microteaching in enhancing the pedagogical skills of female preservice teachers in Ghana. The motivation behind the study stemmed from the need to address the challenges faced by female preservice teachers in developing their teaching skills, particularly in the context of science education. The researchers employed a mixed-methods approach, involving 40 female preservice teachers from a college of education. Participants engaged in video-based microteaching sessions, where they recorded their teaching practices and subsequently analyzed the footage for self-reflection and improvement.

Asante and Ampadu (2022) in their study reported significant improvements in the pedagogical skills of participants who engaged in video-based microteaching compared to those who did not. The quantitative data indicated enhanced self-efficacy scores among participants, suggesting increased confidence in their teaching abilities. Additionally, the qualitative data gathered from interviews and focus group discussions highlighted the value of self-reflection in identifying strengths and areas for improvement. Participants noted that watching their teaching videos helped them develop a better understanding of effective instructional strategies and classroom management techniques.

Asante and Ampadu (2022) highlighted the positive impact of peer feedback on the participants' growth as educators. By sharing their videos with peers and receiving constructive criticism, the preservice teachers were able to refine their teaching methods and adopt more innovative practices. This collaborative learning environment fostered a sense of community among the participants, contributing to their overall development as future science educators. The researchers emphasized that video-based microteaching not only improved pedagogical skills but also promoted a culture of continuous learning among the preservice teachers.

Asante and Ampadu (2022) concluded the study by emphasizing the effectiveness of video-based microteaching as a valuable pedagogical strategy for enhancing the skills of female preservice teachers in Ghana. The study advocates for the integration of video-based microteaching into teacher education programs to better prepare preservice teachers for the complexities of the teaching profession. By facilitating self-reflection, peer feedback, and collaborative learning, video-based microteaching has the potential to significantly improve the quality of science education and boost the confidence of female preservice teachers in their teaching abilities.

Further, Baffoe and Baffoe (2020) conducted a study to investigate the impact of video-based microteaching on the science teaching efficacy of preservice teachers in Ghana. The study aimed to determine whether using video recordings of teaching sessions for self-reflection and feedback could enhance preservice teachers' confidence in their ability to teach science effectively. A sample of 50 female preservice teachers from a Ghanaian teacher training college participated in the study. These teachers were divided into two groups: an experimental group that used video-based microteaching and a control group that followed traditional teaching methods. The researchers assessed the science teaching efficacy of the participants before and after the intervention.

The findings of Baffoe and Baffoe (2020) revealed that preservice teachers in the video-based microteaching group demonstrated significant improvements in their science teaching efficacy compared to the control group. Participants in the experimental group reported higher confidence in lesson delivery, content knowledge, and classroom management after watching their teaching sessions and receiving feedback from peers and instructors. The ability to observe their own teaching performance allowed them to identify areas for improvement, which was critical in building their self-efficacy.

Baffoe and Baffoe (2020) highlighted the benefits of video-based microteaching, particularly in fostering reflective teaching practices. Many participants expressed that watching their recorded lessons provided them with a new perspective on their teaching methods, helping them recognize both their strengths and weaknesses. The researchers emphasized that this approach not only improved teaching efficacy but also promoted a deeper understanding of effective science teaching strategies. Participants also found peer and instructor feedback crucial in helping them refine their teaching practices.

In conclusion, Baffoe and Baffoe (2020) demonstrated that video-based microteaching is an effective tool for enhancing the science teaching efficacy of preservice teachers in Ghana. The study advocated for the incorporation of video-based microteaching in teacher education programs to improve teaching practices and build preservice teachers' confidence. The researchers noted the potential of video-based microteaching to encourage lifelong reflective practice, contributing to continuous professional development in the teaching profession.

Also, Quansah et al. (2024) conducted a comparative study to evaluate the effects of video-based microteaching versus traditional teaching methods on the self-efficacy of female preservice science teachers in Ghana. The study aimed to address the gap in research on the most effective instructional strategies for enhancing preservice teachers' confidence and competence in teaching science, particularly in the Ghanaian context. The researchers employed a quasi-experimental design, involving 70 female preservice teachers divided into two groups: one group experienced video-based microteaching, while the other followed traditional teaching methods. The study sought to compare the changes in self-efficacy between the two groups after the intervention (video-based microteaching).

Quansah et al. (2024) found that participants in the video-based microteaching group demonstrated significantly higher self-efficacy scores than those in the traditional methods group. The finding was attributed to the opportunity for self-reflection provided by the video-based approach, which allowed participants to review their teaching sessions and identify areas for improvement. The video analysis, combined with peer and instructor feedback, enabled participants to become more aware of their teaching practices and take actionable steps to enhance their skills. This process led to increased confidence in their ability to teach science effectively.

In contrast with the higher, statistically significant improvements in the video-based microteaching group's efficacy scores, Quansah et al. (2024) reported that participants in the traditional methods group experienced smaller improvements in their self-efficacy levels. These improvements were not statistically significant. The researchers observed that traditional microteaching strategies often lacked the personalized reflection and targeted feedback provided by video-based microteaching. Although both groups experienced benefits from their respective interventions, the study emphasized that video-based microteaching had a stronger influence on deepening participants' understanding of pedagogical practices and improving their ability to evaluate and refine their teaching performance.

In conclusion, Quansah et al. (2024) emphasized the effectiveness of video-based microteaching as a tool for developing science teaching efficacy among female preservice teachers in Ghana. The researchers recommended that teacher education programs incorporate video-based microteaching into their curricula to better support the development of self-efficacy and teaching skills. They suggested that further research to explore the long-term impact of video-based microteaching and its applicability to other educational contexts.

Additionally, Akoto and Appiah (2023) conducted a comparative study to examine the effects of video-based microteaching versus traditional microteaching on the science teaching efficacy of female preservice teachers in Ghana. The study was motivated by the need to identify more effective teaching strategies to enhance the teaching efficacy of female preservice teachers, particularly in science subjects. A sample of 60 female preservice teachers from two teacher training colleges participated in the study. The participants were divided into two groups: one group engaged in video-based microteaching, while the other participated in traditional peer microteaching. The study sought to assess which method was more effective in improving the participants' science teaching efficacy.

Akoto and Appiah (2023) in their study employed a mixed-methods approach, combining quantitative and qualitative data collection methods. The researchers measured the science teaching efficacy of the participants using a pre-test and post-test design. The quantitative results revealed that the video-based microteaching group demonstrated significantly higher improvements in teaching efficacy compared to the traditional microteaching group. The video-based group showed greater self-confidence in their ability to teach science, manage classrooms, and implement effective teaching strategies. The researchers attributed this improvement to the reflective nature of video-based microteaching, which allowed participants to critically analyze their teaching practices and make necessary adjustments.

In addition to the quantitative findings, qualitative data collected through interviews and focus group discussions provided insights into the participants' experiences. The video-based microteaching group reported that watching their recorded lessons helped them identify both strengths and weaknesses in their teaching. Participants also mentioned that reviewing their performance allowed them to address specific areas of concern, such as content delivery and student engagement. The traditional microteaching group, while also reporting improvements in teaching efficacy, did not experience the same depth of reflection or self-awareness as the video-based group.

In conclusion, Akoto and Appiah (2023) concluded that video-based microteaching is a more effective method for enhancing the science teaching efficacy of female preservice teachers than traditional microteaching. The study recommended incorporating video-based microteaching into teacher education programs in Ghana to help preservice teachers develop stronger teaching skills, particularly in science education. The researchers suggested that the reflective nature of video-based microteaching, coupled with feedback from peers and instructors, played a crucial role in the participants' improvement, making it a valuable tool for teacher training.

Owusu and Kwame (2017) conducted a study to explore the impact of video-based microteaching on the science teaching efficacy of female preservice teachers in Ghana. The study aimed to address the low confidence levels and teaching efficacy typically observed among female preservice teachers in science education. The researchers used a quasi-experimental design involving 50 female preservice teachers, divided into an experimental group that participated in video-based microteaching and a control group that followed traditional teaching methods. The purpose was to assess whether video-based microteaching would lead to significant improvements in the participants' science teaching efficacy.

Owusu and Kwame (2017) found that the experimental group that engaged in video-based microteaching showed a significant improvement in their science teaching efficacy compared to the control group. The participants in the video-based group benefited from watching recordings of their own teaching sessions, which allowed them to identify areas of strength and weaknesses in their teaching practices. This process of self-reflection was key in building their confidence and ability to effectively teach science concepts. Moreover, the study found that the feedback provided by peers and instructors after reviewing the videos was crucial in helping the preservice teachers refine their teaching strategies.

Qualitative data from interviews revealed that participants in the video-based microteaching group felt more comfortable experimenting with new instructional techniques after watching their recorded lessons. Many of them reported feeling empowered to address classroom challenges more effectively, and their anxiety about teaching science decreased as they became more familiar with their own teaching style. The study also revealed that reviewing their performances on video allowed the preservice teachers to engage in deeper self-reflection, which fostered a greater sense of ownership over their professional development.

In conclusion, Owusu and Kwame (2017) demonstrated that video-based microteaching is an effective method for improving the science teaching efficacy of female preservice teachers in Ghana. The study suggests that integrating video-based microteaching into teacher education programs can provide female preservice teachers with valuable opportunities for self-assessment, peer feedback, and professional growth. The researchers recommended that teacher training institutions in Ghana adopt video-based microteaching more widely to help address the persistent challenges female preservice teachers face in science education.

2.3.3 Empirical Review of Literature on the Comparative Effects of the Collaborative Peer and Video-based Microteaching Models on Female Preservice Teachers' Science Teaching Efficacy

Most of the empirical studies on the collaborative peer and video-based microteaching models have focused on highlighting the individual impact of the microteaching models on preservice teachers' science teaching efficacy. Empirical studies that have specifically focused on comparing the impact of the two microteaching models on preservice teachers, specifically female preservice teachers' science teaching efficacy is quite limited.

In one of such comparative studies, Boateng and Yeboah (2021) addressed challenges faced by some Ghanaian female preservice teachers in developing confidence and competence in teaching science by employing collaborative peer and video-based microteaching as interventions. The collaborative peer and video-based microteaching models were compared in terms of their impact on participants' confidence and competence in teaching science.

Using a quasi-experimental design, Boateng and Yeboah (2021) assigned eighty (80) female preservice teachers to two groups: one group engaged in collaborative peer microteaching and the other in video-based microteaching. Participants' science teaching efficacy was measured before and after the intervention using the Science Teaching Efficacy Belief Instrument (STEBI). Both interventions significantly enhanced science teaching efficacy but in distinct ways. Participants in the collaborative peer group benefited from peer support, real-time feedback, and group reflection, which improved teaching practices and reduced anxiety about teaching science. However, its impact on deep self-reflection was limited.

Conversely, participants in the video-based group experienced greater gains in self-analysis by reviewing recordings of their microteaching sessions. This process enabled them to pinpoint specific areas for improvement, such as content delivery and classroom management, resulting in more substantial enhancements in science teaching efficacy related to targeted instructional skills.

Boateng and Yeboah (2021) concluded their study by emphasizing that both microteaching models are effective in developing science teaching efficacy but serve different purposes. Collaborative peer microteaching fosters a supportive learning environment that encourages interaction and collective improvement, while video-based microteaching promotes individual reflection and critical analysis of teaching practices. The study suggests that integrating both methods into teacher training programs could provide a comprehensive approach to developing preservice teachers' science teaching efficacy.

Similarly, Ankrah and Mensah (2020) conducted a study to compare the impact of collaborative peer and video-based microteaching on the teaching self-efficacy of female preservice science teachers in Ghana. The study sought to address the issue of low teaching efficacy among female preservice teachers, particularly in science subjects, and explore how different microteaching models could improve their confidence and competence in teaching. The researchers hypothesized that both collaborative peer and video-based microteaching would enhance teaching self-efficacy, but each model would have different impacts on specific aspects of teaching.

Ankrah and Mensah (2020) sampled fifty (50) female preservice science teachers from two Ghanaian teacher training colleges for the study. Participants were divided into two groups: one group engaged in collaborative peer microteaching, where they taught lessons in small groups and received feedback from their peers, while the second group participated in video-based microteaching, recording their lessons and reviewing them for self-reflection. Pretest and posttest using the Science Teaching Efficacy Belief Instrument (STEBI) were administered to measure changes in self-efficacy, specifically focusing on personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE).

The findings of Ankrah and Mensah (2020) revealed that both collaborative peer and video-based microteaching significantly improved the overall teaching self-efficacy of participants. In the collaborative peer group, participants reported gains in confidence related to classroom management and lesson delivery, attributing this to the immediate feedback and support they received from their peers. This real-time feedback helped them make quick adjustments to their teaching practices, fostering a sense of community and shared learning. However, the collaborative peer model was less effective in promoting deeper self-reflection on specific teaching strategies compared to the video-based model.

In contrast, the video-based microteaching group experienced a greater increase in personal science teaching efficacy (PSTE). The ability to review recorded lessons allowed participants to critically analyze their own teaching performance and identify areas for improvement. This led to more targeted changes in their teaching techniques, particularly in content delivery and instructional strategies. Ankrah and Mensah (2020) concluded that while both models positively impacted teaching self-efficacy, video-based microteaching had a stronger effect on fostering individual reflection and self-improvement, while collaborative peer microteaching was more effective in promoting confidence through peer support and collaboration.

Also, Owusu and Kwame (2017) conducted a study to compare the effects of video-based microteaching and peer feedback on the science teaching efficacy of female preservice teachers in Ghana. The study was designed to address the issue of low science teaching efficacy, particularly among female preservice teachers, by evaluating two distinct methods of microteaching. Video-based microteaching involved participants recording their teaching sessions and reflecting on their performance through video analysis, while peer feedback involved participants teaching in small groups and receiving real-time feedback from their peers. The study aimed to determine which method was more effective in developing science teaching efficacy.

In their study, Owusu and Kwame (2017) sampled 60 female preservice teachers who were divided into two groups: one group participated in video-based microteaching, and the other group engaged in collaborative peer microteaching. The researchers used the Science Teaching Efficacy Belief Instrument (STEBI) to measure participants' teaching efficacy before and after the intervention. The video-based group watched their recorded teaching sessions and engaged in self-reflection, identifying areas for improvement and refining their teaching skills. The peer feedback group received feedback from their peers during group discussions and was encouraged to modify their teaching practices based on the feedback received.

Results obtained by Owusu and Kwame (2017) in the study revealed that both video-based microteaching and peer feedback significantly improved participants' science teaching efficacy, but video-based microteaching was more effective in fostering deeper self-reflection and critical analysis of teaching practices. Participants in the video-based group were able to pause, rewind, and re-watch their teaching sessions, which allowed for a more thorough evaluation of their performance. This process helped them to identify specific areas for improvement, such as lesson structure, content delivery, and classroom management. As a result, the video-based group demonstrated greater long-term improvements in their personal science teaching efficacy compared to the peer feedback group.

On the other hand, the peer feedback group benefitted from the collaborative learning environment, where they could observe their peers' teaching methods, share ideas, and provide constructive feedback. This immediate, real-time feedback helped participants gain confidence in delivering science lessons and improve their classroom management skills. However, the lack of opportunity for in-depth self-reflection limited the extent of their improvement compared to the video-based group. Owusu and Kwame (2017) concluded that while both methods are valuable for developing science teaching efficacy, video-based microteaching has a stronger impact on long-term teaching efficacy due to the depth of reflection it enables.

Akoto and Appiah (2023) also conducted a comparative study to assess the effects of collaborative peer and video-based microteaching on the science teaching efficacy of female preservice teachers in Ghana. The study focused on understanding how each microteaching model influences teaching efficacy, particularly in the areas of lesson delivery, classroom management, and content knowledge. The researchers aimed to address the persistent challenge of low teaching efficacy among female preservice teachers in science education. A quasi-experimental design was used, with 90 female preservice teachers from a Ghanaian teacher education college. These participants were randomly assigned to either the collaborative peer or video-based microteaching groups and participated in a six-week intervention.

Findings by Akoto and Appiah (2023) showed that both microteaching models significantly improved the science teaching efficacy of the participants, but each model had distinct impacts. In the collaborative peer microteaching group, participants reported improved confidence in lesson delivery and classroom management due to the interactive nature of the sessions, where they received real-time feedback from peers. The supportive environment helped reduce teaching anxiety and allowed the participants to test new teaching methods with the assurance of receiving constructive feedback. However, the depth of reflection was somewhat limited compared to the video-based microteaching group, as participants had less opportunity for individual analysis.

The video-based microteaching group, on the other hand, demonstrated greater improvements in content knowledge and self-reflection. By recording and reviewing their teaching sessions, participants were able to critically analyze their performance and identify specific areas for improvement. This method encouraged deeper self-reflection, as participants could revisit their lessons and assess their teaching practices in detail. The ability to observe themselves in action helped participants develop greater awareness of their teaching techniques and classroom dynamics, leading to significant improvements in science teaching efficacy, particularly in content delivery.

Akoto and Appiah (2023) concluded that while both microteaching methods are effective in improving the teaching efficacy of female preservice teachers, they offer different advantages. Collaborative peer microteaching is more effective in fostering immediate confidence and improving classroom management, while video-based microteaching provides deeper self-reflection and content knowledge improvement. The researchers recommended that teacher education programs in Ghana incorporate both methods to maximize their impact on preservice teachers' professional development, suggesting that a blended approach would offer a more comprehensive way to enhance science teaching efficacy.

2.4 Conceptual Framework for the Study

This study was guided by a conceptual framework that integrates the collaborative peer microteaching and video-based microteaching models as two instructional interventions designed to enhance the science teaching efficacy of selected female preservice teachers. Grounded in Bandura's theory of self-efficacy, the framework posits that active engagements in either collaborative peer or video-based microteaching sessions offers female preservice teachers with multiple opportunities to encounter and benefit from the four principal sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and emotional regulation also referred to as physiological and affective states.

Through mastery experiences, preservice teachers build confidence as they successfully plan and deliver science lessons during microteaching, reinforcing their belief in their teaching competence. Vicarious experiences are fostered when they observe their peers or watch video recordings of effective teaching practices, allowing them to model strategies and visualize their own success. Verbal persuasion is provided through constructive feedback and encouragement from peers, mentors, and supervisors, which can positively shape their self-perceptions of teaching ability.

Finally, emotional regulation occurs as repeated exposure to simulated teaching environments reduces anxiety and helps preservice teachers manage the emotional demands of teaching, thereby promoting a sense of efficacy in handling classroom challenges. Collectively, these experiences contribute to the development of a strong science teaching efficacy, which is crucial for effective instruction and positive students' learning outcomes. The conceptual framework for the study is presented in Figure 3.

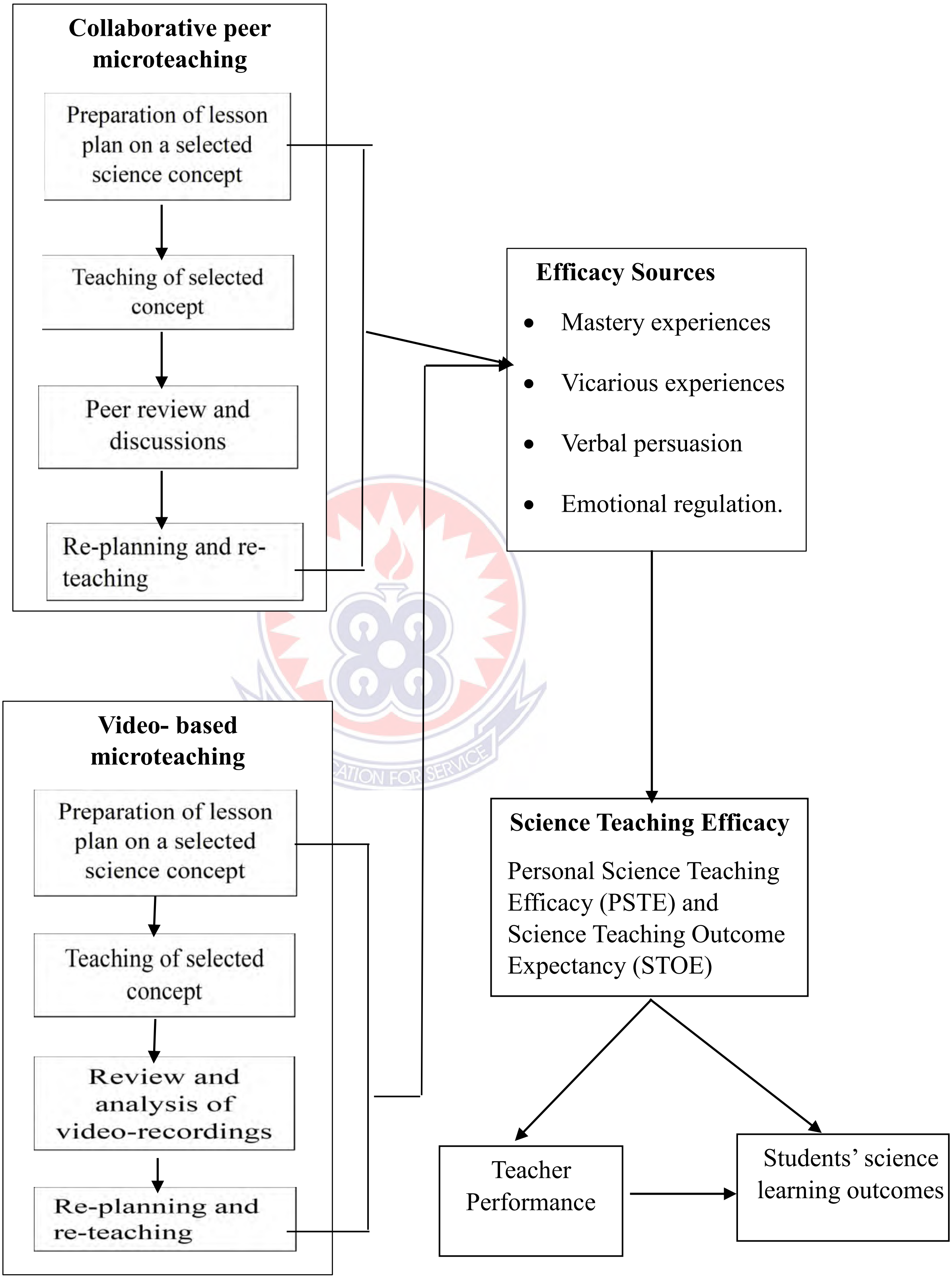

Figure 3: Conceptual Framework for the Study (Researcher's construct, 2025)

2.5 Chapter Summary

Literature was reviewed in this chapter under three main sub-headings; theoretical review, conceptual review and empirical review. The theoretical review of the chapter focused on four theories of learning namely, Bandura's social cognitive theory, the constructivist theory of learning, Kolb's experiential learning theory, and Schön's reflective theory. These theories collectively form a robust theoretical framework for understanding the development of science teaching efficacy in Ghanaian female preservice teachers through collaborative peer and video-based microteaching models.

Bandura's SCT theory emphasizes the role of observational learning, peer interactions, and self-efficacy, aligning with how preservice teachers, specifically female preservice teachers, learn from peers and the feedback they receive during microteaching. The constructivist theory of learning posits that learners construct their own knowledge through active engagement, which is central to both the collaborative peer and video-based microteaching models, where preservice teachers actively practice, reflect, and revise their teaching strategies.

Kolb's experiential learning theory further strengthens this study's theoretical framework by emphasizing the importance of learning through experience, reflection, and experimentation, which are key aspects of microteaching where preservice teachers cycle through teaching, receiving feedback, and refining their approaches.

Schön's reflective theory underlines the importance of reflective practice, particularly in video-based microteaching, where teachers critically review their teaching performance through video playback. Collectively, all the four learning theories underscore the importance of active, reflective, and experiential learning in building science teaching efficacy, making them highly relevant to the study's focus on comparing the two microteaching models.

The conceptual review examined science teaching efficacy as a subset of Bandura's self-efficacy concept, specifically applying the concept to science education. It also explored the individual, institutional, and socio-cultural factors that shape the development of science teaching efficacy in Ghanaian female preservice teachers. Additionally, the review emphasized the importance of science teaching efficacy in the context of female preservice teacher education in Ghana. Further, the conceptual review focused on the collaborative peer and video-based microteaching models, highlighting their significance in enhancing female preservice teacher education.

Finally, the empirical review of literature focused on existing empirical studies on the collaborative peer and video-based microteaching models and the implications of the findings of the empirical studies to this study that explored the comparative effectiveness of the two microteaching models in developing selected Ghanaian female preservice teachers' science teaching efficacy.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter discusses the methodology employed in the study. It provides a detailed description of the research paradigm, research design, population, sampling procedure, data collection instruments, data collection process, as well as the techniques used for data processing and analysis. The concluding part of the chapter highlights the ethical issues addressed in the study.

3.1 Research Paradigm

This study is grounded in the pragmatic research paradigm. Pragmatism is a research paradigm that prioritizes practical solutions and real-world applications over fixed philosophical positions. It is characterized by its flexibility, focus on outcomes, and openness to using mixed methods to address research questions (Creswell & Plano Clark, 2018). Pragmatism is widely recognized as a suitable research paradigm for studies comparing educational interventions, such as in this study where the collaborative peer and video-based microteaching models were compared in terms of their effect on female preservice teachers' science teaching efficacy.

Ontologically, pragmatism embraces a pluralistic view of reality, recognizing that reality is not singular or fixed but is constructed through interactions with the world. Pragmatism views reality as dynamic, practical, and shaped by individual experiences and interactions within specific contexts (Morgan, 2007). This aligns with this study's view of female preservice teachers' science teaching efficacy as a dynamic trait that evolve through practical experiences and contextual influences which could be personal, institutional or cultural.

Epistemologically, pragmatism is not bound by a single notion of truth or knowledge but rather focuses on what works in a specific context to solve real-world problems. Pragmatism emphasizes the practical application of knowledge and supports the use diverse methods to explore what works best in practice (Tashakkori & Teddlie, 2010). This aligns with this study's objective of identifying which microteaching model (collaborative peer or video-based microteaching model) more effectively enhances female preservice teachers' science teaching efficacy. Pragmatism also emphasizes the importance of practical knowledge gained through experience which aligns with the nature of microteaching, where preservice teachers engage in hands-on practice and reflection.

Methodologically, pragmatism supports a pluralistic approach to knowledge generation which involves the integration of knowledge from both quantitative and qualitative sources to holistically address a research problem. Pragmatism advocates for the use of mixed methods to provide a more comprehensive understanding of research problems (Creswell, 2014). In the context of this study quantitative data from the Science Teaching Efficacy Belief instrument (STEBI-B) would provide measurable insights into changes in female preservice teachers' science teaching efficacy before and after their engagement in the collaborative peer and video-based microteaching models, whilst qualitative data from the focus group interview would explore participants' experiences and perceptions of the microteaching models.

3.2 Research Approach

This study employed a mixed methods approach. Mixed methods research integrates both quantitative and qualitative research methods within a single study (Creswell & Plano-Clark, 2018). Mixed methods research approach according to Creswell and Plano-Clark (2018) leverages the strengths of both quantitative and qualitative research methods in providing a more comprehensive understanding of a research problem. This study combined both quantitative and qualitative methods in the comparative analysis of the effects of the collaborative peer and video-based microteaching models on female preservice teachers' science teaching efficacy.

Changes in female preservice teachers' levels of science teaching efficacy resulting from their participation in the collaborative peer and video-based microteaching sessions were determined quantitatively using the Science Teaching Efficacy Belief Instrument (STEBI-B). Perception of collaborative peer microteaching questionnaire (PCPM) was used to gather quantitative data on female preservice teachers' perceptions of collaborative peer microteaching. A focus group interview was conducted to gather qualitative data on female preservice teachers' perceptions and experiences with the video-based microteaching model.

3.3 Research Design

Research design as opined by Polit and Beck (2007) is the overall plan for answering research questions and hypotheses. It spells out the strategies a researcher adopts to gather accurate, objective, and interpretable information. This study employed a comparative research design. Comparative research design is a methodological approach used to systematically compare two or more groups, interventions, or conditions to identify similarities, differences, and potential causal relationships (Bryman, 2016). The design is particularly effective in educational research, where the objective is to evaluate the effectiveness of different teaching methods, programs, or models (Cohen, Manion, & Morrison, 2018).

Comparative research design was employed in this study because as opined by Cohen, Manion and Morrison (2018) the design aligns with studies that aim to systematically compare two or more groups, interventions, or conditions to determine their relative effectiveness or impact. This study sought to compare two microteaching models; the collaborative peer model and the video-based model, and assess their relative effects on selected female preservice teachers' science teaching efficacy. The use of comparative designs as noted by Punch and Oancea (2019) allows researchers to draw meaningful conclusions about the relative effectiveness of interventions by analyzing outcomes within different contexts or among distinct groups.

Again, unlike experimental designs that often include a control group, comparative research can function without a control group, focusing on comparing treatment groups directly (Neuman, 2022). This study compared the science teaching efficacy of female preservice teachers in two treatment groups namely the collaborative peer and video-based microteaching groups. There was no control group. Even though the absence of a control group could pose a significant threat to the internal validity of the study, the threat was however mitigated through the establishment of baseline equivalency of the participants in the two treatment groups in terms of the level of their science teaching efficacy at the beginning of the study using a pretest.

The Science Teaching Efficacy Belief instrument (STEBI-B) was administered as both pretest and posttest. As a pretest, the STEBI-B was used to measure female preservice teachers' initial science teaching efficacy beliefs before being engaged in collaborative peer and video-based microteaching sessions. This baseline measurement of female preservice teachers' initial science teaching efficacy helped to assess how similar or different the female preservice teachers in the two treatment groups were at the beginning of the study. The similarities in pretest scores, as was the case in this study, established baseline equivalency between the two treatment groups.

Finally, comparative studies design offer flexibility in utilizing both quantitative and qualitative methods, aligning well with the pragmatic paradigm adopted for this research. Quantitative data collected through standardized instruments like the STEBI-B provided an objective assessment of changes in participants' levels of science teaching efficacy before and after the interventions, whilst qualitative data from the focus group interview offer deeper insights into how the microteaching model impacted the participants' confidence, teaching practices, and perceptions of support (Merriam & Tisdell, 2016). This mixed-methods approach allowed for a more holistic understanding of the effectiveness of the microteaching models.

3.4 Population

A research population refers to the entire group of individuals, objects, or events that share common characteristics and are of interest to a study. It is a complete set from which a sample may be drawn for the purpose of a study. Research population as opined by Creswell and Creswell (2018) provides the foundation for defining the scope and relevance of a research study.

This study targeted all the one thousand two hundred and twenty-two (1222) female preservice teachers in the Presbyterian Women's College of Education, Aburi in the Eastern Region of Ghana. The accessible population for the study however were all the two hundred and thirty-five (235) second-year female preservice teachers in the college.

3.5 Sample and Sampling Technique

A research sample refers to a subset of individuals, events, or objects taken from a larger population under study (Creswell & Creswell, 2018). A sample is selected to represent a population as closely as possible, in order to enable a researcher, make inferences or generalizations about an entire population based on the data collected from the sample. In many instances, studying an entire population may not feasible due to limitations like time, resources, or accessibility. This makes sampling an essential part of the research process (Creswell & Creswell, 2018). The sample for the study constituted fifty-six (56) second-year female preservice teachers belonging to two intact Early Grade classes.

The sample for this study was selected purposively, specifically through the criterion purposive sampling. Purposive sampling is a non-probability sampling technique in which a researcher deliberately selects participants based on specific characteristics or qualities that align with the purpose of the study. Criterion purposive sampling, a subset of purposive sampling, involves selecting cases or participants that meet a predetermined criterion of importance. In criterion purposive sampling, all participants must meet a predefined set of conditions relevant to the study's objective(s). It is used when researchers need participants who possess specific characteristics or experience related to the research problem (Patton, 2015).

Since the study's focus was on developing the science teaching efficacy of selected Ghanaian female preservice teachers, the first criterion for inclusion in the sample was that the constituents of the research sample should be females enrolled on a teacher education program with a focus on science. The female preservice teachers in the sample, at the time of the study, were all offering a science course that emphasized more on science pedagogy than on content knowledge. The use of the collaborative peer and video-based microteaching models was particularly helpful to the sample as it exposed them to a variety of science instructional strategies and how they are implemented to encourage meaningful learning of science.

Another criterion for inclusion in this study was gender. Since the research primarily focused on developing the science teaching efficacy of female preservice teachers using the collaborative peer and video-based microteaching models, only female preservice teachers were considered for this study and therefore the sample constituted only female preservice teachers.

The final criterion was academic level. The study's sample constituted only second-year preservice teachers. Second-year (Level 200) preservice teachers are generally at the midpoint of their teacher training programme, having gained some foundational knowledge in educational theory and some initial classroom experience. At this stage, they are often involved in practical teaching activities such as microteaching, which was a key focus of this study. Additionally, they are well-positioned to benefit from structured interventions like collaborative peer and video-based microteaching, as they have been introduced to teaching methods but still require further development in applying these methods in practice.

3.6 Research Instrument

The data collection instruments employed in this study comprised the Science Teaching Efficacy Beliefs Instrument (STEBI-B), Perception of Collaborative Peer Microteaching (PCPM) and a focus group interview.

3.6.1 Science Teaching Efficacy Beliefs Instrument (STEBI-B)

The STEBI-B adapted in this study was originally developed by Enoch and Riggs (1990) and is grounded in Bandura's concept of self-efficacy. The STEBI-B is an expert validated tool that is widely employed in empirical studies to assess the self-efficacy beliefs of preservice regarding science teaching (Ngman-Wara, 2012).

The STEBI-B comprise 23 items rated on a five-point Likert scale, ranging from one (strongly disagree) to five (strongly agree), and is divided into two subscales: Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE). The PSTE subscale contains 13 items that measure preservice teachers' confidence in their ability to positively impact students' learning, while the STOE subscale comprises 10 items that assess preservice teachers' beliefs that student outcomes are influenced by effective science teaching. Participants in the study were required to respond to each item on the PSTE and STOE subscales of the STEBI-B by selecting one of the following options: strongly agree (5), agree (4), undecided (3), disagree (2), or strongly disagree (1).

The minimum possible score on the STEBI-B scales is 23, while the maximum is 115. The total score of each participant in the study provided an overall measure of their self-efficacy beliefs toward science teaching. A high score on the PSTE subscale, relative to that of other respondents on the same scale indicated a strong personal belief in one's ability to effectively teach science, while a high score on the STOE subscale indicated a strong expectation that effective science teaching will lead to positive student outcomes.

3.6.2 Perception of Collaborative Peer Microteaching (PCPM)

This questionnaire was developed to measure female preservice teachers' perceptions of the effectiveness of the collaborative peer microteaching in developing their science teaching efficacy. The PCPM comprised fifteen (15) items. The items on the PCPM were designed to determine the perceptions of female preservice teachers regarding the effectiveness of the collaborative peer microteaching in four main areas; the development of their science teaching confidence, promoting reflective practice and peer learning, the development of their teaching competence and skills, and boosting their motivation and self-efficacy. These four areas of development, in addition to the overall perceptions of the effectiveness of the collaborative peer microteaching model constituted the five main themes under which the items of the PCPM were structured.

The items of the PCPM were rated on a five-point Likert scale. The responses to the items on the Likert scale ranged from Strongly Agree (SA), Agree (A), Neutral (N), Disagree (DA) to Strongly Disagree (SD). The responses were scored as follows: Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1).

3.6.3 Interview

A focus group interview was conducted to explore female preservice teachers' perceptions and experiences with the video-based microteaching model. The focus group interview was conducted using an interview guide. The interview guide comprised ten (10) items. Each item had a follow-up question that was designed to further probe and generate more in-depth responses from the female preservice teachers regarding their perceptions and experiences with the video-based microteaching model.

3.7 Validity and Reliability of Instrument

The validity of an instrument as opined by Creswell and Creswell (2018) describes the extent to which an instrument accurately measures what it is intended to measure. Validating research instrument according to Fraenkel et al. (2019) ensures that the results derived from an instrument reflect the actual characteristics or attributes being studied rather than errors or irrelevant factors.

Following the advice and feedback from two experienced senior lecturers in the Faculty of Science, University of Education, Winneba after the vetting of the PCPM and the interview guide, some adjustments were made to the instruments to enhance their face validities. Face validity as opined by Taherdoost (2016) describes the degree to which an instrument appears, on the surface, to measure what it claims to measure.

The construct validity of the STEBI-B, which describes the extent to which the instrument measures the theoretical construct of science teaching efficacy as is intended has been confirmed in several empirical studies (Bleicher, 2014; Burgess, 2016; Schoon & Boone, 2020). The STEBI-B has been found to maintain a two-factor structure: PSTE and STOE subscales that adequately measures the theoretical construct of science teaching efficacy among preservice teachers (Bleicher, 2004).

The Cronbach alpha reliability values of the items in the PSTE and STOE subscales of the STEBI-B in this study were determined to be 0.945 and 0.952 respectively. Similar high Cronbach alpha values for the PSTE and STOE subscales have been reported in studies where the STEBI-B have been used (Ngman-Wara, 2012). While a Cronbach's Alpha of 0.70 is commonly cited as the benchmark for acceptable internal consistency, values between 0.60 and 0.70, though slightly below this conventional threshold, are considered acceptable for adapted or newly developed instrument like the PCPM that targets subjective experiences, which can naturally yield moderate reliability due to variability in respondents' interpretations (Ursachi, Horodnic, & Zait, 2015).

3.8 Treatment of the Groups

Female preservice teachers in this study were assigned to two treatment groups. One group was exposed to the collaborative peer microteaching and the other group was exposed to the video-based microteaching model for a period of six weeks.

3.8.1 Engaging Female Preservice Teachers in Collaborative Peer Microteaching

The collaborative peer microteaching as employed in this study comprised five phases; peer group formation, lesson planning and preparation, microteaching session, post-microteaching sessions, revision and reteaching.

In the peer group formation phase of the collaborative peer microteaching, female preservice teachers were divided into small groups of four, there was one group however that had five members. The total number of groups formed were eight. The groups were then made to ballot for science topics they are to teach. The science topics the female preservice teachers balloted for were topics specified in the Early Grade Science II course outline. Early Grade Science II course was a science course the female preservice teachers were offering the period the study was conducted. The science topics included the following; simple machines, basic electronics, management of e-waste, food, strategies for teaching food, personal hygiene, sunlight and its benefits to plants, and photosynthesis.

In the lesson planning and preparation phase, the female preservice teachers worked together in groups to prepare a lesson plan for the science topic they selected. The lesson plan detailed the learning objective(s) the groups intended to achieve at the end of their lesson, the depth of the science content they intended to cover, their science teaching strategies, teaching and learning materials, and activities they will use to teach the selected science topic. As part of the preparation to teach the topics, members of group decided on the approach they would use to co-teach the lesson. In co-teaching the lesson each member of the group was tasked to handle aspects of the lesson, from the starter to the lesson closure.

During the microteaching sessions, the female preservice teachers were given ten (10) to fifteen (15) minutes to deliver a lesson on the science topic they selected to their peers in class. The peer observers were made to act as early grade learners in order to simulate a classroom environment similar to the real classroom environment within which female preservice teachers are likely to find themselves in the field of work. Whilst the female preservice teachers were teaching the science lesson, their per observers took note of their teaching strategies, science content delivery, strategies for engaging ―students" in the lesson, classroom management and effective use of teaching and learning materials. The peer observers noted the strengths of the lesson and identified areas that required improvement.

During the post microteaching sessions, female preservice teachers engaged in a group discussion where they reflected on and shared their microteaching experiences, what they have learnt from those experiences and how best they can improve on their science teaching efficacy. Peers to whom lessons were taught during the microteaching sessions provided constructive feedback on their colleagues' teaching performance, focusing on the instructional strategies they employed, how they delivered their science content, classroom management strategies, ―students" engagement, and the use of teaching and learning materials. They identified the strengths of the lessons they observed and the areas that required improvement.

Building on their own personal reflections and the feedback received from peers, female preservice teachers were made to plan for and teach another science lesson. The science topics were re-shared among the groups and the female preservice teachers were made to plan and teach lessons on the topics they received. After this microteaching session, the female preservice teachers discussed what they have learnt both as participants and observers. Engaging the female preservice teachers in another microteaching session enabled them to refine their science teaching skills and build on their science teaching efficacy. Working together in groups also fostered s sense of teamwork and collaboration.

3.8.2 Engaging Female Preservice Teachers in Video-based Microteaching

Female preservice teachers' engagement in the video-based microteaching occurred in four phases; lesson planning and preparation, microteaching session, self-assessment and peer feedback, and revision and reteaching.

In the lesson planning and preparation phase, female preservice teachers prepared a lesson plan based on a given science topic. In the lesson plan, they set the learning objective(s) they intended to achieve given the period of time they had to teach, the content of their lesson, instructional strategies they would employ, teaching and learning materials they would need to teach the lesson and the learning activities to engage students in.

During the microteaching session, the female preservice teachers taught short lessons within a period of ten (10) to fifteen (15) minutes. The lessons were video-recorded using a mobile device. The video recordings captured all the relevant aspects of teaching, including teacher behaviour, student interaction, and the overall classroom atmosphere. The preservice teachers were made to act like ―students" in order to simulate a classroom atmosphere similar to that of real classrooms.

After the microteaching, the video-recordings were sent to the female preservice teachers via WhatsApp in order for them to review their own teaching performances, reflect on their teaching, identifying the strengths and weaknesses of their lesson in terms of the instructional strategies they employed, how they delivered their science content, classroom management strategies they employed, their ―students" engagement, and the use of teaching and learning materials. Apart from the reflecting on their own teaching performance via the video recordings, peer observers also provided constructive feedback on the lessons they observed. The feedback highlighted the strengths of the lessons observed and areas that required improvements.

In the final phase of the video-based microteaching session, the science topics were re-shared among the female preservice teachers. The female preservice teachers were then made to plan for and teach the science topics they were given. Providing an opportunity for female preservice teachers to teach another science lesson enabled them to put into practice all that they have learnt from reviewing their own teaching performances and the feedback from peers. The repeated microteaching session enabled the female preservice teachers to refine their science teaching skills and efficacy.

3.9 Data Collection Procedure

Female preservice teachers in the two treatment groups were given the STEBI-B as a pretest before they were engaged in the collaborative peer and video-based microteaching sessions. The STEBI-B was first administered as a pre-intervention assessment to determine female preservice teachers' levels of science teaching efficacy prior to their engagement in the collaborative peer microteaching or video-based microteaching sessions.

After the female preservice teachers were engaged in the collaborative peer and video-based microteaching sessions for a period of six weeks, the STEBI-B was administered again to the female preservice teachers as a post-intervention assessment to measure changes in their levels of science teaching efficacy after engaging in the collaborative peer and video-based microteaching sessions.

Following the administration of the STEBI-B as a post-intervention assessment, female preservice teachers in the collaborative peer microteaching group were given the PCPM questionnaire. The PCPM was used to ascertain the perceptions of female preservice teachers regarding the effectiveness of the collaborative peer in developing their science teaching efficacy. Female preservice teachers in the video-based microteaching group were engaged in a focus group interview to explore their perceptions and experiences with the video-based microteaching and its impact on their science teaching efficacy.

3.10 Data Analysis Procedure

This study gathered and analyzed both quantitative and qualitative data. The Statistical Package for Social Sciences (SPSS) software version 27 was used in analyzing data from the STEBI-B and PCPM questionnaires. The descriptive statistic function of the SPSS software was used to determine the mean and standard deviations of female preservice teachers' scores from the STEBI-B and PCPM questionnaires. Female preservice teachers' mean efficacy scores in the STEBI-B (pre-intervention and post-intervention assessments) were analyzed using the student t-test statistic. The dependent samples t-test statistic was used to determine whether or not differences in the mean science teaching efficacy scores of the female preservice teachers in the same treatment group were statistically significant.

An independent samples t-test analysis was carried out to determine whether there was a statistically significant difference in the mean science teaching efficacy scores of the female preservice teachers in the two treatment groups. An analysis of covariance (ANCOVA) was further conducted to determine whether there was a statistically significant difference in the post-intervention STEBI-B scores of female preservice teachers exposed to the collaborative peer microteaching and video-based microteaching approaches while controlling for pre-intervention scores.

Again, a two-way analysis of covariance (ANCOVA) was conducted to examine the influence of age and prior teaching experience on female preservice teachers' science teaching efficacy, while controlling for the pre-intervention STEBI-B scores.

Finally, a thematic analysis of the data gathered from the focus group interview was carried out. The thematic analysis was conducted purposely to identify common themes and patterns in the participants' responses and to gain a better understanding of the participants' responses.

3.11 Ethical Considerations

This study prioritized the confidentiality of all the responses provided by the participants. The participants were made to respond to the items on the research instruments anonymously without providing any personal identification information. It was ensured that none of the students' responses on the instruments were divulged to anyone outside of the study. The participants were made to respond to the items on the instruments voluntarily without any compulsion. They were told the purpose of the study and why their responses were vital to the study.

Again, all participants in the study were treated with respect and its was ensured that the administration of the treatments (i.e. collaborative peer microteaching and video-based microteaching) was done devoid of any favouritism or biases in order to ensure that all the participants benefitted from the treatments.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Overview

This chapter begins with a presentation of the demographic characteristics of the female preservice teachers involved in this study. The results obtained from the analysis of data from the STEBI-B, PCPM and the focus group interview are presented in this chapter in accordance with the sequence in which the research questions that guided this study were stated. The concluding part of this chapter comprises a discussion of the findings from the data analyzed in relation to existing literature relevant to the study.

4.1 Demographic Characteristics of Participants

Demographic information on the research participants' age, educational level and prior teaching experiences were gathered from the PCPM and STEBI-B questionnaires.

4.1.1 Age Distribution of the Participants

The age distribution of the study's participants is presented in Table 1.

Table 1: Age Distribution of Participants

Age (years)	Number of Participants	Percentage (%)
18-20	4	7
21-23	28	50
24-26	18	32
27-29	5	9
30-above	1	2
Total	56	100

It can be inferred from Table 1 that 28 (50%) out of the total number of 56 participants, which constituted the majority were aged between 21 and 23 years. The age category 30 years and above had the least distribution in terms of the number of participants. There was only one participant in the age category 30 years and above. The mean age of the participants was determined to be 23 years.

4.1.2 Educational Level of Participants

The distribution of the participants based on their level of education is presented in Table 2.

Table 2: Distribution of Participants Based on the Level of their Education

Educational level	Number of Participants
Senior High School (SHS)	56
Bachelor's Degree	-
Postgraduate (Master's/ PHD)	-
Total	56

It could be seen from Table 2 that the senior high school level of education is the highest level of education attained by all the participants in the study. None of the participants had a Bachelor's Degree or Postgraduate Degree at the time when this study was conducted.

4.1.3 Teaching Experiences of Participants

The distribution of the participants based on their teaching experiences is presented in Table 3.

Table 3: Distribution of Participants Based on their Teaching Experiences

Teaching Experience (years)	Number of Participants	Percentages (%)
None	37	66
Less than a Year	8	14
1-2	10	18
3-5	1	2
Total	56	100

It can be observed from Table 3 that majority (66%) of the participants in this study have not had any teaching experience prior to this study. Eight (8) participants representing 14 % of the total number of participants have had less than a year of prior teaching experience. About ten (10) participants representing 18% of the total number of participants have had one (1) to two (2) years of teaching experience prior to this study. Only one (1) participant representing 2% of the total number of participants had three (3) to five (5) years of teaching experience prior to this study.

4.2 Data Presentation and Analysis

4.2.1 Research Question 1: What are the levels of female preservice teachers' science teaching efficacy before and after engaging in collaborative peer microteaching sessions?

In order to assess female preservice teachers' levels of science teaching efficacy before and after their engagement in collaborative peer microteaching sessions, the science teaching efficacy belief instrument (STEBI-B) was administered twice, as a pre-intervention and post-intervention assessment before and after the collaborative peer microteaching sessions. Female preservice teachers' mean science teaching scores from the two subscales of STEBI-B namely the personal science teaching efficacy (PSTE) subscale and science teaching outcome expectancy (STOE) subscale were first analyzed descriptively using mean and standard deviation.

Subsequently, their combined scores from the PSTE and STOE subscales which constituted their overall STEBI-B were also analyzed descriptively using mean and standard deviation. A summary of the descriptive analysis of the collaborative peer groups' STEBI-B results is presented in Table 4.

Table 4: Descriptive Analysis of the Collaborative Peer Microteaching Group's STEBI-B Results

STEBI-B (Subscale)	N	Pre-intervention assessment mean (x)	Post-intervention assessment mean (x)	Mean difference	SD (Pre-intervention assessment)	SD (Post-intervention assessment
PSTE	28	3.209	3.688	0.479	1.015	0.911
STOE	28	3.882	4.204	0.322	1.027	0.945
Overall STEBI-B	28	3.502	3.901	0.399	0.693	0.708

*p<0.05

As displayed in Table 4, female preservice teachers in the collaborative peer microteaching group's mean pre-intervention assessment scores from the PSTE and STOE subscales of the STEBI-B were 3.209 and 3.882 respectively. The PSTE subscale of the STEBI-B assessed female preservice teachers' confidence in their abilities to teach science effectively whilst the STOE subscale assessed female preservice teachers' beliefs in their abilities to positively impact students' science learning outcomes. The personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE) beliefs collectively constitute female science teaching preservice teachers' science teaching efficacy beliefs.

The female preservice teachers' mean pre-intervention assessment scores from the PSTE (3.209) and STOE (3.688) subscales of the STEBI-B and from the overall

STEBI-B pre-intervention assessment results (3.502) all fell within the 3.00 to 3.99 range, and values within this range as noted by Bleicher (2004) suggest moderate levels of science teaching efficacy. This implied that prior to their engagement in collaborative peer microteaching sessions, the female preservice teachers in the collaborative peer microteaching group had moderate levels of science teaching efficacy.

From Table 4 above, it could also be observed that the female preservice teachers' mean STOE (pre-intervention assessment) score of 3.882 prior to their engagement in the collaborative peer microteaching sessions was higher than their mean PSTE (pre-intervention assessment) score of 3.209. This indicated that prior to their engagement in the collaborative peer microteaching sessions, the female preservice teachers had more confidence in their abilities to positively influence students' learning outcomes in science than in their personal abilities to teach the subject effectively.

This finding highlighted a common challenge among female preservice teachers in science education which is that despite recognizing the importance of effective science instruction, female preservice teachers often had low confidence in their personal abilities to effectively teach science subjects (Smith et al., 2018). The low personal science teaching efficacy as noted by Johnson and Lee (2021) could stem from the female preservice teachers' limited prior exposure to hands-on teaching experiences, societal and gender stereotypes regarding science teaching, or perceived inadequacies in their science content knowledge and pedagogical skills.

The standard deviation (SD) values for the PSTE (pre-intervention assessment) and STOE (pre-intervention assessment) were 1.015 and 1.0271 respectively. The standard deviation values provided insight into the spread and variabilities in female preservice teachers' science teaching efficacy beliefs before the intervention (collaborative peer microteaching). The SD of 1.015 for the PSTE (pre-intervention assessment) indicated moderate variability in female preservice teachers' personal beliefs about their abilities to teach science. It suggested that the female preservice teachers had moderately diverse self-perceptions of their science teaching capabilities before participating in the collaborative peer microteaching sessions.

The SD value of 1.027 for the STOE (pre-intervention assessment) also suggested moderate variability in the female preservice teachers' beliefs about the extent to which effective science teaching can lead to positive student learning outcomes. The slightly higher SD value of the STOE (1.027) compared to the PSTE (1.015) however indicated that some of the female preservice teachers were less certain about whether good teaching alone could lead to improved science learning outcomes. This uncertainty as noted by Enochs and Riggs (1990) could possibly be due to the influence of certain external factors such as students' interest, prior knowledge, or resource availability in schools.

There was an improvement in the female preservice teachers' mean PSTE and STOE post-intervention assessment scores together with their overall mean STEBI-B **post-** intervention assessment scores following their engagement in the collaborative peer microteaching sessions. Female preservice teachers' mean PSTE scores increased from 3.209 (pre-intervention assessment) to 3.668 (post-intervention assessment) with a mean difference of 0.459 whilst their mean STOE scores increased from 3.882 (pre-intervention assessment) to 4.204 (post-intervention assessment) with a mean difference of 0.322.

The improvements in the female preservice teachers' mean PSTE and STOE post-intervention assessment scores following their engagement in collaborative peer microteaching sessions suggested that the collaborative peer microteaching model was effective in building the female preservice teachers' personal science teaching efficacy and outcome expectancy beliefs. The larger improvement in female preservice teachers' mean PSTE post-intervention assessment scores (mean difference = 0.459) compared to their mean STOE post-intervention assessment scores (mean difference = 0.322) implied that the collaborative peer microteaching model had a greater impact on the female preservice teachers' personal science teaching confidence (PSTE) than on their general outcome expectations (STOE).

The female preservice teachers' overall STEBI-B scores increased from 3.502 (pre-intervention assessment) to 3.901 (post-intervention assessment) with a mean difference of 0.399. The improvement in the female preservice teachers' overall STEBI-B scores indicated that the collaborative peer microteaching model had an overall positive impact on the female preservice teachers' science teaching efficacy beliefs and was effective in enhancing those beliefs.

The standard deviation (SD) value of the PSTE subscale decreased from 1.015 (pre-intervention assessment) to 0.911 (post-intervention assessment). This indicated reduced variability in female preservice teachers' personal beliefs about their science teaching capabilities. It also suggested more consistency in female preservice teachers' responses on the subscale after the intervention. The SD value of the STOE subscale also decreased from 1.027 (pre-intervention assessment) to 0.945 (post-intervention assessment), which indicated reduced variability in female preservice teachers' science teaching outcome expectancy beliefs after engaging in the collaborative peer microteaching sessions.

In order to determine whether or not the increase in the female preservice teachers' mean PSTE and STOE (pre-intervention assessment and post-intervention assessment) scores and their overall STEBI-B results were statistically significant, a dependent samples t-test analysis was conducted. The results from the dependent samples t-test analysis are displayed in Table 5.

Table 5: Dependent Samples t-Test Analysis of the Collaborative Peer Microteaching Group's STEBI-B Results

STEBI-B (Subscale)	N	df	Pre-intervention assessment mean (x)	SD	Post-intervention assessment mean (x)	SD	t	P	Cohen's d
PSTE	28	27	3.209	1.015	3.688	0.911	-3.212	.003	0.756
STOE	28	27	3.882	1.027	4.204	0.945	-3.167	.004	0.537
Overall STEBI-B	28	27	3.502	0.693	3.901	0.708	-4.376	.000	0.483

*p<0.05

The dependent samples t-test analysis displayed in Table 5 compared the collaborative peer group's levels of science teaching efficacy before and after the intervention (collaborative peer microteaching) based on their mean PSTE and STOE pre-intervention assessment and post-intervention assessment scores, as well as their overall STEBI-B results. The analysis revealed that there was a statistically significant difference ($t(27) = -3.212$, $p = 0.003 < .05$) in the female preservice teachers' mean PSTE pre-intervention assessment and post-intervention assessment scores.

The statistically significant p-value (0.003) indicated that the increase in the female preservice teachers' mean PSTE score from 3.209 (pre-intervention assessment) to 3.668 (post-intervention assessment) was unlikely to be due to chance. It therefore suggested that the intervention (collaborative peer microteaching model) implemented between the two assessments had a considerable impact on the female preservice teachers' personal science teaching efficacy beliefs. The effect size as determined by Cohen's d was 0.756.

Effect size, as quantified by the Cohen's d value, describes the magnitude of the impact of a study's intervention (Alwahaibi et al., 2020). Cohen's d value of 0.200 indicates a ―small" effect size, 0.500 indicates a ―medium/moderate" effect size, and 0.800 indicates a ―large" effect size. The Cohen's d value of 0.756 for the PSTE indicated that the collaborative peer microteaching model had a moderate-to-large effect on female preservice teachers' personal science teaching efficacy beliefs. It also implied that the effect of the collaborative peer microteaching model on female preservice teachers' personal science teaching efficacy beliefs was quite substantial.

The dependent samples t-test analysis also revealed a statistically significant difference ($t(27) = -3.167$, $p = 0.004 < .05$) in the female preservice teachers' mean STOE pre-intervention assessment and post-intervention assessment scores. The statistically significant p-value (0.004) indicated that the increase in the female preservice teachers' mean STOE score from 3.882 (pre-intervention assessment) to 4.204 (post-intervention assessment) was unlikely to be due to chance but rather the impact of the intervention.

It suggested that the collaborative peer microteaching model had a considerable impact on the female preservice teachers' science teaching outcome expectancy beliefs. The collaborative peer microteaching model enhanced female preservice teachers' beliefs in their ability to positively influence students' science learning outcomes. The effect size as determined by Cohen's d for the STOE was 0.537, indicating that the collaborative peer microteaching model had a moderate effect on the female preservice teachers' science teaching outcome expectancy beliefs.

The dependent samples t-test analysis further revealed that the difference between the overall STEBI-B pre-intervention assessment and post-intervention assessment scores was statistically significant ($t(27) = -4.376$, $p = 0.000 < .05$). This suggested that the collaborative peer microteaching model had an overall positive impact on the female preservice teachers' science teaching efficacy beliefs.

The impact of the collaborative peer microteaching model on the female preservice teachers' science teaching efficacy beliefs was not as a result of chance, as further indicated by the Cohen's d value (0.483). The Cohen's d of 0.483 for the overall STEBI-B suggested that the collaborative peer microteaching model had a moderate effect on the female preservice teachers' overall science teaching efficacy.

In summary, the findings from the dependent samples t-test analysis of the collaborative peer group's STEBI-B results revealed that the collaborative peer microteaching model was effective in enhancing female preservice teachers' science teaching efficacy beliefs. The improvements in the female preservice teachers' mean PSTE and STOE post-intervention assessment scores together with their overall STEBI-B post-intervention assessment scores after their engagement in the collaborative peer microteaching sessions further reflected the effectiveness of the model.

The Cohen's d values for the PSTE (0.756) and STOE (0.537) subscales, together with the overall STEBI-B (0.483), further showed that the effect of the collaborative peer microteaching model on female preservice teachers' science teaching efficacy beliefs was substantial and not a product of chance. The collaborative peer microteaching model had a moderate-to-large effect on female preservice teachers' personal science teaching efficacy beliefs and a moderate effect on their science teaching outcome expectancy beliefs. The overall effect of the collaborative peer microteaching model on the female preservice teachers' science teaching efficacy beliefs was moderate

4.2.2 Research Question 2: What are the levels of female preservice teachers' science teaching efficacy before and after participating in video-based microteaching sessions?

In order to assess female preservice teachers' levels of science teaching efficacy before and after participating in video-based microteaching sessions, the Science Teaching Efficacy Belief Instrument (STEBI-B) was administered twice; as a pre-intervention assessment and post-intervention assessment before and after the video-based microteaching sessions. Female preservice teachers' mean PSTE and STOE pre-intervention assessment and post-intervention assessment scores, together with their overall STEBI-B results, were analyzed descriptively using mean and standard deviation. A summary of the descriptive analysis is presented in Table 6.

Table 6: Descriptive Analysis of the Video-based Microteaching Group's STEBI-B Results

STEBI-B (Subscale)	N	Pre-intervention assessment mean (x)	Post-intervention assessment mean (x)	Mean difference	SD (Pre-intervention assessment)	SD (Post-intervention assessment)
PSTE	28	3.329	4.129	0.800	0.630	0.554
STOE	28	3.968	4.400	0.432	0.621	0.416
Overall STEBI-B	28	3.625	4.082	0.457	0.622	0.457

*p<0.05

The female preservice teachers in the video-based microteaching group's mean PSTE (pre-intervention assessment), STOE (pre-intervention assessment) and overall STEBI-B (pre-intervention assessment) scores displayed in Table 6 were 3.329, 3.968 and 3.625 respectively. These pre-intervention assessment scores were all within the

3.00–3.99 range and values within this range as indicated by Bleicher (2004) suggested moderate levels of science teaching efficacy. It implied that prior to their participation in the video-based microteaching sessions, the female preservice teachers in the video-based microteaching group had moderate levels of science teaching efficacy.

The female preservice teachers' mean STOE (pre-intervention assessment) score of 3.968 was higher than their mean PSTE (pre-intervention assessment) score of 3.329 and this suggested that whilst the female preservice teachers generally believed that good science teaching could lead to student success in the subject, they were less confident in their personal abilities to teach science effectively. This finding aligns with existing literature that suggests that preservice teachers, particularly females in science education, often struggle with confidence in their instructional skills, even though they recognize the importance of good science teaching and its impact on students' learning outcomes in science subjects (Menon & Azam, 2021).

The standard deviation (SD) values for the PSTE (pre-intervention assessment) and STOE (pre-intervention assessment) were 0.630 and 0.621 respectively. These SD values indicated some levels of variability in the female preservice teachers' personal science teaching efficacy and outcome expectancy beliefs before participating in the video-based microteaching sessions. Variabilities in the female preservice teachers' science teaching efficacy beliefs prior to their engagement in intervention activities (video-based microteaching sessions) have been associated with differences in prior exposure to science teaching/prior teaching experiences, personal interest in science and level of mastery over science content knowledge (Menon & Sadler, 2016).

There was an improvement in the female preservice teachers' mean PSTE and STOE post-intervention assessment scores, together with their overall STEBI-B (post-intervention assessment) following their participation in the video-based microteaching sessions. As displayed in Table 6, the female preservice teachers' mean PSTE scores increased from 3.329 (pre-intervention assessment) to 4.129 (post-intervention assessment) with a mean difference of 0.800 whilst their mean STOE scores increased from 3.968 (pre-intervention assessment) to 4.400 (post-intervention assessment) with a mean difference of 0.432. Their overall STEBI-B scores also increased from 3.625 (pre-intervention assessment) to 4.247 (post-intervention assessment) with a mean difference of 0.622.

The increase in the female preservice teachers' mean PSTE and STOE post-intervention assessment scores following their participation in video-based microteaching sessions suggested that the video-based microteaching model was effective in helping female preservice teachers gain more confidence in their abilities to teach science effectively and positively impact students' science learning outcomes. The larger improvement in the female preservice teachers' mean PSTE post-intervention assessment scores (mean difference = 0.800) compared to their mean STOE post-intervention assessment scores (mean difference = 0.432) implied that the video-based microteaching model had a greater impact on the female preservice teachers' personal science teaching efficacy beliefs compared to their science teaching outcome expectancy beliefs.

The improvement in the female preservice teachers' overall STEBI-B results indicated that the video-based microteaching model had an overall positive impact on the female preservice teachers' science teaching efficacy beliefs which comprise their personal science teaching (PSTE) and outcome expectancy (STOE) beliefs. The SD values for the PSTE subscale reduced from 0.630 (pre-intervention assessment) to 0.554 (post-intervention assessment) and this suggested that the female preservice teachers were less diverse in terms of their self-perceptions of their science teaching capabilities. It indicated that the female preservice teachers' responses on the subscale became more consistent after engaging in the intervention (video-based microteaching).

The SD values for the STOE subscale also reduced from 0.621 (pre-intervention assessment) to 0.416 (post-intervention assessment) and this suggested that the female preservice teachers' responses on the subscale became more uniform after the intervention. The reduction in the SD values of the STOE indicated that the video-based microteaching model helped to reinforce shared positive beliefs among the female preservice teachers regarding the impact of effective science teaching on students' learning.

A dependent samples t-test analysis was carried out in order to determine whether or not the increase in the female preservice teachers' mean PSTE and STOE post-intervention assessment scores, and their overall STEBI-B post-intervention assessment scores following their participation in video-based microteaching sessions were statistically significant. A summary of the dependent samples t-test analysis is presented in Table 7.

Table 7: Dependent Samples t-Test Analysis of the Video-based Microteaching Group's STEBI-B Results

STEBI-B (Subscale)	N	df	Pre-intervention assessment mean (x)	SD (Pre-intervention assessment)	Post-intervention assessment mean (x)	SD (Post-intervention assessment)	t	p	Cohen's d
PSTE	28	27	3.329	0.630	4.129	0.554	-6.289	.000	0.619
STOE	28	27	3.968	0.621	4.400	0.416	-4.604	.001	0.497
Overall STEBI-B	28	27	3.625	0.457	4.247	0.371	-7.906	.000	0.404

*p<0.05

The dependent samples t-test analysis displayed in Table 7 compared female preservice teachers' mean PSTE, STOE, and overall STEBI-B pre-intervention assessment and post-intervention assessment scores before and after participating in video-based microteaching sessions in order to determine whether the differences in the pre-intervention assessment and post-intervention assessment scores from these three measures were statistically significant. The analysis revealed that there was a statistically significant difference (t (27) = -6.289, p (0.001) < .05) in the female preservice teachers' mean PSTE pre-intervention assessment and post-intervention assessment scores.

The statistically significant p-value (0.001) indicated that the increase in the female preservice teachers' mean PSTE score from 3.329 (pre-intervention assessment) to 4.129 (post-intervention assessment) after participating in video-based microteaching was unlikely to be due to chance. It therefore suggested that the video-based microteaching model implemented between the pre-intervention assessment and post-intervention assessment had a considerable impact on the female preservice teachers' personal science teaching efficacy beliefs. The effect size, as determined by Cohen's d, was 0.619, indicating that the video-based microteaching model had a moderate-to-large effect on female preservice teachers' personal science teaching efficacy beliefs. This implied that the video-based microteaching model was effective in enhancing female preservice teachers' confidence in their science teaching capabilities.

The dependent samples t-test analysis also revealed a statistically significant difference ($t(27) = -4.604$, $p (0.001) < .05$) in the female preservice teachers' mean STOE pre-intervention assessment and post-intervention assessment scores. The statistically significant p-value (0.001) indicated that the increase in the female preservice teachers' mean STOE score from 3.968 (pre-intervention assessment) to 4.400 (post-intervention assessment) was unlikely to be due to chance but rather due to the impact of the video-based microteaching model (intervention). The effect size of the video-based microteaching model on female preservice teachers' science teaching outcome expectancy beliefs (STOE), as determined by Cohen's d, was 0.497. This implied that the video-based microteaching model had a moderate effect on the female preservice teachers' science teaching outcome expectancy beliefs.

The dependent samples t-test analysis of the overall STEBI-B scores revealed a statistically significant difference in the female preservice teachers' overall STEBI-B pre-intervention assessment and post-intervention assessment scores ($t(27) = -7.906$, $p (0.000) < .05$). This indicated that the video-based microteaching model had an overall positive impact on the female preservice teachers' science teaching efficacy beliefs, which comprise both their personal science teaching (PSTE) and outcome expectancy beliefs (STOE). The statistically significant t (-7.906) and p (0.000) values suggested that the overall positive impact of the video-based microteaching model on the female preservice teachers' science teaching efficacy was unlikely to be due to chance. The Cohen's d value of 0.404 implied that the video-based microteaching model had a moderate effect on the female preservice teachers' science teaching efficacy beliefs.

In summary, the dependent samples t-test analysis of the video-based microteaching group's STEBI-B results revealed that the improvements in female preservice teachers' mean PSTE and STOE post-intervention assessment scores, together with their overall STEBI-B post-intervention assessment scores following their participation in video-based microteaching, were not a product of chance but rather due to the positive impact of the intervention (video-based microteaching model).

The video-based microteaching model was effective in enhancing both the female preservice teachers' personal science teaching efficacy and outcome expectancy beliefs, which collectively form their science teaching efficacy. The Cohen's d values for the PSTE (0.619), STOE (0.497), and overall STEBI-B (0.404) further showed that the effect of the video-based microteaching model on female preservice teachers' science teaching efficacy beliefs was substantial.

4.2.3 Research Question 3: What are the mean science teaching efficacy levels of female preservice teachers engaged in collaborative peer microteaching as compared with those engaged in video-based microteaching?

In order to address research question 3, the mean STEBI-B pre-intervention assessment and post-intervention assessment scores of the female preservice teachers in the collaborative peer microteaching group were compared with those in the video-based microteaching group. The comparison of the mean STEBI-B pre-intervention assessment and post-intervention assessment scores of the female preservice teachers in the collaborative peer microteaching group with those in the video-based microteaching group was carried out using descriptive statistics, including mean and standard deviation. A summary of the descriptive analysis of the mean STEBI-B pre-intervention assessment and post-intervention assessment scores of the collaborative peer and video-based microteaching groups is presented in Table 8.

Table 8: Descriptive Analysis of the STEBI-B Results of the Collaborative Peer and Video-based Microteaching Groups

STEBI-B (Group)	N	Pre-intervention assessment mean (x)	Post-intervention assessment mean (x)	Mean difference	SD (Pre-intervention assessment)	SD (Post-intervention assessment)
Collaborative Peer Microteaching	28	3.502	3.901	0.399	0.693	0.708
Video-based Microteaching	28	3.625	4.247	0.622	0.622	0.371

*p<0.05

From the STEBI-B results of the collaborative peer and video-based microteaching groups displayed in Table 8, it could be observed that the female preservice teachers in the two microteaching groups had moderate levels of science teaching efficacy prior to their engagement in the interventions (collaborative peer and video-based microteaching). The female preservice teachers in the two microteaching groups had their mean STEBI-B pre-intervention assessment scores falling within the 3.00 to 3.99 range, and values within this range, as noted by Bleicher (2004), suggest moderate levels of science teaching efficacy.

Prior to their involvement in any intervention, the video-based microteaching group had a slightly higher mean STEBI-B pre-intervention assessment score of 3.625 compared to the collaborative peer microteaching group's mean STEBI-B pre-intervention assessment score of 3.502. This suggested that participants in the video-based microteaching group initially had a marginally higher level of science teaching efficacy compared to those in the collaborative peer microteaching group.

There was an increase in the mean STEBI-B post-intervention assessment scores of the female preservice teachers in both the collaborative peer and video-based microteaching groups following their participation in the collaborative peer and video-based microteaching sessions, respectively. The collaborative peer microteaching group's mean STEBI-B scores increased from 3.502 in the pre-intervention assessment to 3.901 in the post-intervention assessment with a mean difference of 0.399, whilst the video-based microteaching group's mean STEBI-B scores increased from 3.625 in the pre-intervention assessment to 4.247 in the post-intervention assessment, resulting in a higher mean difference of 0.622 compared to the collaborative peer microteaching group.

The higher mean difference in the STEBI-B pre-intervention assessment and post-intervention assessment scores of the video-based microteaching group (0.622) compared to the collaborative peer microteaching group (0.399) indicated that, comparatively, the video-based microteaching model was more effective in enhancing the female preservice teachers' levels of science teaching efficacy.

The standard deviation (SD) values for the STEBI-B pre-intervention assessment and post-intervention assessment scores of the collaborative peer microteaching and video-based microteaching groups were (0.630 and 0.783) and (0.457 and 0.371), respectively. The higher SD values of the collaborative peer microteaching group's STEBI-B pre-intervention assessment (0.630) and post-intervention assessment (0.783) compared to the video-based microteaching group's STEBI-B pre-intervention assessment (0.457) and post-intervention assessment (0.371) indicated greater variability among the female preservice teachers in the collaborative peer group in terms of their science teaching efficacy beliefs.

The lower SD values of the video-based microteaching group indicated that the female preservice teachers in the group were less diverse and more uniform in their perceptions of their science teaching efficacy. The decrease in SD values from the pre-intervention assessment (0.457) to post-intervention assessment (0.371) in the video-based group suggested that participants' science teaching efficacy beliefs became more stable and aligned after the intervention.

An independent samples t-test was conducted to compare the STEBI-B results of the collaborative peer and video-based microteaching groups and determine if the increment in the mean STEBI-B pre-intervention assessment and post-intervention assessment scores of both groups was statistically significant. A summary of the analysis is presented in Table 9.

Table 9: An Independent Samples t-Test Analysis of the STEBI-B Results of the Collaborative Peer and Video-based Microteaching Groups

STEBI-B (Group)	N	df	Pre-intervention assessment mean (x)	SD	Post-intervention assessment mean (x)	SD	t	p	Cohen's d
Collaborative Peer Microteaching	28	27	3.502	0.693	3.901	0.708	-4.376	.000	0.483
Video-based Microteaching	28	27	3.625	0.457	4.247	0.371	-7.906	.000	0.404

*p<0.05

The independent samples t-test analysis of the collaborative peer and video-based microteaching groups' STEBI-B results presented in Table 9 revealed that there was a statistically significant difference in the mean STEBI-B (pre-intervention assessment and post-intervention assessment) scores of female preservice teachers in both microteaching groups. The statistically significant t and p values for the STEBI-B (pre-intervention assessment and post-intervention assessment) scores of the collaborative peer and video-based microteaching groups were (t = -4.376, p = 0.000) and (t = -7.906, p = 0.000) respectively. The larger t-statistic for the mean STEBI-B (pre-intervention assessment and post-intervention assessment) scores of the video-based microteaching group (-7.906) compared to that of the collaborative peer microteaching group (-4.376) suggested that, comparatively, the video-based microteaching model had a stronger impact on the female preservice teachers' science teaching efficacy beliefs.

The effect size of the collaborative peer and video-based microteaching models on the female preservice teachers' science teaching efficacy beliefs, as determined by Cohen's d, were 0.483 and 0.404 respectively. The Cohen's d value of 0.483 for the collaborative peer microteaching group indicated that the microteaching model had a moderate positive impact on the female preservice teachers' science teaching efficacy beliefs. The Cohen's d of 0.404 for the video-based microteaching model, though slightly smaller than that of the collaborative peer microteaching model, also indicated that the microteaching model was moderately effective in enhancing female preservice teachers' science teaching efficacy.

In summary, the independent samples t-test analysis revealed that the implementation of the collaborative peer and video-based microteaching models, as interventions, led to statistically significant improvements in the mean science teaching efficacy scores of the female preservice teachers in the two treatment groups (collaborative peer and video-based microteaching groups). The video-based microteaching group had a greater mean improvement (mean difference = 0.622) in their STEBI-B (pre-intervention assessment and post-intervention assessment) scores and a larger, statistically significant t-value of -7.906 compared to the collaborative peer microteaching group's mean difference of 0.399 and t-value of -4.376. This implied that, comparatively, the video-based microteaching model was more effective in enhancing the science teaching efficacy of female preservice teachers.

An analysis of covariance (ANCOVA) was further conducted to determine whether there was a statistically significant difference in the post-intervention STEBI-B scores of female preservice teachers exposed to the collaborative peer microteaching and video-based microteaching approaches while controlling for pre-intervention scores. A summary of the results is presented in Table 10.

Table 10: A summary of ANCOVA analysis of the Post-Intervention STEBI-B Assessment Scores of Female Preservice Teachers in the Collaborative Peer and Video-based Microteaching Groups (Pre-test Controlled)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared (η^2)
Corrected Model	3.214	2	1.607	6.842	.002	.203
Intercept	21.457	1	21.457	91.354	.000	.629
Pre-intervention STEBI-B assessment (Covariate)	1.126	1	1.126	4.794	.033	.082
Group	1.874	1	1.874	7.982	.007	.128
Error	12.909	53	0.244			
Total	937.614	56				
Corrected Total	16.123	55				

*p<0.05

The results of the ANCOVA revealed that the overall model was statistically significant, $F(2, 53) = 6.842$, $p = .002$, $\eta^2 = .203$) indicating that the variables included in the model significantly explained variations in the post-intervention science teaching efficacy scores. The pre-intervention STEBI-B assessment score, which served as the covariate, was also found to have a significant effect on the post-intervention scores, $F(1, 53) = 4.794$, $p = .033$, $\eta^2 = .082$. This indicated that the initial level of science teaching efficacy of the female preservice teachers had a significant influence on their post-intervention efficacy levels.

The analysis further showed that the two microteaching models: collaborative peer and video=based microteaching models had a statistically significant impact on the post-intervention STEBI-B assessment scores of the female preservice teachers in the treatment groups, $F(1, 53) = 7.982$, $p = .007$, $\eta^2 = .128$). This indicated that, after controlling for the pre-intervention STEBI-B scores, there was a statistically significant difference in the mean science teaching efficacy levels of female preservice teachers exposed to the collaborative peer microteaching and video-based microteaching models.

The partial eta squared value of 0.128 indicates a moderate effect size, implying that the collaborative peer and video-based microteaching models contributed substantially to the variation in the post-intervention science teaching efficacy scores of the female preservice teachers in the treatment groups. In terms of the mean efficacy scores, female preservice teachers who participated in the video-based microteaching approach demonstrated higher post-intervention STEBI-B mean scores compared with those who participated in the collaborative peer microteaching approach. This indicates that although both approaches contributed to improvements in science teaching efficacy, the video-based microteaching approach produced relatively higher mean science teaching efficacy levels among the female preservice teachers.

In summary, the findings from the ANCOVA suggest that while both collaborative peer and video-based microteaching models were beneficial in improving the science teaching efficacy of the female preservice teachers, the video-based microteaching was comparatively more effective in enhancing female preservice teachers' levels of science teaching efficacy when their pre-intervention differences were statistically controlled.

4.2.4 Research Question 4: What influence do the demographic variables age and prior teaching experiences have on female preservice teachers' science teaching efficacy?

In order to answer Research Question 4, an analysis of covariance (ANCOVA) was conducted to examine the influence of the demographic variables of age and prior teaching experience on the science teaching efficacy of female preservice teachers in the collaborative peer and video-based microteaching groups. The female preservice teachers' pre-intervention STEBI-B assessment scores was included as a covariate to control for initial differences between the groups. A summary of the two-way ANCOVA is presented in Table 11.

Table 11: A Summary of the Two-way ANCOVA of the STEBI-B Results of Female Preservice Teachers in the Collaborative Peer and Video-based Microteaching Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	0.528	5	0.106	0.616	0.689	0.058
Intercept	167.858	1	167.858	977.732	< .001	0.951
Pretest STEBI-B (Covariate)	0.252	1	0.252	1.440	0.236	0.028
Age	0.031	2	0.015	0.089	0.915	0.004
Prior teaching experience	0.114	1	0.114	0.665	0.419	0.013
Age * Prior teaching experience	0.131	1	0.131	0.762	0.387	0.015
Error	8.584	49	0.175			
Total	770.259	55				
Corrected Total	9.112	54				

*p<0.05

From Table 11, it can be observed that the demographic variables age and prior teaching experience, as well as their interaction effect, did not have a statistically significant influence on the STEBI-B scores of the female preservice teachers after controlling for their pretest scores. The p-value for age ($p = 0.915$) was greater than the significance level of 0.05, indicating that age did not significantly influence the science teaching efficacy of the female preservice teachers in this study after adjusting for baseline differences. The partial eta squared ($\eta^2 = 0.004$) indicates that age accounted for only 0.4% of the variance in the STEBI-B scores, suggesting a negligible effect.

Similarly, the p-value for prior teaching experience ($p = 0.419$) was greater than 0.05, indicating that prior teaching experience did not significantly influence the science teaching efficacy of the female preservice teachers when the pretest scores were controlled. This suggests that participants who had prior teaching experience did not necessarily demonstrate higher levels of science teaching efficacy than those without such experience. The partial eta squared value ($\eta^2 = 0.013$) indicates that prior teaching experience explained only 1.3% of the variance in the STEBI-B scores.

The interaction effect between age and prior teaching experience ($p = 0.387$) was also not statistically significant. This result indicates that the influence of prior teaching experience on science teaching efficacy was not dependent on age. In other words, the combined effect of age and prior teaching experience did not significantly affect the science teaching efficacy of the female preservice teachers in this study.

Furthermore, the corrected model was not statistically significant ($p = 0.551$), indicating that age, prior teaching experience, and their interaction did not significantly predict the posttest STEBI-B scores after controlling for the covariate. This suggests that these demographic factors contributed minimally to the variation in the female preservice teachers' science teaching efficacy.

The intercept was statistically significant, $F(1, 50) = 977.732$, $p < .001$, with a large effect size (Partial $\eta^2 = .951$). This indicates that, independent of the demographic variables and after controlling for the covariate, the overall mean science teaching efficacy score of the female preservice teachers was substantially above zero. The large effect size further suggests that most of the variance in the STEBI-B scores was attributable to the overall group mean rather than differences associated with age or prior teaching experience.

In summary, the two-way ANCOVA results revealed that age, prior teaching experience, and their interaction effect had no statistically significant influence on the science teaching efficacy of the female preservice teachers in this study after controlling for pretest differences. This suggests that these demographic variables contributed very little to the variation in participants' science teaching efficacy beliefs.

4.2.5 Question 5: What are female preservice teachers' perceptions regarding the collaborative peer microteaching model?

In order to answer research question 5, a perception of collaborative peer microteaching (PCPM) questionnaire was administered to all the female preservice teachers in the collaborative peer microteaching group to ascertain their views about the effectiveness of the collaborative peer model and its impact on their science teaching efficacy. Sixteen (16) out of the twenty-eight (28) female preservice teachers in the collaborative peer microteaching group voluntarily completed and submitted the PCPM questionnaire.

Participants' responses to the PCPM were analyzed using frequencies, percentages, mean and standard deviation. The mean score of each item of the PCPM was computed to determine the level of preservice teachers' agreement or disagreement with the items of the questionnaire. A summary of the analysis of female preservice teachers' views of the collaborative peer microteaching model is presented in Table 12.

Table 12: Analysis of Female Preservice Teachers' Views of the Collaborative Peer Microteaching Model

S/N	ITEMS	SA (5)	A (4)	U (3)	DA (2)	SD (1)	Mean	Total
1.	I feel more confident teaching science after participating in collaborative peer microteaching sessions	10 (63%)	6 (37%)	0 (0%)	0 (0%)	0 (0%)	4.63	.500
2.	I am now more confident in explaining scientific concepts to students as a result of participating in collaborative peer microteaching	7 (44%)	8 (50%)	1 (6%)	0 (0%)	0 (0%)	4.38	.619
3.	The feedback I received from my peers helped me believe in my ability to teach science effectively	7 (44%)	9 (56%)	0 (0%)	0 (0%)	0 (0%)	4.44	.512
4.	Collaborative peer microteaching allowed me to reflect critically on my science teaching techniques	8 (50%)	7 (44%)	1 (6%)	0 (0%)	0 (0%)	4.31	1.01
5.	Watching my peers teach helped me develop better strategies for teaching science	12 (75%)	2 (12.5%)	2 (12.5%)	0 (0%)	0 (0%)	4.63	.719
6.	Engaging in discussions with peers after microteaching helped improve my understanding of how to teach science concepts	7 (44%)	9 (56%)	0 (0%)	0 (0%)	0 (0%)	4.44	.512
7.	Peer feedback during CPM focused on both my strengths and areas for improvement in teaching science.	6 (38%)	8 (50%)	0 (0%)	2 (12%)	0 (0%)	4.13	.957
8.	Collaborative peer feedback has helped me improve my lesson planning and preparation for science classes	5 (31%)	10 (63%)	1 (6%)	0 (0%)	0 (0%)	4.19	.750
9.	Collaborative peer microteaching has improved my ability to plan and organize effective science lessons	8 (50%)	8 (50%)	0 (0%)	0 (0%)	0 (0%)	4.50	.516
10.	The collaborative nature of the microteaching sessions enhanced my classroom management skills for science lessons.	10 (63%)	6 (37%)	0 (0%)	0 (0%)	0 (0%)	4.63	.500
11.	Peer feedback helped me improve my questioning techniques during science instruction.	7 (44%)	9 (56%)	0 (0%)	0 (0%)	0 (0%)	4.44	.512
12.	Collaborative peer microteaching has increased my belief that I can overcome challenges while teaching science.	9 (56%)	5 (32%)	1 (6%)	1 (6%)	0 (0%)	4.38	.619
13.	Participating in collaborative peer microteaching increased my motivation to teach science.	10 (63%)	6 (37%)	0 (0%)	0 (0%)	0 (0%)	4.63	.500
14.	I am more confident in my ability to help students understand difficult science concepts after engaging in peer microteaching sessions.	8 (50%)	7 (44%)	1 (6%)	0 (0%)	0 (0%)	4.44	.629
15.	Overall, I believe that the collaborative peer microteaching model is effective in developing my science teaching efficacy.	14 (88%)	2 (12%)	0 (0%)	0 (0%)	0 (0%)	4.88	.342

From Table 12, it could be observed that all the items of the PCPM had mean values greater than 4.0 which indicated that the female preservice teachers had an overall positive view of the collaborative peer microteaching model. Item 15 recorded the highest mean score of 4.88 whilst item 7 recorded the least mean score of 4.13. Items 1, 2 and 3 collectively sought to examine the female preservice teachers' views regarding the impact of the collaborative peer microteaching model on their confidence in teaching science.

All the female preservice teachers in response to Item 1 of the PCPM agreed that their engagement in collaborative peer microteaching sessions made them feel more confident in teaching science. With the item 2, majority (94%) of the female preservice teachers indicated that they felt more confident about explaining scientific concepts to students after participating in the collaborative peer microteaching sessions. With the third item, all the female preservice teachers agreed that feedback from peers during collaborative peer microteaching sessions helped them to believe more in their abilities to teach science effectively. The high mean values all the three items (1, 2, and 3), with no disagreement or strong disagreement to any of the three items indicated a strong consensus among the female preservice teachers with regards to effectiveness of the collaborative peer microteaching model in boosting their confidence in teaching science effectively.

Items 4, 5, 6 and 7 collectively sought female preservice teachers' views regarding the effectiveness of the collaborative peer microteaching model in promoting learning through critical reflection, and peer feedback and interaction. All the items (4, 5, 6 and 7) had mean scores greater than 4 which indicated a strong consensus among the female preservice teachers regarding the effectiveness of the collaborative peer microteaching model in promoting learning through critical reflection, peer feedback and interaction.

Almost all (94%) of the female preservice teachers in response to Item 4 agreed that engaging in collaborative peer microteaching sessions enabled them to critically reflect on their science teaching techniques, one of the participants however had a neutral view. Majority (88%) of the female preservice teachers agreed with the fifth item that observing their peers teach during the microteaching sessions enabled them develop better strategies for teaching science. Two (12%) of the female preservice teachers had neutral views regarding the fifth item.

In response to Item 6, all the female preservice teachers agreed that engaging in discussions with peers after the collaborative peer microteaching sessions helped to improve their understanding of how to teach science concepts. Majority (88%) of the female preservice teachers in response to the seventh item of the PCPM agreed that the feedback they received from peers during the collaborative peer microteaching sessions was helpful as it highlighted both their strengths and weaknesses. Two (12%) of the female preservice teachers disagreed with the seventh item.

Items 8, 9, 10, 11 and 12 collectively sought to examine female preservice teachers' views regarding the effectiveness of the collaborative peer microteaching model in developing their science teaching skills and competency. All the female preservice teachers in response to item 8 of the PCPM agreed that the feedback received from peers during the collaborative peer microteaching sessions helped to improve their lesson planning and preparation for science classes. In their response to the ninth item, all the female preservice teachers agreed that there were improvements in their abilities to plan and effectively organize science lessons after participating in collaborative peer microteaching sessions.

In response to item 10, all the female preservice teachers agreed that the collaborative nature of the microteaching sessions they engaged in enhanced their classroom management skills. All of the female preservice teachers in response to the eleventh item of PCPM agreed that the peer feedback they received during the collaborative peer microteaching sessions helped to improve their questioning skills during science instruction. Majority (88%) of the female preservice teachers in their response to item 12 of the PCPM agreed that the collaborative peer microteaching model increased their belief that they could overcome challenges that may arise during science instruction. One of the female preservice teachers disagreed with item 12 whilst another one remained neutral in her response.

Items 13 and 14 sought to examine the female preservice teachers' perceptions of the collaborative peer microteaching model in terms of its effectiveness in building female preservice teachers' self-efficacy and motivation to teach science effectively to promote meaningful learning of the subject. In response to item 13, all the female preservice teachers agreed that participating in collaborative peer microteaching sessions increased their motivation to teach science. Majority (94%) of the female preservice teachers in their response to item 14 agreed that they felt more confident in their ability to facilitate students' understanding of difficult science concepts after engaging in peer microteaching sessions. Both items 13 and 14 had mean scores greater than 4 which indicated that there was a strong consensus among the female preservice teachers regarding the effectiveness of the collaborative peer microteaching model in building their self-efficacy and motivation to teach science.

The female preservice teachers' overall perceptions of the collaborative peer microteaching model as measured by item 15. The item had a mean value of 4.88 which indicated that the female preservice teachers had an overall positive view of the collaborative peer microteaching model. Majority (88%) of the female preservice teachers in their response to item 15 agreed that overall, the collaborative peer microteaching model was effective in developing their science teaching efficacy beliefs. Two (12%) of the female preservice teachers were neutral in their response.

4.2.6 Research Question 6: What are female preservice teachers' perceptions and experiences with the video-based microteaching model?

In order to answer research question, ten female preservice teachers in the video-based microteaching group were engaged in a focus group interview. Twelve questions were posed to the participants in the group to ascertain their perceptions and experiences with the video-based microteaching model. The analysis of the participants' responses resulted in the derivation of three main themes: self-awareness and improvement, impact on science content understanding, and development of teaching competencies and strategies and experiences.

Pertaining to the first theme: self-awareness and improvement, two sub-themes emerged and these included development through self-assessment and strengths and weaknesses awareness. The participants were of the view that the feedback from peers and reflecting on their own performances from the video recordings of their teaching practice sessions enabled them to identify their strengths and areas in their instructional practice that required improvements. Some of the views expressed by the respondents in relation to the first theme are presented as follows:

Participant 1 expressed that:

> *Prior to the microteaching, I was very anxious but when I reflected on my performance from the video recordings, I was able to identify my strengths and weaknesses. I did better in the second microteaching practice session because I was able to build on my strengths and overcome my weaknesses.*

To buttress the view earlier expressed by Participant 1, Participant 2 also said that:

> *After participating in the first microteaching session and watching the video recording of my teaching practice session, I realized I could do better and this enabled me to perform better in the subsequent microteaching session. It also taught me how to speak well and confidently among people.*

The views expressed by the two participants echoed a general perception among the female preservice teachers regarding the effectiveness of the video-based microteaching in promoting self-reflection, awareness and assessment which is critical to building their science teaching efficacy.

In relation to the second theme: impact on science content understanding, a sub-theme that emerged was science content mastery. The participants indicated that through the video- microteaching practice sessions, they were able to handle certain aspects or topics in science they otherwise considered to be difficult and were able to engage their students better in their lesson.

For example, Participant four expressed that:

> *In the first microteaching session, I handled only the closure aspect of the lesson, I thought that was the only aspect I could do but as the microteaching*

practice sessions progressed, I realized that I could teach more of the other aspects of the science lesson.

The views of the participants regarding the effectiveness of the video-based microteaching model in promoting science content mastery aligns with findings of researchers Choy et al. (2019), who found that video-based reflections enhanced preservice teachers' content understanding and pedagogical reasoning. Santagata and Yeh (2016) also reported that video analysis fostered deeper engagement and active learning among preservice teachers.

Pertaining to the third theme: development of teaching competencies and strategies, two sub-themes namely teaching strategies and techniques, and feedback and teaching confidence emerged. The participants expressed that the video-based microteaching model enhanced their classroom management skills and questioning skills. They also noted that engaging in the microteaching video-based microteaching model also made them more confident. Some of the views expressed by the participants in relation to the third theme are presented as follows:

Participant 5 expressed that:

I was very nervous prior to engaging in the first microteaching session but I became more confident in the other microteaching sessions.

Corroborating Participant 5 statement, Participant 3 expressed that:

In the first microteaching, I was nervous but I became confident in the subsequent microteaching practice sessions.

Participant 1 also stated that:

> *In the first microteaching session my classroom management was poor but it improved in the other microteaching sessions.*

In addition to Participant 1 statement, Participant 7 expressed that:

My questioning skills and teaching strategies improved in my second microteaching practice session because in the first microteaching session, I was very nervous.

All the participants expressed that the feedback they received during their first microteaching practice was beneficial in their improvement in the second microteaching practice session. The effectiveness of the video-based microteaching model in enhancing female preservice teachers' teaching techniques and their confidence have been corroborated by findings from other empirical studies such as Tripp and Rich (2012), who found that video analysis helped preservice teachers identify areas for improvement and refine their instructional strategies, and Santagata and Guarino (2011), who reported that engaging with video-based reflections significantly increased teachers' confidence and self-efficacy in lesson delivery.

4.3 Discussion of Findings

The results obtained from the analysis of the data gathered in this study are discussed in this section with reference to findings from existing literature. The discussions are presented sequentially in the order in which the research questions were stated.

4.3.1 Research Question 1: What are the levels of female preservice teachers' science teaching efficacy before and after engaging in collaborative peer microteaching sessions?

The descriptive analysis of the collaborative peer microteaching group's STEBI-B results displayed in Table 4 revealed that prior to their engagement in the collaborative peer microteaching sessions, the female preservice teachers had moderate levels of science teaching efficacy. The female preservice teachers in the collaborative peer microteaching group's personal science teaching efficacy beliefs which describes the belief or confidence the female preservice teachers have in their own abilities to teach science effectively as measured by the personal science teaching efficacy (PSTE) subscale STEBI-B was lower than their science teaching outcome expectancy (STOE) prior to their engagement in the collaborative peer sessions.

This finding reflects a pattern observed in several other empirical studies. Research shows that preservice teachers often enter teacher education programs with higher STOE than PSTE scores (Bleicher, 2004). This is because even though preservice teachers tend to believe strongly that effective science teaching strategies could positively influence student science learning outcomes (high STOE), they are often not very confident in their personal ability to teach science effectively (low PSTE) (Bleicher, 2004). The low PSTE as noted by (Yilmaz-Tüzün, 2008) is often pronounce in female preservice teachers due to various socio-cultural and educational factors.

In a study that sought to investigate the impact of microteaching on the science teaching efficacy beliefs of Ghanaian preservice teachers, with a specific focus on gender differences, Osei-Anto (2018) found that some female preservice teachers entered teacher education programs with significantly lower PSTE scores compared to their male counterparts, even though both groups had relatively high science teaching outcome expectancy (STOE). The low PSTE was attributed to a lack of confidence in teaching science content, limited prior hands-on experience, and cultural perceptions of science as a male domain.

Similar to Osei-Anto's (2018) findings, Boateng and Ampiah (2016) in a study that examined Ghanaian preservice teachers' science teaching experiences and challenges encountered during practicum reported that many preservice teachers, especially females, expressed a lack of confidence in their ability to teach science effectively. The low personal science teaching efficacy (PSTE) among the female preservice teachers was linked to limited prior exposure to practical science, inadequate training facilities, insufficient teaching materials, and restricted opportunities for classroom practice.

Boateng and Ampiah (2016) and Osei-Anto (2018) in their studies also reported improvements in the female preservice teachers' levels of personal science teaching efficacy (PSTE) following their engagement in structured microteaching experiences in a collaborative learning environment with peer support systems, and frequent hands-on activities. This finding is consistent with this current study's finding that following their engagement in collaborative peer microteaching sessions, the female preservice teachers' showed improvements in their personal science teaching efficacy (PSTE). There were also improvements in their science teaching outcome expectancy (STOE) and their overall science teaching efficacy.

Collaborative peer microteaching is widely recognized as a significant strategy in teacher education programs, particularly for enhancing the science teaching efficacy beliefs of preservice teachers, including females (Cinici, 2016). In a study on microteaching and pre-service teachers' sense of self-efficacy in teaching, Arsal (2014) found that engaging in preservice teachers in collaborative peer microteaching sessions enhanced their sense of self-efficacy in the classroom.

Boateng and Ampiah (2016) noted that the collaborative peer microteaching model provided preservice teachers, especially female preservice teachers, with a safe and supportive environment for female preservice teachers to practice and refine their teaching skills. The constructive peer feedback the preservice teachers receive during the collaborative peer microteaching sessions helps correct their misconceptions and builds their confidence. Boateng and Ampiah (2016) further noted that the female preservice teachers' feelings of isolation and low self-efficacy caused by traditional lecture-based science methods could be mitigated through the creation of collaborative learning environment, provision of peer support systems and engagement in hands-on practice. These are all important features of the collaborative peer microteaching model.

Cinici (2016) conducted a study with thirty-six (36) preservice science teachers enrolled in a science methods course that incorporated collaborative peer microteaching sessions and found significant improvements in the participants' science teaching self-efficacy beliefs following their engagement in collaborative peer microteaching sessions. The findings revealed that the collaborative peer microteaching sessions provided the preservice teachers with a supportive and enriching environment, leading to significant improvements in their science teaching self-efficacy beliefs.

Yilmaz-Tuzun (2008) found that female preservice teachers benefited significantly from the hands-on activities and peer collaboration components of the collaborative peer microteaching model, which were crucial in building their science teaching self-efficacy. Collectively, the studies by Boateng and Ampiah (2016), Cinici (2016), Arsal (2014) and Yilmaz-Tuzun (2008) all underscore the positive impact of the collaborative peer microteaching model on preservice teachers' science teaching efficacy. The microteaching model was found to provide a structured and supportive learning environment that enhanced preservice teachers' confidence through shared experiences and peer support. For female preservice teachers, who may face additional challenges in science teaching due to societal stereotypes or limited prior experiences, the collaborative microteaching model was found to be particularly empowering, as it provided them with opportunities to practice and refine their science teaching skills in a supportive environment. This ultimately builds their confidence in their science instructional skills (Boateng & Ampiah, 2016).

4.3.2 Research Question 2: What are the levels of female preservice teachers' science teaching efficacy before and after participating in video-based microteaching sessions?

The descriptive analysis of the video-based microteaching group's STEBI-B results displayed in Table 6 revealed that prior to their participation in the video-based microteaching sessions, the female preservice teachers had moderate levels of science teaching efficacy. The female preservice teachers had higher science teaching outcome expectancy (STOE) compared to their personal science teaching efficacy (PSTE). Female preservice teachers' higher STOE compared to their PSTE prior to their engagement in any form of intervention have been associated with the lack of mastery experiences in science teaching (Osei-Anto, 2018); sociocultural and gender stereotypes (Boateng & Ampiah, 2016); and the disconnect between beliefs about the importance of science teaching and confidence in doing it (Velthuis et al., 2015).

Osei-Anto (2018) found that even though Ghanaian female preservice teachers strongly believed teaching science effectively could result in positive student outcomes in the subject (high STOE), they often exhibited low PSTE due to the lack of sufficient practical science teaching experiences. Similarly, Yilmaz-Tuzun (2008) found that preservice elementary teachers in Turkey had a higher STOE compared to the PSTE and this was also attributed the preservice teachers limited direct teaching experiences in science classrooms.

According to Bandura's (1997) social cognitive theory, preservice teachers' outcome expectancy beliefs (STOE) are often shaped by their general beliefs about cause-effect relationships in science teaching and learning, whilst their personal self-efficacy (PSTE) is more sensitive to direct experience and mastery. Engaging preservice teachers in structured microteaching experiences like the video-based microteaching have been found in several empirical studies to be effective in building preservice teachers, particularly female preservice teachers' personal science teaching efficacy (PSTE), science teaching outcome expectancy (STOE) and their overall science teaching efficacy (Tripp & Rich, 2012; Aydin et al., 2013).

Following their participation in the video-based microteaching sessions, this study found significant improvements in the video-based groups' levels of personal science teaching efficacy (PSTE), science teaching outcome expectancy (STOE) and their overall science teaching efficacy. The findings are consistent with the findings from other empirical studies on the microteaching model. Erdogan and Gokbel (2020) in a study on the effect of video-based microteaching practices on preservice science teachers' teaching self-efficacy found significant improvement in PSTE scores for preservice science teachers who engaged in video-based microteaching.

Yerdelen et al., (2019) in a study on the impact of a teaching practice course enriched with video-case microteaching on prospective science teachers' self-efficacy found that the preservice teachers maintained high self-efficacy levels throughout the teaching practice course enriched with video- case microteaching. The preservice teachers' high self-efficacy was attributed to the positive impact of the intervention, and feedback the preservice teachers received from mentors and peers during the course.

In a study on pre-service science teachers' self-efficacy beliefs through video-based teaching in Ghanaian colleges of education, Amankwah et al. (2019) found that following their engagement in video-based microteaching, the study's participants recorded significant improvement in their personal science teaching efficacy beliefs. The female preservice teachers who participated in the study reported increased teaching confidence after watching and critiquing recordings of their own lessons and those of their peers.

The findings from the studies above collectively highlight the effectiveness of the video-based microteaching model in enhancing preservice teachers' levels of science teaching efficacy. The model was found to be particularly effective in enhancing preservice teachers, particularly female preservice teachers' personal science teaching efficacy (Amankwah et al., 2019). A study by Tripp and Rich (2012) revealed that when preservice teachers watch recordings of their lessons, they become more aware of their instructional strengths and weaknesses. This reflective process is key to building their science teaching efficacy.

Kpanja (2012) also noted that female preservice teachers, in particular, benefited from the opportunity to privately analyze their teaching performance without the anxiety often associated with live peer feedback. The opportunities the female preservice teachers had to engage in self-reflection during the microteaching confidence was key to building their confidence in teaching science, a subject often perceived as intimidating.

4.3.3 Research Question 3: What are the mean science teaching efficacy levels of female preservice teachers engaged in collaborative peer microteaching as compared with those engaged in video-based microteaching?

The descriptive analysis of both the collaborative peer and video-based microteaching groups' STEBI-B results displayed in Table 8 revealed that prior to their participation in the collaborative peer and video-based microteaching sessions, the female preservice teachers in both microteaching groups had moderate levels of science teaching efficacy.

The findings of this study revealed that the female preservice teachers in the collaborative peer and video-based microteaching groups had lower personal science teaching efficacy (PSTE) as compared to their science teaching outcome expectancy (STOE). This finding is consistent with findings from some existing empirical studies. Preservice teachers' personal science teaching efficacy beliefs (PSTE) have been found to be closely associated with mastery experiences, which preservice teachers typically lack before participating in microteaching sessions or practicum. Bleicher (2004) in a study on revisiting the STEBI-B: measuring self-efficacy in preservice elementary teachers found that even though preservice teachers generally believed that effective science teaching could positively affect students' outcomes in science (high STOE), they had low PSTE scores prior to their field experiences.

Menon and Sadler (2016) in a study that explored the relationship between preservice teachers' science self-efficacy beliefs and their science content knowledge found that preservice teachers with weak science content knowledge felt less confident in their abilities to teach science effectively (low PSTE) even though they believed strongly in the positive impact of good science teaching strategies on students' learning outcomes (high STOE). Oduro (2015) found that many Ghanaian female preservice teachers had low PSTE due to sociocultural perceptions that science is a male-dominated domain, despite acknowledging that science teaching improves learning outcomes (STOE).

This study found that following their engagement in the collaborative peer and video-based microteaching sessions, there were significant improvements in the personal science teaching efficacy, science teaching outcome expectancy and the overall science teaching efficacy of female preservice teachers in both the collaborative peer and video-based microteaching groups. The female preservice in the video-based microteaching group experienced more gains in their mean PSTE, STOE and overall STEBI-B scores compared to their peers in the collaborative peer microteaching group.

Consistent with the finding of this study, the video-based microteaching model has been found in some empirical studies to be more effective in enhancing female preservice teachers' levels of science teaching efficacy compared to the collaborative peer microteaching model. For example, in a study on using video to support in-service and pre-service teacher learning in Ghana, Major and Watson (2018) found that the video-based microteaching model enabled preservice teachers, especially female preservice teachers to critically analyze their own classroom performances. The structured reflection boosted their self-awareness and self-efficacy more than traditional peer feedback, which was often limited or less constructive.

Similarly, in a study on using video to develop preservice teachers' knowledge and self-efficacy, Tripp and Rich (2012) found that preservice teachers who engaged in video-based self-analysis showed significantly higher gains in their teaching efficacy compared to those in traditional or peer-based models. Watching recordings of their own teaching practice sessions helps the preservice teachers to recognize both their strengths and areas needing improvement. This ultimately builds their confidence in their instructional skills.

Further, in a study that explored preservice teachers' perspectives on video-based microteaching, Saban and Çoklar (2013) found that video-supported microteaching had a statistically significant effect on increasing self-efficacy beliefs, especially for female preservice teachers, who often face gendered barriers in science confidence. Whilst some researchers agree that the peer feedback and collaboration component of the collaborative peer microteaching model is effective in enhancing preservice teachers' personal science teaching efficacy (PSTE), it lacked the depth of self-reflection provided by video-based microteaching model (Odeh et al.,2019).

In a study on the effectiveness of microteaching in teacher education programs: a case study on pre-service teachers' perceptions, Odeh et al., (2019) found that whilst the collaborative peer microteaching helped preservice teachers improve their communication and teamwork skills, it was less effective than video-based approaches in promoting individual reflection and personal teaching efficacy, especially for preservice teachers who required more individualized feedback and self-paced learning.

Finally, Choy et al. (2014) in a study that explored the impact of video-based reflection during microteaching found that the video-based microteaching model significantly improved preservice teachers' awareness of their pedagogical strengths and weaknesses. The authors noted that video-based reflection was especially valuable for female preservice teachers, who often preferred the self-paced and non-threatening nature of video review compared to peer critique.

4.3.4 *Research Question 4: What influence do the demographic variables age and prior teaching experience have on female preservice teachers' science teaching efficacy?*

This study found that the demographic factors age and prior teaching experience, and their interactions had no statistically significant effect on the STEBI-B results of the female preservice teachers in the collaborative peer and video-based microteaching groups. This suggested that these variables impact on the science teaching efficacy of the study's participants was not statistically significant.

Empirical studies on the effect of demographic variables such as age, prior teaching experiences and their interaction effects on preservice teachers, especially female preservice teachers' science teaching efficacy have reported mixed findings. Whilst some studies reported significant positive correlations between the variables (ages, prior teaching experiences and their interaction effects) and preservice teachers' science teaching efficacy beliefs, other studies like this this current study found that these variables had no statistically significant influence or correlation with preservice teachers' science teaching efficacy.

Hechter (2011) and Moseley et al., (2002) in studies that examined the influence of age on preservice teachers' personal science teaching efficacy (PSTE) reported that older preservice teachers generally exhibited higher personal science teaching efficacy (PSTE) than the younger ones. The higher PSTE of the older preservice teachers was attributed to their greater life experiences, maturity, and often more developed coping strategies when confronting challenging science concepts. Moseley et al., (2002) reported that older preservice teachers tend to have more confidence and perseverance compared to younger preservice teachers, and this boosts their science teaching efficacy.

In contrast with Hechter (2011) and Moseley et al., (2002) findings, Menon and Sadler (2016) in a study that explored preservice elementary teachers' science self-efficacy beliefs and science content knowledge found no significant correlation between the participants' age and science teaching efficacy. The researchers noted that preservice teachers' cognitive engagement and exposure to science pedagogy, not age, were more critical in building preservice teachers' science content knowledge and self-efficacy beliefs.

Tschannen-Moran and Hoy (2007) in a study on the differential antecedents of self-efficacy beliefs of novice and experienced teachers found that teaching experience and contextual factors influence efficacy development differently for novice and experienced teachers. The researchers further noted that for both novice and experienced teachers, mastery experiences were more critical than demographic variables like age alone in building preservice teachers' teaching efficacy.

Velthuis et al., (2014) and Yilmaz and Cavas (2008) in studies that explored the influence of prior teaching experiences on preservice teachers' science teaching efficacy beliefs found that preservice teachers with prior teaching experiences had higher personal science teaching efficacy beliefs (PSTE) compared to those without it. Yilmaz and Cavas (2008) noted that preservice teachers with prior informal or formal teaching experiences (e.g., tutoring or teaching assistant roles) were more confident in their science instructional skills compared to those without such experiences.

In a study on teacher training and pre-service primary teachers' self-efficacy for science teaching, Velthuis et al., (2014) found that prior teaching experiences in educational settings gave female preservice teachers confidence in classroom management and delivery, leading to stronger efficacy in science teaching. Contrast findings by this current study and studies by Palmer (2006) and Bleicher (2004) indicated that preservice teachers' prior teaching experiences had no statistically significant influence on their science teaching efficacy beliefs. This study found that the prior teaching experiences of the preservice teachers in the collaborative peer and video-based microteaching groups had no statistically significant impact on their mean PSTE, STOE and overall STEBI-B scores.

In a study on revisiting the STEBI-B: measuring self-efficacy in preservice elementary teachers, Bleicher (2004) found no statistically significant differences in the participants' science teaching efficacy beliefs based on their prior teaching experiences and suggested that unless the experience is specifically related to science, it may not influence science teaching efficacy. Palmer (2006) observed that prior teaching experience influences self-efficacy only when individuals interpret those experiences as successful or mastery-oriented, which is consistent with Bandura's identified sources of self-efficacy.

Studies that have explored the influence of the interaction effect of age and prior teaching experiences on preservice teachers' science teaching efficacy have produced mixed findings. Sak et al. (2018) in a study that explored how age and prior teaching experiences interact to influence preservice preschool teachers' science teaching efficacy found that preservice teachers' age and prior teaching experiences had a moderate interaction effect on preservice teachers' science teaching efficacy.

Contrasting findings were made by Swackhamer et al. (2009) in study that focused on increasing the self-efficacy of in-service teachers through content knowledge. The researchers found that the demographic variables age and prior teaching experiences, and their interaction effect had no statistically significant effect on the teachers' science teaching efficacy beliefs. This finding is consistent with the current study's finding that preservice teachers' science teaching efficacy beliefs were not significantly influenced by their age, prior teaching experiences and the interaction effects of the two variables.

4.3.5 Research Question 5: What are female preservice teachers' perceptions regarding the collaborative peer microteaching model?

The perception of collaborative peer microteaching model questionnaire (PCPM) was given to the female preservice teachers in the collaborative peer microteaching group to explore their views regarding the collaborative peer microteaching model and its effectiveness in five main areas; the development of their science teaching confidence, promoting reflective practice and peer learning, development of their teaching competence and skills, boosting their motivation and self-efficacy and the overall effectiveness of the model in developing their science teaching efficacy.

Items 1, 2 and 3 collectively sought to examine the female preservice teachers' views regarding the impact of the collaborative peer microteaching model on their confidence in teaching science. In response to these items, there was a general consensus among the female preservice teachers with regards to effectiveness of the collaborative peer microteaching model in boosting their confidence in teaching science effectively. Akinbobola (2015) found that using collaborative microteaching notably improved preservice teachers' self-efficacy in teaching science by fostering a positive and less stressful learning environment that encouraged active participation.

In a similar vein, Kpanja (2001) highlighted that peer feedback during microteaching sessions played a crucial role in boosting preservice teachers' confidence and reflective teaching practices. Additionally, Ambusaidi and Al-Balushi (2012) found that cooperative microteaching approaches strengthened science teaching efficacy by promoting the exchange of ideas and collaborative learning among preservice teachers.

Items 4, 5, 6 and 7 of the PCPM questionnaire collectively sought the female preservice teachers' views regarding the effectiveness of the collaborative peer microteaching model in promoting learning through critical reflection, and peer feedback and interaction. The female preservice teachers' responses to these items revealed a robust consensus among the participants regarding the effectiveness of the collaborative peer microteaching in promoting reflective practice and peer learning. Kurt and Bütüner (2020) found that collaborative peer microteaching provided a practical platform for preservice teachers to improve their instructional strategies, engage in critical reflection, and benefit from mutual support and shared learning. Amobi and Irwin (2009) also emphasized that collaborative microteaching fosters a supportive environment for constructive feedback and reflection. Peer interactions during collaborative peer microteaching sessions were found Saban and Çoklar (2013) to be effective in encouraging deeper professional learning and critical self-assessment among preservice teachers.

The female preservice teachers in the collaborative peer microteaching group generally perceived the collaborative peer microteaching model as effective in developing their science teaching skills and competency and this reflected in their responses to the items 8, 9, 10, 11 and 12 of the PCPM. This finding has been corroborated Akram and Malik (2022), who found that collaborative peer microteaching not only improved science content delivery but also fostered higher teaching competency and confidence among preservice teachers in STEM education. Çakmak (2012) highlighted that collaborative microteaching helped preservice teachers develop teaching techniques through reflective peer discussion, enhancing their pedagogical skills in science instruction.

Finally, the female preservice teachers' responses to the items 13, 14 and 15 of the PCPM indicated that the female preservice teachers generally perceived the collaborative peer microteaching model as effective in boosting their motivation and developing their science teaching efficacy. Similar finding was reported by Çakır and Aksan (2020), who found that collaborative microteaching practices significantly enhanced female preservice science teachers' confidence, motivation, and perceived teaching competence through peer support and constructive feedback.

4.3.6 Research Question 6: What are female preservice teachers' perceptions and experiences with the video-based microteaching model?

The analysis of female preservice teachers' responses regarding their perceptions and experiences with the video-based microteaching model resulted in the generation of three main themes which comprised self-awareness and improvement, impact on science content understanding, and development of teaching competencies and strategies. Many empirical studies have reported the effectiveness of the video-based microteaching model in enhancing female preservice teachers' self-awareness and science content understanding, as well as developing their science teaching competencies and strategies. For instance, Tripp and Rich (2012) found that video analysis of recordings of microteaching practice sessions enabled preservice teachers to critically examine their instructional practices, increasing their self-awareness and pedagogical insight. Similarly, Santagata and Guarino (2011) reported that engaging with video-based reflections helped teachers to connect theory to practice, deepening their understanding of science content and improving instructional decision-making. Additionally, Lee and Wu (2021) demonstrated that video-based microteaching fostered the development of effective teaching strategies among female preservice teachers, leading to increased science teaching self-efficacy and competence. The findings outlined above affirm that the video-based microteaching provides a valuable platform for reflective practice and skill enhancement, particularly for female preservice teachers.

4.4 Chapter Summary

The analysis of the data gathered in this study revealed that the collaborative peer and video-based microteaching models were both effective in enhancing female preservice teachers' personal science teaching efficacy and outcome expectancy beliefs, which collectively constitutes their science teaching efficacy beliefs. The participants in this study prior to their engagement in any microteaching practice sessions had moderate levels of science teaching efficacy. There was a statistically significant improvement in the participants' levels of science teaching efficacy following their engagement in the collaborative peer and video-based microteaching practice sessions. The effect size of the interventions (collaborative peer and video-based microteaching), as determined by the Cohen's d was moderate to large which indicated that the microteaching models had significant impact on the participants' science teaching efficacy.

Comparatively, the video-based microteaching model was found to be more effective in enhancing the participants' science teaching efficacy and this was evident in the large mean difference between the video-based microteaching group's pre-intervention and post-intervention assessment scores on the PSTE and STOE subscales of the STEBI-B, and the overall STEBI-B results as compared to that of the collaborative peer microteaching group. The female preservice teachers in the collaborative peer microteaching group generally perceived the collaborative peer microteaching model as effective in developing their science teaching efficacy and this reflected in their responses to the items of the perception of collaborative peer microteaching (PCPM) questionnaire.

The analysis of the qualitative data gathered from the focus group interview of participants in the video-based microteaching group revealed that the participants regarded the video-based microteaching model as effective in improving their science content understanding, self-awareness and science teaching competencies.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter begins with a summary of the entire study. The chapter also highlights the major findings of the study and the conclusions drawn from the findings of the study. The concluding part of the chapter comprise recommendations for further research on the collaborative peer and video-based microteaching models and its impact on preservice teachers' science teaching efficacy.

5.1 Summary

This study investigated the effects of the collaborative peer and video-based microteaching models on the science teaching efficacy of selected female preservice teachers from the Presbyterian Women's College of Education, Aburi in the Akuapim South Municipality. The sample for the study comprised fifty-six (56) second-year female preservice teachers belonging to two intact Early Grade classes. The study's participants were assigned to two treatment groups: one group was exposed to the collaborative peer microteaching and the other group was exposed to the video-based microteaching model within a period of six weeks.

In both treatment groups, the female preservice teachers were made to plan brief lessons (10 to15 minutes), teach the lessons to peers, receive feedback, replan the lessons and teach them again to the peers. In the collaborative peer microteaching sessions, the female preservice teachers engaged in peer discussions after their teaching practice sessions and through the peer discussion, the female preservice teachers receive feedback on their teaching performance. The female preservice teachers were made to reteach their lesson building on the feedback they received.

In the video-based microteaching session, the female preservice teachers' after delivering their lessons, engage in self-reflection by watching recordings of their microteaching practice sessions. By reviewing their own teaching performance and that of their colleagues, the female preservice teachers identify the strengths of their instruction and areas that requires improvement. The female preservice teachers were made to replan and reteach their lessons building on the knowledge they derived from reflecting on their previous teaching performances.

Prior to their engagement in the collaborative peer and video-based microteaching sessions, the female preservice teachers in the two treatment groups were given the science teaching efficacy belief instrument (STEBI-B) as a pre-intervention assessment to determine their initial levels of science teaching efficacy. After engaging in the collaborative peer and video-based microteaching sessions for a period of six weeks, the STEBI-B was administered again to the female preservice teachers as a posttest to assess changes in their science teaching efficacy after the treatments.

A perception of the collaborative peer microteaching model (PCPM) questionnaire was administered to the collaborative peer microteaching group to determine their perceptions of the collaborative peer microteaching model and its effectiveness in developing their science teaching efficacy. The video-based microteaching group's perceptions and experiences the video-based microteaching was determined through a focus group interview with ten of the group's participants.

Inferential statistics such as t-test and a two-way analysis of covariance (ANCOVA) was employed in the analysis of the pre-intervention and post-intervention STEBI-B assessment results of the female preservice teachers in both the collaborative peer and video-based microteaching groups. The t-test and two-way ANCOVA were carried out at a P-vale of 0.05. Effect size, as determined by the Cohen's d was calculated to measure the magnitude of the impact of the collaborative peer and video-based microteaching models on the female preservice teacher' science teaching efficacy. Data from the perception of the collaborative peer microteaching model (PCPM) questionnaire was analyzed quantitatively using descriptive statistics such as mean. Thematic analysis of the data gathered from the focus group interview of some participants in the video-based microteaching group was also carried out.

5.2 Key Findings

The key findings made from the analysis of data gathered in this study are presented below in accordance with the sequence in which the research questions were stated.

1. ***What are the levels of female preservice teachers' science teaching efficacy before and after engaging in collaborative peer microteaching sessions?***

The study found that the female preservice teachers' levels of science teaching efficacy prior to the collaborative peer microteaching sessions, as evidenced by their STEBI-B pre-intervention assessment results were moderate. The female preservice teachers' personal science teaching efficacy beliefs were lower than their science teaching outcome expectancy beliefs prior to their engagement in the collaborative peer microteaching session. This finding corroborates earlier findings by Bleicher (2004) that indicated that preservice teachers often entered teacher education programs with higher science teaching efficacy beliefs as compared to their personal teaching efficacy. Yilmaz-Tüzün (2008) found that low personal science teaching efficacy beliefs (PSTE) was often more pronounce in female preservice teachers due to various socio-cultural and educational factors.

Following their engagement in the collaborative peer microteaching sessions, the female preservice teachers in the collaborative peer microteaching group's personal science teaching efficacy and outcome expectancy beliefs which collectively constitutes their science teaching efficacy improved significantly, as evidenced by their STEBI-B post-intervention assessment results. The effect size of the collaborative peer microteaching model as determined by the Cohen's d was 0.537, which indicated that the microteaching model had a moderate impact on the female preservice teachers' science teaching efficacy.

Collaborative peer microteaching has been found to be an effective strategy in teacher education programs that provides opportunities for preservice teachers to practice and refine their instructional skills, and these as opined by Cinici (2016) is critical to building their science teaching efficacy.

2. What are the levels of female preservice teachers' science teaching efficacy before and after participating in video-based microteaching sessions?

The study found that the female preservice teachers' prior to participating in the video-based microteaching sessions had moderate levels of science teaching efficacy and this was evidenced by their pre-intervention STEBI-B assessment results. The female preservice teachers' science teaching outcome expectancy (STOE) was higher than their personal science teaching efficacy (PSTE). Female preservice teachers' higher science teaching outcome expectancy (STOE) compared to their personal science teaching efficacy (PSTE) prior to their engagement in any form of intervention have been associated with several reasons; the lack of mastery experiences in science teaching (Osei-Anto, 2018), sociocultural and gender stereotypes (Boateng & Ampiah, 2016), and the disconnect between beliefs about the importance of science teaching and confidence in doing it (Velthuis et al., 2015).

Following their participation in the video-based microteaching sessions, the female preservice teachers' levels of science teaching efficacy improved significantly. The dependent samples t-test analysis of the video-based microteaching group's pre-intervention and post-intervention STEBI-B assessment results revealed that there was a statistically significant difference in the female preservice teachers' mean STEBI-B pre-intervention and post-intervention assessment scores. The effect size of the video-based microteaching model, as determined by Cohen's d was 0.4043 which indicated that the video-based microteaching model had a moderate effect on the female preservice teachers' science teaching efficacy beliefs.

3. ***What are the mean science teaching efficacy levels of female preservice teachers engaged in collaborative peer microteaching as compared with those engaged in video-based microteaching?***

The study revealed that the female preservice teachers in both the collaborative peer and video-based microteaching groups had moderate levels of science teaching prior to been engaged in any form of microteaching session. The science teaching efficacy levels of the female preservice teachers in both the collaborative peer and video-based microteaching groups increased significantly after the microteaching sessions, and this was evidenced by the significant improvements in their post-intervention STEBI-B assessment results.

The independent samples t-test analysis of the pre-intervention and post-intervention STEBI-B assessment results of the female preservice teachers in the collaborative peer and video-based microteaching groups revealed that comparatively, the video-based microteaching model was more effective in enhancing female preservice teachers' levels of science teaching efficacy. The video-based microteaching group experienced more gains in their mean PSTE, STOE and overall STEBI-B scores as compared to their peers in the collaborative peer microteaching group. Major and Watson (2018) opined that the opportunities that female preservice teachers have during the video-based microteaching sessions to critically reflect and analyze on recordings of their own classroom performances was critical to boosting their self-awareness and self-efficacy.

Further, an analysis of covariance (ANCOVA) of the collaborative peer and video-based microteaching groups' post-intervention STEBI-B assessment results revealed that after controlling for differences in the pre-intervention STEBI-B scores, there was a statistically significant difference in the mean science teaching efficacy levels of female preservice teachers who participated in the collaborative peer microteaching and video-based microteaching sessions.

The female preservice teachers who participated in the video-based microteaching sessions recorded higher post-intervention STEBI-B mean scores than those who participated in the collaborative peer microteaching approach which suggested that while both microteaching models improved the science teaching efficacy levels of female preservice teachers, the video-based microteaching model resulted in relatively higher efficacy levels.

4. ***What influence do the demographic variables age and prior teaching experience have on female preservice teachers' science teaching efficacy?***

This study found that the demographic factors age and prior teaching experience, and their interactions had no statistically significant effect on the STEBI-B results of the female preservice teachers in the collaborative peer and video-based microteaching groups. The two-way analysis of covariance (ANCOVA) of the STEBI-B results of the video-based and collaborative peer microteaching groups revealed that the P-values of the demographic variables age and prior teaching experience, and their interaction effect were greater than 0.05 which indicated that age, prior teaching experience and their interaction effect had no statistically significant influence on female preservice teachers' science teaching efficacy.

5. What are female preservice teachers' perceptions regarding the collaborative peer microteaching model?

A perception of the collaborative peer microteaching model (PCPM) questionnaire comprising fifteen (15) items rated on a five point Likert scale was administered to the collaborative peer microteaching group to ascertain their perceptions of the collaborative peer microteaching model and its effectiveness in five main areas: the development of their science teaching confidence, promoting reflective practice and peer learning, development of their teaching competence and skills, boosting their motivation and self-efficacy and the overall effectiveness of the model in developing their science teaching efficacy.

There was a general consensus among the female preservice teachers with regards to effectiveness of the collaborative peer microteaching model in boosting their confidence in teaching science effectively. Majority of the female preservice teachers agreed with the items 1, 2 and 3 of the PCPM which collectively sought to explore female preservice teachers' views regarding the effectiveness of the collaborative peer microteaching model in boosting their confidence in teaching science.

The female preservice teachers' responses to the items 4, 5, 6, and 7 of the PCPM also revealed a robust consensus among the female preservice teachers regarding the effectiveness of the collaborative peer microteaching model in promoting learning through critical reflection, and peer feedback and interaction. Majority of the female preservice teachers agreed with the items 8, 9, 10, 11 and 12 of the PCPM which collectively sought to explore their perceptions of the collaborative peer microteaching model regarding its effectiveness in developing their science teaching skills and competency.

Items 13, 14 and 15 of the PCPM collectively sought to ascertain the female preservice teachers' views regarding the effectiveness of the collaborative peer microteaching model in boosting their motivation and developing their science teaching efficacy. The female preservice teachers agreed with all the items which indicated that they generally perceived the collaborative peer microteaching model as effective in boosting their motivation and developing their science teaching efficacy.

6. What are female preservice teachers' perceptions and experiences with the video-based microteaching model?

Ten female preservice teachers from the video-based microteaching group were interviewed to explore their perceptions and experiences with the video-based microteaching model. The thematic analysis of the female preservice teachers' responses from the focus group interview resulted in the generation of three main themes which comprised self-awareness and improvement, impact on science content understanding, and development of teaching competencies and strategies. The female preservice teachers were of the view that the feedback from peers and reflecting on their own performances from the video recordings of their teaching practice sessions helped to improve their self-awareness.

The female preservice teachers expressed that the video-based microteaching model enhanced their classroom management skills and questioning skills. They indicated that engaging in the microteaching video-based microteaching model made them more confident in handling complex science concepts.

5.3 Conclusion

This study sought to compare two microteaching models namely the collaborative peer microteaching model and the video-based microteaching model in terms of their effectiveness in developing the science teaching efficacy of the selected female preservice teachers in the Presbyterian Women's College, Aburi. The study found that even though both the collaborative peer microteaching model and video-based microteaching models significantly enhanced the study's participants' levels of science teaching efficacy, comparatively, the video-based microteaching model was found to be effective as determined by the larger improvements in the post-intervention STEBI-B assessment results of the video-based microteaching group compared to that of the collaborative peer microteaching group.

The study also found that the demographic variables age, prior teaching experiences and their interaction effect did not significantly influence the STEBI-B results of female preservice teachers in both the collaborative peer and video-based microteaching groups. The analysis of the collaborative peer microteaching group's responses to the perception of the collaborative peer microteaching model (PCPM) revealed that they regarded the collaborative peer microteaching model as effective in developing their science teaching confidence, promoting reflective practice and peer learning, development of their teaching competence and skills, boosting their motivation and self-efficacy and the overall effectiveness of the model in developing their science teaching efficacy. The video-based microteaching group also regarded the video-based microteaching as effective in developing their science teaching efficacy.

This study concluded that the video-based microteaching model enhances female preservice teachers' science teaching efficacy more effectively than the collaborative peer microteaching model by promoting focused self-reflection through visual feedback. The opportunities that female preservice teachers had during video-based microteaching sessions to review and reflect on video recordings of their own teaching performances and that of their colleagues repeatedly enabled them to critically evaluate their teaching practices, identify areas for improvement, and build confidence through self-awareness and continuous learning.

5.4 Recommendations

Based on the findings and conclusions drawn from this study, the following recommendations are made to ensure that microteaching strategies that blends the strengths of the collaborative peer and video-based microteaching models are prioritized in female preservice teacher education. The recommendations are classified into three: for teacher training institution, instructors of preservice teachers and preservice teachers.

5.4.1 Recommendations for Teacher Training Institutions

1. Teacher training institutions should prioritize the integration of both collaborative peer and video-based microteaching models into their science education curricula, ensuring dedicated time and resources for their effective implementation.
2. Teacher training institutions should also invest in appropriate technology for video recording and playback, and provide technical support for both instructors and preservice teachers.
3. Teacher training institutions should promote a culture where reflection is not just encouraged but systematically integrated into all aspects of preservice

teacher training. This involves providing structured opportunities for preservice teachers to critically analyze their own teaching, receive constructive feedback, and engage in self-assessment.

4. Teacher training institutions should also allocate resources for workshops and training sessions that focus on best practices in facilitating microteaching, providing constructive feedback, utilizing video analysis tools, and fostering collaborative learning environments. This ensures that instructors are well-equipped to guide preservice teachers through these complex pedagogical experiences.

5.4.2 Recommendations for Instructors of Preservice Teachers

1. Before engaging in microteaching, instructors must ensure preservice teachers have strong foundation in science pedagogical content knowledge (PCK). This involves not only understanding scientific concepts but also knowing how to effectively teach those concepts to diverse learners, anticipate misconceptions, and design engaging science activities Microteaching then becomes a platform to practice and refine this PCK.
2. Instructors should design microteaching sessions, whether collaborative peer or video-based, with well-defined learning objectives that target specific science teaching skills. Clearly stated objectives help maintain focus, guide the teaching process, and ensures that feedback is precise and aligned with desired outcomes.
3. Instructors should model and guide preservice teachers in providing constructive, specific, and actionable feedback. Rather than offering vague praise or broad criticisms, instructors should help preservice teachers identify

specific instances within their teaching performance that requires improvements, then propose clear and practical strategies for improvement.

4. Instructors should systematically monitor and document the progress of preservice teachers throughout their microteaching practice sessions in order to track changes in teaching efficacy.

5.4.3 Recommendations for Preservice Teachers

1. Preservice teachers should be encouraged to critically self-reflect on their microteaching practices, particularly when using video recordings. This involves analyzing their strengths, weaknesses, and areas for improvement based on their own observations and instructor/peer feedback.
2. Preservice teachers should actively participate in peer feedback sessions, offering constructive criticism and being open to receiving feedback from their peers.
3. Preservice teachers should also learn to interpret and apply the feedback received from instructors and peers during microteaching practice sessions to refine their teaching strategies and improve their science teaching efficacy.
4. Preservice teachers are encouraged to be proactive in seeking out additional resources such as exemplary science teaching videos and opportunities to observe experienced science teachers, to further enhance their pedagogical skills.

5.5 Suggestions for Further Studies

1. Subsequent research could explore how the collaborative peer and video-based microteaching models affect both male and female preservice teachers in mixed-gender Colleges of Education. This would reveal whether gender

dynamics influence the effectiveness of each model and inform more inclusive teacher training strategies.

2. Further research could examine the impact of a hybrid model that blends both the collaborative peer and video-based microteaching models on preservice teachers' science teaching efficacy. Blending the collaborative peer and video-based microteaching models combines the strengths of both models which provides a more robust framework for enhancing science teaching efficacy.
3. Further research could analyze how factors such as prior academic achievement, science background, technological proficiency, and teaching practicum environment moderate the effectiveness of collaborative peer and video-based microteaching models.
4. Further research ought to be carried out to investigate how the improvements in science teaching efficacy gained through collaborative peer or video-based microteaching during preservice education translates into actual classroom performance and student outcomes during in-service teaching.
5. Finally, this study could be replicated across multiple Colleges of Education in different regions of Ghana to assess the generalizability of the findings.

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APPENDICES

APPENDIX A

SCIENCE TEACHING EFFICACY BELIEF INSTRUMENT (STEBI-B)

Introductory Statement

This questionnaire was designed to assess the level of confidence you have in your ability to teach science effectively and positively impact students' learning outcome in the subject. in Please be assured that all the information you provide will remain confidential and used solely for research purposes. Your time and effort in completing this questionnaire is greatly appreciated. Thank you.

PART A

Demographic Information:

Age: [ ] 18-20 years [ ] 21- 23 years [ ] 24- 26 years [ ] 27- 29 years [ ] 30 years - above

Educational Background:

[ ] Senior High School

[ ] Bachelor's Degree in Education

[ ] Bachelor's Degree in Science

[ ] Master's Degree

Other: …………………………………………………………….

Prior Teaching Experience: [ ] None [ ] Less than 1 year [ ] 1-3 years [ ] 3-5 years [ ] More than 5 years

Subject(s) previously taught (if applicable):

……………………………………………........

PART B:

I. Personal Science Teaching Efficacy (PSTE) Items:

I am confident in my ability to teach science concepts effectively.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

2. I believe I can teach science successfully, even if students have difficulty understanding it.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

3. I am able to help students understand complex science concepts.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

4. I feel capable of teaching science content that is challenging.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

5. I can provide effective science instruction regardless of students' prior knowledge.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

6. I am confident in my ability to engage students in science learning.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

7. I believe I can help students develop a positive attitude toward science.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

8. I can effectively use a variety of teaching strategies to teach science.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

9. I feel I am competent to teach science despite my own limitations in knowledge.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

10. I am capable of using hands-on science activities to teach science concepts.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

11. I am confident in my ability to manage science laboratory activities.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

12. I believe I can adapt science lessons to meet diverse student needs.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

13. I feel that I can successfully teach science to students with different learning styles. Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

II. Science Teaching Outcome Expectancy (STOE) Items:

14. If I teach science well, my students will perform better in science.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

15. Effective science teaching will result in higher student achievement in science.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

16. Students will understand science concepts better if I teach them effectively.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

17. Good science teaching can positively impact students' interest in science.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

18. Students will be more motivated to learn science if I teach it well.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

19. Teaching science effectively will lead to improved student attitudes toward science. Strongly Agree [ ] Agree [ ] Neutral [ ]

Strongly Disagree [ ] Strongly Disagree [ ]

20. If I teach science effectively, my students will be more successful in science assessments.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

21. My science teaching efforts will result in better student understanding of science.

Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

22. Effective science instruction will help students perform well in science-related tasks. Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ]

Strongly Disagree [ ]

23. Teaching science effectively will lead to increased student engagement in science activities. Strongly Agree [ ] Agree [ ] Neutral [ ] Strongly Disagree [ ] Strongly Disagree [ ]

APPENDIX B

PERCEPTIONS OF COLLABORATIVE PEER MICROTEACHING QUESTIONNAIRE

Introductory Statement:

This questionnaire is part of a research study aimed at investigating the effectiveness of the collaborative peer microteaching model in developing the science teaching efficacy of Ghanaian female preservice teachers. Your responses will provide valuable insights into how this model has impacted your confidence and ability to teach science. The information you provide will be kept confidential and will only be used for research purposes. Please take your time to answer the questions honestly. Thank you for your participation.

Instructions: For each statement below, please indicate your level of agreement or disagreement to the items below by selecting one of the following options:

(1) Strongly Disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly Agree

Demographic Information:

Age: [ ] 18-20 years [ ] 21- 23 years [ ] 24- 26 years [ ] 27- 29 years [ ] 30 years - above

Educational Background:

[ ] Senior High School

[ ] Bachelor's Degree in Education

[ ] Bachelor's Degree in Science

[ ] Master's Degree

Other: ……………………………………………

Prior Teaching Experience: [ ] None [ ] Less than 1 year [ ] 1-3 years

[ ] 3-5

years [ ] More than 5 years

Subject(s) previously taught (if applicable):

………………………………………….....................

PART B:

Theme 1: Science Teaching Confidence

1. I feel more confident teaching science after participating in collaborative peer microteaching sessions. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]
2. I am now more confident in explaining scientific concepts to students as a result of participating in collaborative peer microteaching. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]
3. The feedback I received from my peers helped me believe in my ability to teach science effectively. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]

Theme 2: Reflective Practice and Peer Learning

4. Collaborative peer microteaching allowed me to reflect critically on my science teaching techniques. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]
5. Watching my peers teach helped me develop better strategies for teaching science. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]
6. Engaging in discussions with peers after microteaching helped improve my understanding of how to teach science concepts. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]
7. Peer feedback during CPM focused on both my strengths and areas for improvement in teaching science. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]

Theme 3: Teaching Competence and Skill Development

8. Collaborative peer feedback has helped me improve my lesson planning and preparation for science classes. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]
9. Collaborative peer microteaching has improved my ability to plan and organize effective science lessons. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]
10. The collaborative nature of the microteaching sessions enhanced my classroom management skills for science lessons. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]

11. Peer feedback helped me improve my questioning techniques during science instruction Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]

12. Collaborative peer microteaching has increased my belief that I can overcome challenges while teaching science. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]

Theme 4: Motivation and Self-Efficacy

13. Participating in collaborative peer microteaching increased my motivation to teach science. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]

14. I am more confident in my ability to help students understand difficult science concepts after engaging in peer microteaching sessions. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]

Theme 5: Overall Perception of Collaborative Peer Microteaching

15. Overall, I believe that the collaborative peer microteaching model is effective in developing my science teaching efficacy. Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree [ ]

APPENDIX C

INTERVIEW GUIDE

EXPLORING the EFFECTIVENESS of VIDEO-BASED MICROTEACHING in DEVELOPING SCIENCE TEACHING EFFICACY

Introductory Statement

Thank you for agreeing to participate in this interview. This interview will focus on your experiences with the video-based microteaching model, specifically how it has impacted your confidence and ability to teach science. Your insights will help the researcher better understand how the microteaching model contributes to the development of science teaching skills.

Your responses will be kept confidential and used solely for the purpose of this research. There are no right or wrong answers, so please feel free to share your honest thoughts and experiences. The interview will take approximately 20-30 minutes.

<u>Interview Questions</u>

1. Can you describe your overall experience with the video-based microteaching model during your science education course?

(Probe: How did you feel about being recorded and reviewing the recordings of your teaching?)

2. How did watching recordings of your own teaching affect your perception of your teaching abilities in science?

(Probe: Did it help you identify areas for improvement? If so, how?)

3. What specific teaching strategies or techniques did you develop or improve after reviewing your video-based microteaching sessions?

(Probe: Did you notice changes in your instructional approach, questioning skills, or classroom management?)

4. How did the feedback you received from peers and instructors after the video-based microteaching sessions influence your teaching confidence in science?

(Probe: Can you provide examples of feedback that was particularly helpful?)

5. Can you share any challenges or difficulties you encountered while participating in the video-based microteaching model?

(Probe: How did you overcome these challenges, if at all?)

6. In what ways, if any, did video-based microteaching help you better understand scientific content and concepts that you will be teaching in the future?

7. How do you compare the video-based microteaching model with other teaching approaches or models (e.g., collaborative peer microteaching) in terms of developing your science teaching efficacy?

(Probe: Which model do you feel has been more beneficial, and why?)

8. To what extent do you believe video-based microteaching has improved your confidence in delivering science lessons in front of a class?

(Probe: Can you share specific examples where you felt more confident after the sessions?)

9. Do you feel that video-based microteaching has made you more aware of your strengths and weaknesses as a science teacher?

(Probe: How has this awareness impacted your teaching?)

10. Has video-based microteaching influenced your ability to engage students and make science lessons more interactive and interesting?

(Probe: If yes, in what ways?)

11. How did the opportunity to self-assess through video reflections shape your development as a future science teacher?

(Probe: Did you notice improvements in lesson planning, delivery, or classroom interaction?)

12. What recommendations would you give to improve the effectiveness of the video-based microteaching model for preservice science teachers?

(Probe: Are there specific aspects of the process that you think could be enhanced or changed?)

APPENDIX D

SAMPLE LESSON PLANS

COLLABORATIVE PEER MICROTEACHING GROUP

Date: 27th September, 2024 Class: Basic 5 Class size: 30. Duration: 90 minutes	Subject: Science. Strand: Basic Electronics Sub-strand:
Content Standard: B5.4.2.1 Demonstrate knowledge of generation of electricity, it's transmission and transformation into other forms.	Indicator: B5.4.2.1.1 Identify the components of an electric circuits and the functions.

Performance Indicator: learners identify the components of an electric circuits and know their functions	Keywords: Battery, Wire, Capacitor, Resistor, Switch, Circuit, store, Charge	Resources: Cardboard containing drawings of the symbols of electronic components.

Phase one 5mins. Including starter and review of learners' Prior knowledge.

Teacher Strategy	Teacher Activities	Learner Activities	Core Competences.
Questioning.	. Teacher review learners prior knowledge by asking learners questions related to the lesson. . Teacher introduces the topic to learners and treat keyword with learners.	. Learners share their prior knowledge on the lesson. . learners listen attentively to the teacher and repeat after the teacher.	Communication.
Phase two 10mins Including assessment			
	Step 1: . Teacher displays the cardboard containing drawing of the symbols of electronic components to learners. . Teacher explains the functions of the various components in an electronic circuit to learners.	. Learners listen attentively to the teacher and watch the drawings on the board. . Learners pay active attention to the ~~fact~~ teacher.	Communication. Communication.
Discussion.	Step 2: Teacher shows a video of a complete circuit to learners for better understanding and discusses it	. Learners watch the video for further understanding and discuses with the teacher.	Communication.
Group work.	Step 3: ASSESSMENT. . Teacher ask learners in groups to give the functions of some of the electronic components.	. Learners in groups tell the functions of some of the electronic components.	Communication.
Phase three 5mins / Reflection.			
	. Teacher ask learners what they have learnt from the lesson and gives learners homework exercise	. Learners share what they have learnt from the lesson and take an exercise home.	Communication.

DATE : 27TH SEPTEMBER 2024	PERIOD : 30minutes	SUBJECT : SCIENCE
TIME :		STRAND :
CLASS : KG	CLASS SIZE : 36	Sub-STRAND : SIMPLE MACHINE
CONTENT STANDARD : B2.4.3.2 RECOGNISE SOME SIMPLE MACHINES AND THEIR ADVANTAGES OF MAKING WORK EASIER	INDICATOR : IDENTIFY SIMPLE MACHINES USED FOR SPECIFIC WORK. B.2.4.3.2.1	LESSON 1 OF 1
PERFORMANCE INDICATOR : LEARNERS WILL BE ABLE TO IDENTIFY SPECFIC WORK	RESOUR.	
KEYWORDS HAMMER, SCISSORS, NAIL CLIPPER, WHEEL BARROW, KNIFE.		

PHASE	TEACHERS ACTIVITIES	LEARNERS ACTIVITIES	CORE-COMPETENCES.
Phase 1 Starter 5minutes.	Teacher Revise R.P.K of Learners about simple machines they Know.	Learners identify simple machines they Know.	
Phase 2 MAIN LESSON 15 MINUTES.	The teacher ask learners what simple machine is, in their own understanding.	Learners explain what simple machine.	Communication and Collaboration.
	The teacher explain simple machine to the Learner with examples.	Learners identify some of the examples of simple machine	Communication skills.
	The teacher dicuss the types of simple machine Inclined Plane, Lever, Wedge, Screw and pulley with their examples.	Learners identify examples of the types of simple machines.	
	The teacher discuss the uses of simple machine.	Learners identify the uses of simple machines.	Critical thinking.
Phase 3 Reflection 5minutes.	The teacher ask Learners what they ~~Lear~~ have learn about simple machine.	Learner say what they have learnt about simple machine.	Critical thinking and problem solving.

27/09/2024

Date: 26-09-2024 Time: 7:00 – 7:15 Period: 2 period	Duration: 15 min	Subject: Integrated Science Strand: Electronics Sub-strand: Basic Electron	
Content standard: K.G 2.4.2 Know the functions and assemblage of the basic electronic components	Indicator: KG 2.4.2.1 By the end of the lesson the learners will be able to know the: 1. Definition of simple electronics 2. Types of simple electronics 3. Simple electronics component and role they play in the gadgets.		Lesson: 1 of 2
Performance indicator: Learners will be able to define simple electronics components and the role they play in the gadgets		Resources: Iron, mobile phone, laptop, light buld.	
Keywords: electronics, components, gadget			
Phrase 1	Phrase 2	Phrase 3	Core – competencies
1. I will introduce the lesson by asking learners to mention some electronic gabgets they know. I will take responses from learners. 2. I will then build the discussion into the new topic: Basic Electronic.	• Have learners brainstorm and come up with the meaning of electronics and gives at least two components. • I will explain electronic and its components to learners using the teaching learning resources (TLR) brought to class. • Have learners tell the roles each component play in the gabgets. Assessment: Mention two examples of electronic Components.	Teachers wraps up by saying: what have you learnt today? • Homework: Draw one electronic gabget.	Critical thinking, Problems solving, Communication and Collaboration.

2/09/2025 Seen

Duration : 15mins Class : 1	Class Size : 25	Strand : Basic Electronics Sub strand : Define electronics, simple electronic gadgets and types, simple electronic component and role they Play.	
Content Standard	Indicator		Lesson 1 of 2

Performance indicator : At the end of the lesson, learners will be able to define electronics, know some simple electronics gadgets and the types of simple electronic gadgets, know the component of electronics and the function.	Core competences Critical thinking & Problem solving, Communication and collaboration.

Keywords : Electronic, component, cell, wire, battery, gadget

Phase / Duration	Learner's Activities / Teacher's activities	Resources
Phase 1 : Starter (Preparing the brain for learning) 3 mins	. Brainstorm learner about their RPK about the topic - Let learners sing a song related to the topic eg: Electronics oo electronics, Wire is an electronic, Switch is an electronic, Battery is an electronic.	Manila Card
Phase 2 : Main (New Learning including assessment) 10 mins	. Guide learners to pronoun the keywords by writing them on the manila card. . Define electronics . Define simple electronic gadget and examples . Types of simple electronic gadget . Electronic component . Component of electronic component Assignment . Let learners talk about component of electronics and their function	Manila Card
Phase 3 Reflection 2 min	. Ask learners what they have learnt about the topic	

[signature] 27/09/2025

Date : 25/09/2024 Time : 7:00 - 7:45	Class size : 36 Duration : 45 mins	Strand . Machines Sub-strand . Simple Machines
Class : B1	Subject : Intergrated Science II	

Content Standard. B1.1.1.1 Demonstrate understanding of simple machine .	Indicator. B1.1.1.1.1 Identify basic Machines and its uses and types .	Performance Indicator. B1.1.1.1.1.1 By the end of the lesson, learners will be able to know simple machines, its uses and types .

Resources . Flash Cards of simple machine , Drawings of basic machines on a manilarcard . Core competences : Critical thinking and problem solving, collaboration and team work .	Keywords . Wheel and Axle, Fan, door knob, Lever, scissors , Inclined plan,

Phase	Teacher's Activities	Learner's Activities
Starter (5mins)	- Let learners sing along with teacher a song about Simple machine . - Teacher ask learners to mention key words they have heard from the song .	Learners sings songs along the teaching .
Main Lesson (35mins)	step:1 Teacher guides learners to mention some simple machines they have seen before (scissor, knife)	Learners mention simple machine they have seen . (Scissor, knife)
	step. 2 With the aid of the Flash card teacher guides learners to identify some type of machines	Learners mention some types of machines .
	step 3. Teacher guides learners to mention the uses of the simple machines found in their homes .	Learners mention the uses of simple machines .
	Assessment : Teacher assess learners to mention the types, examples of machines orally in class .	Learners mention the types and examples of machines orally in class .
Reflection (5mins)	Teacher guide learners to share with their friends the new thing they have learnt .	Learners share with their friends the new things they have learnt .

Date 27th September, 2024 | Duration 45 minutes | Subject Integrated Science
Class: B5 | Class Size 30 | Strand Forces and Energy
Time 9:00 – 945 | | Sub Strand Electricity & Electronics

Content Standard B5.4.2.1. Demonstrate knowledge of generation of electricity, its transmission and transformation into other forms	Indicator B5.4.2.1.1. identify the components of an electric circuit and their functions.	lesson 1 out of 2

Performance indicator: Learners will be able to identify the components of an electric circuit and their function	Resources: Manilla Card containing series & parallel connection.

Keywords: Battery, resistor, wire, Series, Parallel

phase	Teacher strategies	Teacher Activities	Learner Activities	Core Competences
Phase 1 Starter 5 minutes	Questioning and answering	Teacher revises learners R.P.K by asking them questions on what they know about simple electrical circuit.	Learners give responses about what they know about simple electrical circuit.	Communication skills and Critical thinking
Phase 2 Main lesson 30 minutes	Discussion	Step 1: Teach keywords regarding the lesson.	learners repeat keywords after the teacher	Communication skills
	Brainstorming	(ii) Explain the concept of electronic circuit to learners	Learners listen to the explanation of electronic circuit.	
		Step 2: (i) Teacher show a sample of a simple electronic circuit ~~and~~ how to learners.	Learners have a look at the sample of ~~ele~~ simple electronic circuit	
	Demonstration	(ii) Teacher explains how the components of a simple electronic circuit are arranged in parallel and series by using learners as demonstration.	Learners sit and listen to the explanation of how the components ~~of an~~ a simple electronic circuit are arranged in parallel and series	Listening skills
		Step 3: Teacher asks learners to differentiate between the series and parallel connection.		
phase 3	Questioning and answering	Teacher reflect lesson with the learners through questioning.	Learners answers questions asked by the teacher.	Communication skills.
		(ii) Give learners homework to draw a simple electronic circuit in series [illegible]	learners write down their homework.	Creativity and innovation.

27/09/2024 Seen

LESSON PLAN

Date: 9/09/2024 Period 1	Subject: Integrated Science
Time: 8:30 - 8:45am	Strand: Force and energy
Class: Kindergarten 2 class size: 20	Sub Strand: Simple Electronics
Content standard KG2.4.2 Know the functions and assemblage of the basic electronic components.	Indicator: KG2.4.2.1 By the end of the lesson, the learners will be able to know the: 1. Definition of simple electronic 2. Types of simple electronic gadgets. 3. Simple electronic component and the role they play in the gadgets.
Performance Indicator: Learners will be able to define simple electronics and name some electronic components and the role they play in the gadgets.	
	Core Competencies: Critical thinking, problem solving, Communication and collaboration.
Keywords: electronics, componets, gadgets.	

Phase 1 Starter (3 minutes)	Phase 2 (7 minutes)	Phase 3 (5min) Reflection / Plenary	Teaching Learning Resources
1. 1. I will introduce the lesson by asking learners to mention some electronic gadgets they know. I will take responses from learners.	Have learners brainstorm and come up with the meaning of electronics and give at least two examples of electronic components.	Teacher wraps up by saying; what you have learnt today?	Iron, laptop, light bulb, Mobile-phone.
2. I will then build the discussion into the new topic: "Basic Electronics.	I will explain electronics and its components to learners using the teaching learning resources (TLRs) brought to class.	09/09/2024	

	Phase 1	Phase 2	Phase 3
		* Have learners tell the roles each components play in the gadgets. Assessment: Mention two examples of electronic components.	* Homework: Draw one electronic gadget.

-09-24 | Duration: 45minutes | Subject : Integrated Science.
2am– 10:45am | Class Size : 30 | Strand : Science
sic 1 | | Sub strand : food

ndard B1.1.2.1 learners will understand the d groups, the importance of food and how ods contribute to health and growth.

Indicator : B1.1.2.1.1 : learners can identify food groups and explain their importance.
-learners can create a balanced meal using knowledge of food types and nutritional requirements.

Lesson : 1 of 2

Indicator :-Learners will be able to identify types of food.
-Learners will be able to classify foods into their respective groups (protein, fats, Carbohydrate, Vitamins) etc.
-Learner will able to explain the importance of food for growth and development.

TLR(s) : food group chart, flash-cards with various food items, Worksheets for classification of food groups, Cutouts of plates and food for meal planning.

: food, classes of food, carbohydrate, Protein, Fibre, minerals, Vitamins, Water, Uses of food.

	Teacher's activities	Learner's activities	Core Competencies.
Starter (…tes).	•Begin the lesson by asking the class: what are your favourite foods? and why do we need food? •Show a chart of different food groups and introduce the idea that different foods provide different nutrients that are important for health. •Explain the term food and emphasize the importance of consuming different classes of foods in the right proportions.	•learners Share their favourite foods and their reasons for eating them. •learners Observe the food chart and listen to the explanation of food groups. •learners participate in a brief discussion on why we need to eat a variety of foods.	Critical thinking
Main lesson (…nutes).	•Introduce the five major food groups (carbohydrate, protein, fats, Vitamins, and minerals). •Hand out food flash cards to the learners and ask them to work in groups to sort the cards into the correct food groups. •After the sorting activity, guide the learners in planning a balanced meal using the paper plates and cutout food items making sure each meal includes food from all the groups	•learners in groups, sort the flash cards into their corresponding food groups. •Each group Shares their food sorting with the class, explaining why certain foods belong in specific groups. •learners engage in the meal planning activity by creating a balanced meal on their paper plates, ensuring they include Carbohydrates, protein, fats, Vitamins and minerals.	Communication and Collaboration
Reflection (…mins)	•Review the meal plans created by the learners and provide constructive feedback •lead a class discussion about how a balanced diet can help maintain health, Prevent illness, and provide energy for daily activities •Distribute worksheet where students will match food items to their respective food groups and answer a few reflection questions, on balanced diets. Assessment : Teacher Observation of group activities (sorting food, groups and planning.	•learners reflect on their meal plans and discuss the importance of each food groups in a balanced diet. •learners complete the worksheet by matching foods to their appropriate groups and answering reflection questions. •Participate in the class discussion about how their eating habits can improve based on what they have learned. •Review of Worksheets to assess learner's ability to classify foods and create balance meal.	Communication

5/09/2024

Day: Monday	Subject: Early Grade Science II	Sub class: 1
Date: 09-09-2024 Period: 2 (9:00am - 9:45am)	Strand: Simple Electronics Sub-strand: Operation of electronic toys	Class size: 35 Time: 15 min
Indicator: B1.5.2.1	Content Standard: B1.5.2.1.1 Understand electronic toys uses.	Performance Indicator B1.5.2.1.1 By the end of the lesson, learners will be able to identify operation of electronic toys
Core competences communicating and collaboration creativity and innovation.		Resources: Pictures on manila card music box, phone

Phase	Teacher activity	Learners activities
Phase1 Starter (3 minutes)	- Sing rhyme to freshing up their minds - Outline the Learning indicator	Learners sing rhymes with teacher
(Phase 2) 10 minutes	Step1: With the aid of the manila card Teacher discuss Examples of electronic toys.	Learners collaborate with the teacher.
	Step1 2 Teacher have learners to point the pictures on the manila card and say the uses of it.	Learner point and state uses of electronic toys.
	Step2. Teacher discuss the effect of electronic waste, and how to dispose it	Learners listen to the teacher and collaborate.
Phase 3 3 minutes	• Guide learners to discuss the news things they have learnt. • Play music with an electronic toy to entertain them.	Learners orally say what they have learnt.

09/09/2024

sday -09-2024 rd	Class : B1 class side: 37 Duration: 15mins	Subject : Early Grade Science Strand : Machines Sub-strand : Simple Machines
B1.6.1.1 Simple machines and s:	Content standard : B1.6.1.1.1 Demonstrate the understanding of simple machines and identify the types	Performance Indicator: B1.6.1.1.1 By the end of the lesson learners should be to identify simple machines
mpetences : Digital literacy thinking	Resources: Mobile phone, flash card	

Phase	Teacher activities	Student Activities
1 mins	-Teacher teach a song. -Ask learners to predict the the topic -Outline the objectives	Learner learn the song Learner predict the sub-strand.
2 lesson	-step1. Teacher introduce the topic to learners thus simple machine -step1.1 Teacher ask learners pridict some example of simple machine.	Learners listen to the teacher - Learners mention some example of simple machines
	- With the aid of the mobile phone, teacher show learners pictures of the types of simple machine.	
	-Teacher teach learners the uses of some simple machine. Assessment	Learners learn some uses of simple machine.
	-Teachers ask learners what they have learnt	Learners all say what they have learnt

Date: Thursday 26 september, 2024
Time: 10:00 am
Content Standard:

Class: KG 1
Period/Duration:
Indicator: K1.1.4.1.1

Subject: Science
Strand: Food
Sub-strand: Groups/kind of food

Performance indicator: At the end of the lesson learners will know the kinds groups of food.

Resources: Manilla card containing drawing of the kinds of food.

Keywords:

PHASE	STRATEGIES	TEACHING ACTIVITIES	LEARNERS ACTIVITIES	CORE-COMPETENCIES
Phase 1	Brainstorming	Start the lesson with familiar songs containing words of food and let learners pay attention to food mentioned. Teacher revise learners RPK about any food they know	Learners sing songs and pay attention to foods mentioned. Learners answer questions	Critical thinking and problem solving
Phase 2	Questioning and Answers	Teacher brainstorm with learners to initiate discussions on food uses, relying on their personal need for food. i) Teacher guides learners with chart to discuss the kinds of food, based on the earlier activity ii) Teacher groups learners to give examples of the three groups of food. Assessment Teacher ask learners to draw their favourite food and colour it	Learners answer questions on uses of food and their personal need for food. Learners base on earlier activity to bring out the kinds of food. Learners in groups give examples of the food groups (Energy giving foods, Body building foods, protective foods) Learners draw and colour their favourite food.	Critical thinking and problem solving
Phase 3		Teacher ask what learners have learnt	Learners tell the teacher what they have learnt	

APPENDIX E

SAMPLE LESSON PLANS

VIDEO-BASED MICROTEACHING GROUP

Day: Wednesday Date: 24/01/2024 Time: 8:00am- 8:25am Class: Basic 2 Class size : 25 Period:1(25mins)	**Subject: Integrated Science** **Strand: Forces and Energy** **Substrand: Electricity and electronics**

Content standard: B2.4.2.2 Know the ways electronic waste operates and it's effect on the environment.	**Indicator: B2.4.2.2.7** Investigate the processes electronic waste goes through to operate.	Lesson 1 of 2

Performance Indicator: Learners know ways electronic waste is operated.	Resources -Picture of how electronic waste operates -Textbook

Keywords: waste, plastics, glass, transport, sort, process.

Phase/Duration)	Teacher Strategies	Teacher Activities	Learner Activities	Core Competencies
Phase One Starter (5min)	Brainstorming	• Revise the RPK of learners by singing songs and reciting familiar rhymes. • Explain that today, they will learn about the various ways electronic waste	Learners sing songs and familiar rhymes	Communication and Collaboration Personal Development and Leadership Digital Literacy Critical Thinking and Problem Solving Creativity and Innovation

		operates.		
Phase Two Main lesson **(15min)**	Demonstration Discussion	**Step 1: Identifying processesof electronicwaste operation(10 minutes)** 1. Provide learners with an illustration of how electronic waste operates. 2. Ask learners if they find anything familiar in the illustrations. 3. Explain to learners in a simple language the various stages each illustration represents. **Step 2: Discussing Effects (5 minutes)** 1. Teacher asks learners the	Learners take a look at the diagram familiar things. Learners pay attention to listen to the explanation of the various stages. Learners says the possible effects of electronic waste on the environment.	

		possible effects of electronic waste on the environment. 2. Teacher explains the effects of electronic waste on the environment. **Assessment**: -Evaluate how well learners can identify the various stages of how electronic waste operates.	Learners identify the various stages of how electronic waste operates.	
Phase Three **Reflection(5min)**	Questioning	Review the diagram by asking learners what they have learnt in the lesson.	Learners say what they have learnt in the lesson.	

Date: 26th September.2024 Class: KG1			**Period**: (25minute). Lesson 1 of **Class size**: 30	
Subject: Natural science		**Strand: Food**	**Sub- strand**: Eating good food	
Content standard: K1.14.1. Demonstrate the understanding that eating good food will help me grow healthy and strong			**Indicator**: K1.1.4.1.1 Learners talk about the benefits derived from eating good foods at home and classify those that can make them grow healthy (Body building food, energy giving food etc.).	
Performance indicator: At the end of the lesson Learners will be able to; 1 Explain food 2 Identity the benefits of food 3 Classify food into the various kinds we have			**Resources**: Manilar card containing the various kinds of food groups	
Keywords: Food, body, Fruit, Nutrients, Energy.				
PHASE / DURATION	**TEACHER STRATEGIES**	**TEACHER ACTIVITIES**	**LEARNERS' ACTIVITIES**	**CORE COMPETENCIES**
Phase 1: Starter 5 minutes	Questioning and answers	Teacher uses related rhymes to the topic "food" to draw learners' attention. Teacher asks learners questions about the food they eat in the house and school to revise their R.P.K	Learners sing along with the teacher. Learners answer questions about the food they eat in the house and school	Critical thinking and Problem Solving

Phase 2: Main lesson 15 minutes	Discussion	1. Teacher introduce the lesson by going through the keywords with the learners	Learners pronounce the keywords together	Communication and collaboration skills
	Think-pair-share	2. Teacher allows learners to think- pair- share on the benefits of food	Learners think - pair-share the uses of food	Critical thinking
	Discussion	3. Teacher shows the Manilar card containing the drawings of the kids of food to learners to discuss it's important Teacher asks learners to draw their favourite food and colour	Learners draw and colour their favourite food	Critical thinking
Phase 3 : Reflection 5minutes	Discussion and Brainstorming	Guide Learners to reflect on what they have learnt	Learners reflect on what they have learnt	Critical thinking Personal Development

Date: 27th September,2024 **Class**: KG1	**Period**: (25minute). Lesson 1 of **Class size**: 30

Subject: Natural science	**Strand**: All About Me	**Sub- strand**: Caring for parts of my body.

Content standard : K1.1.3.1.Demonstrate the understanding of the importance of personal hygiene and how to care for my body parts eg: washing,finger nails,feet	**Indicator**: K1.1.3.1.1 ; Sing songs and recite rhymes about how we take care of each part of the body and demonstrate how to do it
Performance indicator: At the end of the lesson Learners will be able to; 1 . Know how to bath properly	**Resources**: Manilar card containing the various activities of personal hygiene

Keywords: Body, bathing , brushing, clean, wash

PHASE / DURATION	TEACHER STRATEGIES	TEACHER ACTIVITIES	LEARNERS' ACTIVITIES	CORE COMPETENCIES
Phase 1 : Starter 5 minutes	Questioning and answers	Teacher sings rhymes related to the topic "personal hygiene" to draw learners attention. Teacher asks learners questions about how they keep their selves clean to revise their R.P.K	Learners sing along with the teacher. Learners answer questions about how they keep their selves clean .	Critical thinking and Problem Solving

Phase 2 : Main lesson 15 minutes	Discussion	1. Teacher introduce the lesson by going through the keywords with the learners	1.Learners pronounce the keywords together	Communication and collaboration skills
	Think-pair-share	2. Teacher talks about some activities under personal hygiene using the manilar card	Learners listen attentively	Communication and collaboration
	Demonstration	3.Teacher demonstrates how to care for their body by bathing Assessment Teacher asks learners to draw and colour someone who is bathing.	Learners observe the actions carefully	Critical thinking
Phase 3 : Reflection 5minutes	Discussion and Brainstorming	Guide Learners to reflect on what they have learnt	Learners reflect on what they have learnt	Critical thinking Personal Development

		about electrical household appliances and their importance.		and Innovation
Phase Two Main lesson **(15min)**	Demonstration	**Step 1: Identifying Common Electronic Devices (5 minutes)** 1. Show the learners a picture of some electronic devices. 2. Ask learners to name the devices as you show them. 3. As you introduce each item, use simple language to explain its use: - TV: For watching programs or news. - Radio: For listening to music and news. - Mobile phone: For calling people and playing games.	Learners take a look at the picture chart to identify some of the electronic devices Learners pay attention to listen to what the electronic devices do. Learners say what the devices are used for.	

	Demonstration	- Fan: For keeping us cool. - Torchlight: For seeing in the dark. **Step 2: Discussing Uses (5 minutes)** 1. For each device, ask learners what they think it is used for. Reinforce the correct answers. - Example questions: "What do you watch on the TV?" or "When do you use a torchlight?" **Step 3: Matching Activities (5 minutes)** 1. Give learners flashcards with the names of devices (TV, phone, fan, etc.) and ask them to match them with the correct picture or object. 2. Encourage learners to say the name of	Learners use flashcards to match the correct picture of the device Learners say the names of each device.	

		each device and one use. **Assessment**: -Evaluate how well learners can identify the devices and describe their uses during the lesson. -Assess their ability to match the flashcards to the correct devices.		
Phase Three **Reflection(5min)**	Questioning	Review the devices by asking learners to name them again and describe one use for each.	Learners name the devices and describe the use of it.	

Day: Wednesday Date: 24/01/2024 Time: 8:00am- 8:25am Class: BS1 Class size : 25 Period:1(25mins)	Subject: Integrated Science Strand: Food Sub strand: Types of food

Content standard: K1.1.4.1Demonstrate the understanding that eating good food will help me grow healthy and strong	Indicator: K1.1.4.1.1 Learners talk about the benefits derived from eating good foods at home and classify those that can make them grow healthy (Body building food, energy giving food etc).	Lesson 1 of 2

Performance Indicator: Learners can talk about the benefits derived from eating good food at home and classify those that can make them grow healthy.	Resources: -Picture cards of different food items (vegetables, fruits, rice, fish, eggs, etc.) - Chart with the three food groups: Body-building food, Energy-giving food, Protective food

Keywords: protein, carbohydrates, protective food, energy giving food, banku, butter etc.

Phase/Duration)	Teacher Strategies	Teacher Activities	Learner Activities	Core Competencies
Phase One Starter (5min)	Brainstorming	• Revise the RPK of learners by singing songs and reciting familiar rhymes. • Teacher guides learners by asking	Learners sing songs and familiar rhymes. Learners	Communication and Collaboration Critical

		the learners if they have eaten today and what they ate. Guide them to briefly talk about the foods they like.	say what they have eaten and the food the like best.	Thinking
Phase Two Main lesson (15min)	Demonstration	Step 1. (5 minutes) • Teacher display the chart with the three food groups on it. • Introduce the concept of classifying food into three groups: Body-building food (e.g., meat, eggs, fish), Energy-giving food (e.g., rice, bread, yam), and Protective food (e.g., fruits, vegetables). Step 2: (5 minutes) • Teacher places the learners into small groups and give each group some food cards. • Guide the the learners to sort the food items into body-building, energy-giving, and protective food categories. • Have each group present one item and	Learners take a look at the picture chart to identify the food groups. Learners in groups sort the food items into body-building, energy-giving food and protective food.	Communication skills Critical thinking Communication and

	Demonstration	explain which group it belongs to and why. Step 3: (5 minutes) • Have a brief discussion about the benefits of eating good food. For example, energy-giving food gives us strength to play and run, body-building food makes us grow strong muscles, and protective food keeps us from falling sick. • Ask the learners to repeat key phrases such as "Good food makes me strong!" or "Eating fruits helps me stay healthy!" Assessment: • Observe learners' participation in the sorting activity and listen to their responses during the discussion and recap.	Learners in groups present one item and say which food group it belong to. Learners pay attention and listen to the benefits of eating good food Learners repeat key phrases that the teacher says.	Collaboration Critical thing and problem solving
Phase Three Reflection(5min)		Teacher guides learners to reflect on what they have learnt by asking them how they feel after eating good	Learners reflect on what they have learnt	

		food and why it's important	by saying how the feel after eating good food.	