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Teacher Educators Experience Adopting Problem-Based Learning in Science Education

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Abstract: Higher educational institutions have utilized problem-based learning (PBL) approaches over the last two decades. The approach has been found to enable educators to adopt different teaching and learning strategies. This study examined how teacher educators have adopted technology integrated PBL in teacher education. The study aimed to understand teacher educators perceptions of adopting the approach in their classrooms. Interviews were conducted with three teacher educators in Ghana. A thematic analysis was used to analyse the data from the interviews. The teacher educators believed integrating PBL into the curriculum emphasizes students learning roles to support their independent and self-directed learning. They also perceived that the PBL approach enabled them to create collaborative learning activities to interact and communicate with students, which can lead to conceptual knowledge development. The educators also indicated challenges such as a lack of beliefs and competence, inadequate resources, and limited time allocation for school inquiry-based lessons.

Keywords: problem-based learning; technology; teacher education; engagement; collaborative learning; professional development

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1. Introduction

Over the past two decades, educators in higher education have relied on different teaching methods, including lectures and demonstrations. Many researchers have suggested that educators should design their instructions to meet the needs, challenges, and opportunities of 21st-century students learning [1–3]. New emerging insights and evidence of science teaching suggest that learning sciences with traditional approaches emphasizing students recall abilities of disconnected facts should be replaced with learning that enables them to "critically think, solve a problem and transfer ideas, knowledge, and skills in new situations" [4]. In this context, Perkins and Perkins [2] suggested providing opportunities for students to "play the whole game" and experience how knowledge is constructed rather than learning about facts and definitions or procedures and rules (p. 25). One approach that has been found to foster students engagement to apply knowledge in new situations is problem-based learning.

According to Barron and Darling-Hammond [5], "inquiry-based learning constitutes a group of teaching approaches including problem-based learning, project-based learning, designed-based learning which are classified under one umbrella due to their similarities in characteristics" (p. 201). Problem-based learning (PBL) is a pedagogical and learning approach in which students are actively engaged in learning activities that are facilitated by an instructor [6], allowing them to make some level of decisions in the learning process [7,8]. Other researchers define PBL as activities that guide students inquiries, generate meaningful questions, and find answers to discovering new knowledge [9–11]. PBL is a student-centred instructional approach that helps students working on real-case scenarios to interpret data, construct models, and develop ideas through integrated scientific knowledge activities [12–14]. In exploring PBL, seven indicators exist to follow in solving problems. These indicators include problem identification, formulating, analysing, determining solutions, drawing conclusions, evaluating, and solving the problem [15].

According to Pedaste et al. [16], PBL allows students to explore questions or problems by experimenting, predicting, and drawing conclusions.

Recent curricula have emphasized the concept of inquiry as a teaching approach and advocated for integrating technology into inquiry learning practices in science education [14]. It has been established that technology-infused PBL helps educators to encourage students to develop skills actively learning on their own [17–19], build learning communities for students to collaborate and communicate [5], and foster creativity for their understanding of conceptual knowledge [19,20]. Therefore, there is a need to emphasize using PBL in science education. This study examines how chemistry teacher educators have experienced integrating technology to adopt problem-based teaching in a college of education in Ghana. The following research questions guided the study:

1. In adopting the new curriculum, what are teacher educators perceptions on including PBL in the curriculum?
2. What are the perceptions of teacher educators on the advantages and challenges of PBL as an instructional approach?

Problem-Based Learning in Chemistry and Teacher Education

In the literature, several studies have investigated the effects of PBL on student teachers learning attitudes, thinking skills, and academic performance. Studies on PBL have shown that the approach positively affects students learning, especially student teachers. For instance, researchers have contended that including a problem-based curriculum in teacher education programs has supported student teachers in acquiring theoretical concepts for future practice [20,21]. Research has shown that PBL activities improve student teachers learning gains in attitudes and beliefs, helping them to develop knowledge for future teaching [21–23]. For instance, Laursen et al. [21] concluded that PBL is an effective instructional approach for supporting student teachers attitudes towards group work to discover ideas for understanding mathematics concepts. Some studies have indicated that PBL improves student teachers critical thinking skills [24–26]. For instance, Aidoo et al. [24] showed that PBL enhances student teachers motivation to develop critical thinking skills to understand and apply their knowledge into practice. In other research, many studies have reported that PBL improves student teachers academic performance [24,27,28]. For instance, Owusu [27] investigated the effects of PBL on student teachers academic performance in trigonometry. The results showed that the post-test mean scores of students instructed with problem-based learning were higher than those in the conventional instruction class.

Furthermore, PBL is an effective instructional approach in chemistry classrooms. For instance, research has shown the approach improves students attitudes toward chemistry concepts [29–31]. For instance, Ni'mah et al. [31] reported that PBL helps to improve students attitudes towards learning solubility and buffer solution concepts. Other studies have shown that PBL helps to improve students academic performance [32–34]. Similar results have been found in other studies [34–36], which have examined the effect of PBL activities on student critical thinking skills. These studies findings indicate that PBL is an effective instructional approach that facilitates students attitudes, conceptual understanding, thinking skills, and academic achievement, and could contribute to the development of student teachers learning. Many studies have raised concerns about the use of PBL. For instance, Settlage [37] argued that open inquiry is an impracticable mythology for science education. Research has revealed that teachers are not adopting PBL due to their low pedagogical content knowledge [38–40], lack of good resources [38,39,41], and lack of time [42,43]. These issues have affected teachers adoption and implementation of PBL in schools.

In Ghana, the current National Council for Curriculum and Assessment (NaCCA, 2019) statement focuses on using appropriate strategies, such as inquiry learning, to help learners to develop knowledge construction skills to solve problems rather than memorizing knowledge. Adopting the appropriate pedagogical strategies is essential to developing 21st-century core skills such as creativity, critical thinking, innovation, problem solving,

and communication skills. Students are then tested on scientific knowledge related to remembering and understanding, the application of knowledge, and experimental and process skills dimensions [44]. There are concerns about students knowledge ability at these three organizational levels which affects their performance in national tests [44,45]. Regardless of the concerns, Ghanaian teachers are mandated to adopt PBL in their classrooms, as done in the USA's Next Generation Science Standards [46]. Some studies on PBL have been conducted in the country targeting K-12 levels [39,40] and pre-service teachers [22,24,27,28]. Despite the mandatory utilization of PBL, limited studies have been conducted on teacher educators views and experiences, especially at colleges of education. Meanwhile, in the colleges of education, teachers are required to adopt pedagogical approaches that ensure creativity, innovation, critical thinking skills, and problem-solving skills in student teachers. Effective pedagogical approaches and classroom management practices in science education have gained space in the current curricula to achieve instructional competence and career readiness beyond teacher training.

Studies have shown that teachers usually practice how they are taught as students because they lack experience of PBL [38,40]. Thus, as teachers are required to use PBL, they need to experience and use it during their teacher training and practice the approach [47]. This suggests that effective instructional strategies during teacher training and professional development are critical to students learning outcomes. Recommendations for teacher professional development on using PBL are ongoing [48–50]. Researchers have indicated that professional development helps to build teachers knowledge and dispositions. Given this, policies have focused on changes towards the curriculum, assessment, and effective pedagogies in science teacher education, including PBL [43,51], which is yet to come to pass. This study explores teacher educators perceptions of the benefits and challenges of implementing PBL in science education.

2. Materials and Methods

This study involves a longitudinal case study [52] to generate in-depth and rich information on the studied phenomenon. This study aimed to complement the conception of how teacher educators experience problem-based learning and the benefits and challenges of adopting the approach in their classroom. For this reason, a case study was appropriate for the researcher to understand the relations between contexts and practice and provide a contextual understanding of the benefits of problem-based learning in teacher education [53]. In case study designs, an inductive approach is used to generate theories to hypothesize and build theory by drawing findings from the cases stated [52].

2.1. Participants and Data Collection

Three teacher educators from three colleges of education across southern Ghana were identified to participate in the study. These educators were selected based on their experience in implementing PBL and their availability to participate in the study during the pandemic. A semi-structured online interview using the Zoom App and WhatsApp was conducted, and questions were asked to explain their experiences of integrating the approach in their classrooms.

Some studies have utilized multiple data sources to assess and evaluate the extent to which problem-based instructions are used in classrooms to make informed decisions [54,55]. Brief teacher interviews are a unique source of classroom data that are easy to obtain and do not consume instructional time. Although teacher interviews are typically lengthy and analysed using complex qualitative methods, they are flexible and provide detailed information from respondents [56], allowing a greater depth and rich information of judgement, unlike questionnaires. Further, Oppong-Nuako et al. [57] noted that brief teacher interviews with a straightforward coding system are effective in assessing the extent of teachers inquiry experience. In this research, brief teacher interviews were used to assess the teachers descriptions of their typical instruction, classroom practices, and anticipated student learning outcomes.

Each interview lasted between 45 and 60 min and was recorded and stored on the Microsoft stream App. The educators were asked their views on the rationale for including PBL and their experiences using PBL. Similarly, the teacher educators were asked about any benefits and challenges faced when integrating the approach into their chemistry classes. The research took place between August 2020 and April 2021. The first set of interviews was conducted in September 2020 to explore the teacher educators experiences integrating student-centred strategies, including PBL. All colleges and universities were closed during this period, and educators shifted to online learning. I was interested to know how the teacher educators adopted the learning. After the first interview, we (the author and the three participants) collaborated to design and develop teaching and learning materials that followed the principles of PBL from the national teacher education curriculum. The second set of interviews was conducted in December 2020, when full classroom sessions (i.e., no restrictions with entire teaching and activities in place) existed. Examples of the questions used to explore the teacher educators experiences with PBL are:

i. What teaching styles do you use in your classroom, and how do you use them to organize or prepare your class for teaching and learning?
ii. What is your definition of a student-centred learning approach?
iii. What teaching method(s) do you consider as student-centred learning approaches?
iv. Have you been using them in your classroom, and why do you use them?
v. How do you describe your role, or what role do you play in the traditional face-to-face classroom compared to the PBL classroom, can you summarize your roles?
vi. What are your views on including PBL in the curriculum and whether it is necessary to adopt it?
vii. Describe your experiences in using PBL in teaching.
viii. Describe how you use ICT and implement the PBL approach in your classroom.
ix. Can you explain some advantages of using PBL as a teaching and learning approach?
x. What challenges or barriers can limit the use of the PBL approach?

2.2. Data Analysis

The video and audio data files from the interviews were saved in Microsoft stream. The data files were transcribed using Microsoft stream and approximately 10,529 words and 730 sentences were identified from the transcripts. The transcripts were then printed out and analysed using paper and pencil methods to categorise them into themes by identifying patterns for analysis within the data. The patterns in the data were analysed using a thematic analysis [58]. The teacher educators were identified using pseudonyms such as Albert, Frank, and George.

2.3. Ethical Considerations

The teacher educators were reached through contacts in the various colleges. Prior to the research, the purpose was explained to the teacher educator and an informed consent form was sent to them for approval. On the consent form, information about their voluntary participation, anonymity about themselves and their institutions, and voluntary withdrawal at any point in time was clearly stated. In addition, a request for the recording and transcribing of the interviews with hidden identities during a presentation of the results was also included. The teachers welcomed the idea and responded that they understood the purpose of the research and that the publication of the results, including anonymity and other consent forms, was explained to them. The research was conducted in accordance with the Constitution of the Ghana Association of Administrators of Research Ethics Committees (GHAAREC, 2015). In ensuring the trustworthiness of the data collection, the transcripts were sent to the participants for member checking and approval before the final draft was drafted for publication. Three experts from both the University of Iceland and University of Helsinki reviewed the interview protocol, transcriptions, and provided feedback for review.

3. Results

The data from the interviews with the teacher educators revealed that they perceived the approach as a pedagogical approach aimed at transforming classroom practices to impact their work and students learning. These benefits are elaborated in the next session.

3.1. Views on the Rationale for PBL Inclusion

The teacher educators were asked to explain their views and acceptance of including PBL in the curriculum. The identified themes regarding the teacher educators perceived views on the rationale for adopting PBL were categorized, students learning roles and learning responsibilities, and independent and self-directed learning.

3.1.1. Students Learning Roles and Responsibilities

The recent curriculum has focused on transforming classroom practices to adopt innovative teaching approaches. There is a focus on integrating learning approaches that emphasize students learning roles and responsibilities. The PBL approach focuses on the principle that students actively participate in their learning. The educators believed the approach was introduced in the curriculum to change their roles to facilitators and for students to take responsibility for their learning. According to Albert, the inclusion of the PBL approach in the curriculum is geared towards changing their classroom practices from a teacher-centred approach to a more student-centred learning approach. He believed adopting PBL was meant to emphasize students active learning. He indicated that they often use approaches allowing students to take on much more learning responsibilities than in the traditional classroom. For instance, he narrated his teaching experiences and said,

> *"Integrating PBL is one of the many teaching strategies in my courses. I believe that the PBL is an approach that emphasizes students active role in the learning process; through PBL, students can explore learning materials, ask questions, and share ideas when working on group tasks."*

In addition, Frank also expressed similar views as Albert on integrating PBL to focus on students active participation in the learning process. To him, the approach enables teachers to shift their instructions to place students as the lesson's focus, with teachers facilitating such a process. He added,

> *"The PBL creates a student-centred learning environment that allows students to take ownership of their learning through experience because they do most of the activities, unlike in the lecture-based method, in which students become passive learners."*

As stipulated in the new curriculum, teachers acceptance of PBL and ICT integration is essential to innovative teaching. George also believed the intent of blending these two key ideas was to strengthen and improve their pedagogical practices, which could lead to improving students learning outcomes. He reflected on his views and experience in the interview that,

> *"We are required to adopt PBL and integrate ICT in our classroom activities. These practices are familiar, and I have experienced using ICT in my classroom activities. In the past 5 years, I have incorporated their use to promote students interactions, communication, innovation, and scaffolding toward creativity, critical thinking, and problem-solving as essential curriculum components."*

3.1.2. Independent and Self-Directed Learning

Teaching with an inquiry is an independent strategy where students are engaged in an active learning process that reflects scientific inquiry. The educators understood the requirement for the transition to develop and integrate active learning strategies to improve students learning outcomes. They believed that active learning approaches focus on students independent learning and that students become active learners when they learn independently. Frank further indicated the approach,

"Allow students to explore information independently, discover, and develop new ideas."

This indicates that the educators guided students to learn independently through their facilitation. Other educators emphasized the need for students to learn by themselves. For example, Albert also pointed out that,

"In PBL settings, it is required that students become independent learners so they can find information by themselves."

These findings showed that the educators were aware of the requirement for students independent learning approaches, such as the PBL approach, as stipulated in the curriculum document.

3.2. Benefits and Challenges of Implementing PBL

The teacher educators perceived that adopting PBL was beneficial to their classroom practices. These benefits included "classroom interactions", "collaborating learning", and "conceptual knowledge."

3.2.1. Classroom Interactions

Problem-based learning is an avenue for teachers to interact and communicate with students. In this study, the teacher educators emphasized their facilitating role in helping students to construct their ideas. George believed the approach created an opportunity to interact with the students to motivate and provide feedback constantly. According to him, these interactions enhanced students learning progress in performing tasks. He noted that,

"The approach creates opportunities for deeper interaction between teachers and students."

Frank also highlighted the benefits of using ICT tools to create a social learning channel where he could have weekly interaction and discussions with students. According to him, regular interactions with students allowed his students to ask questions about their misconceptions and other learning difficulties. He added that the interactions helped to build confidence in some weaker students to participate in the discussion forum. For example, Frank explained that,

"Engaging and interacting with students brings cordial relationships to the extent that they don't feel reluctant to answer and ask questions in class."

3.2.2. Collaborative Learning

The use of technology contributes to the emergence of collaborative learning during PBL lessons. PBL is a constructivist pedagogy focusing on active and collaborative learning that helps students to solve real-life problems. Albert believed PBL can help instructors to develop avenues to plan lessons that enhance students collaboration in the online learning environment. He felt the integration of technology enabled him to create an enabling environment for students to collaborate. He noted that,

"Through the online applications, creating a collaborative learning platform that allows students to work with their peers and share their ideas and learning experiences is possible."

3.2.3. Conceptual Knowledge

Problem-based learning emphasizes skills and effective practices such as collaboration and problem solving for knowledge acquisition. Active engagement in collaborative and problem-solving activities challenges students to acquire more information for knowledge construction. The teacher educators perceived that the PBL approach made it easy for the students to actively participate in the lesson, as most students participated in the activities. According to George, students used the instructional videos as a guide to engage and work on challenging tasks. Active participation enables students to work on tasks that can enable them to apply ideas learned in real-life situations. He mentioned that:

"Students can make connections about what they are learning, which allows them to understand the topic better."

Apart from the benefits of using PBL, the educators perceived they faced challenges adopting it. They felt that their beliefs and competencies were low. They also did not have the adequate materials and resources, and there was limited time allocation for science lessons. These issues were identified themes from the data.

3.2.4. Beliefs and Competences

Problem-based learning practices demands teacher knowledge, skills, and competence including designing and managing the learning activities. Although educators chose relevant and appropriate type of inquiry activities based on the available learning facilities. However, the educators had difficulty to effectively manage the classroom activities. Some of them could not create the online learning communities and monitor students activities simultaneously. According to the teacher educators, planning activities, managing group work, and assessing students were difficult, and it took more time to provide an effective lesson on content. For instance, Albert indicated he lacked the understanding and competence to manage students online group work. He commented in his reflection on the teaching experience that:

"Managing the design, preparation, delivery, and assessment of students inquiry learning group tasks is complex. Teachers should have adequate knowledge and competence to adopt that approach."

Frank also acknowledged the importance of his skills and competence in engaging and monitoring students learning progress continuously. He added,

"Creating online learning groups monitoring students activities within the shortest time available to provide immediate feedback to students is more challenging."

3.2.5. Materials and Resources

Implementing PBL demands an adequate preparation and planning of the activities and resources available. Due to the hands-on and practical nature of the learning activities, more resources are required. The educators indicated that, due to the large class size, the resources were inadequate for them, especially during group work and experiments. According to Frank, one challenge he encountered adopting inquiry instructions was the lack of adequate science equipment and apparatus for engaging the students during group tasks and practical work. He pointed out that,

"I had a challenge with the classroom resources, like learning materials, that will enable us to deliver instructions efficiently without any difficulties."

George also added that there were inadequate concrete learning materials to explain the models, such as the ball and sticks. He explained that,

"The lack of concrete chemistry materials, tools, and equipment for some practical works to help facilitate instruction to the students was inadequate."

3.2.6. Time Allocation

Implementing problem-based learning activities, planning activities, and designing experiments require time. In guided inquiry, instructors must guide students to design their activities, which requires a lengthy and well-planned process. George explained that PBL implementation planning and implementing was lengthy and time-consuming; therefore, adequate time is needed. He said he felt more time was required to plan and design the activities and handle the materials. Due to the lack of time, he could not perform many of the activities. He further complained about the demands of the curriculum, student accountability, types of assessments, and the rigid nature of the timetable. To him, the rigid timetable provided limited flexibility for conducting extra activities like experiments, especially with large class sizes. He explained that,

"Due to inadequate time allocation for practical activities, problem-based learning is challenging, especially when many students are in the class."

4. Discussion

This research examined teacher educators views and experiences of using PBL in their classrooms during the pandemic. The findings highlighted the views held by the participants on the inclusion, advantages, and barriers of adopting PBL in teacher education.

Curriculum revision, adoption, and inclusion of student-centred approaches aim to improve educators classroom practices. Inquiry learning is a student-centred approach that allows for students to participate actively in their learning [12–14]. The teachers believed that the inclusion of PBL reveals the relevance of the principles of students independent learning, where the central focus is how learners can experience and gain knowledge. According to the teacher educators, PBL can help students to understand how to acquire knowledge through their desires and ways to initiate, manage, and perform tasks to gain knowledge independently [2]. These suggest that the teacher educators role was to guide students to enact a more significant part of the learning by themselves, where the instructor becomes a facilitator. Slavich and Zimbardo [3] pointed out that inquiry-based learning emphasizes teachers role of facilitating students active participation and responsibility for discovering new knowledge. Through experience, students develop the skill of becoming active learners as they engage in activities. Some researchers have pointed out that, with technology, educators can support students to take on an active role and become responsible for their learning [17–19,59,60]. Kuhn et al. [60] argued that inquiry learning can be effective when integrated with technology and materials to support students' learning experiences. The educators believed that, when students are introduced to the concept by explaining, they can find relevant information themselves. Such an opportunity can help students to develop the relevant learning experiences related to synthesizing, analysing, and applying knowledge [15]. This suggests that PBL, as a learning procedure, emphasizes students roles and usually places them at the centre of learning and interacting with their colleagues on a topic.

It has been established that technology infused PBL helps educators to encourage students to develop skills in actively and independently learning [18,60] and be better prepared to engage with other students during group learning. Through developing self-confidence, students can collaborate and communicate with their peers to build a learning community. Regular classroom interactions between teachers and students have an impact on students learning. The participants in this study believed PBL promotes effective classrooms among instructors and students to promote their communication skills. In this study, the educators led the students to engage in group tasks, write reports, and make presentations to the whole class. Such an opportunity improved the students confidence to communicate and discuss their results. This finding confirms other results reported in earlier studies [14,17,19] that integrating technology to implement PBL helps educators to communicate with students and enhance students communication skills.

Research has indicated that the effective use of a technology-infused curriculum helps students to move beyond relying on teachers information to develop deeper learning efficacies [59,61]. In this study, the educators felt that allowing students to take on learning responsibilities enabled them to become active learners to construct their knowledge that boosted their understanding of the concepts. According to Panjaitan and Siagian [15], PBL includes learning processes involving checking facts and observations through identifying a problem and generating ideas to resolve the problem. In the online PBL environment, teachers use different instructional strategies to provide students with opportunities for open-inquiry learning activities that enhance their higher-order thinking experiences, leading to a better understanding of content knowledge and how to create their knowledge. This finding aligns with other studies showing that PBL is a valuable technique that allows students to relate classroom learning to the real world and understand concepts

better [18–20,24,34]. These findings suggest that students can retain information that improves their conceptual knowledge development when actively involved in learning.

According to Tondeur et al. [59], using technology can help educators to scaffold and design inquiry learning activities that facilitate the development of cognitive tasks in the classroom. This study found that the educators valued the PBL activities and provided an understanding of integrating in-class and out-of-class activities. The educators perceived that technology integration effectively supported students collaborative learning, enabling them to develop deeper learning. The results indicate that teachers can use the approach to engage students in a collaborative learning environment involving hands-on practices that promote scientific concepts [5]. In this research, students were engaged in tasks that allowed them to ask questions and explain their scientific knowledge through collaborative work with peers. In the PBL environment, instructors guide and facilitate groups for collaborative learning communities where students can learn how to design and generate new ideas and solutions to problems under investigation [1,21]. This suggests that a technology-infused learning environment effectively supports teachers professional growth in creating online learning communities for students.

Educators competence is a critical factor in implementing PBL activities. Educators must provide effective inquiry learning and opportunities to students to improve their learning outcomes. However, this is not the case, as most educators lack the requisite skills to design and implement problem-based instructions. Researchers have reported that educators lack of understanding of the inquiry instructional approach and their competencies in using PBL make it challenging to work with it in their classrooms [36,38]. As argued by McKeown et al. [62], many educators are narrow-minded about using inquiry instructions in their classroom practices. Educators lack the desired background knowledge, pedagogy, classroom management, and curriculum design to adopt PBL effectively [37]. Dai et al. [63] pointed out that teachers always focus on using PBL to guide students to gain the skills of measuring data recording as the essential requirement of the PBL curriculum. There is less focus on the conceptual and epistemic aspects of inquiry design, and the data analysis processes, evidence interpretation, explanations reasoning, relationships, and casual effects for conclusion are often left out. As indicated by Sjöberg [64], teachers adopt a teaching approach based on their experience during their teacher training. Therefore, it is essential to include PBL in the teacher education curriculum. These findings suggest that educators gain much confidence and experience in PBL when they develop an understanding of and motivation to practice it.

Studies have shown that adequate resources facilitate educators adoption of PBL activities. The educators recognized the benefit of teaching and learning materials such as models and equipment. According to the educators, the teaching and learning materials facilitated students understanding of conceptual knowledge because of the pictorial representation of the concepts learned. However, the educators indicated they lacked the excellent learning models and other resources that could bring about the needed change in their teaching to adopt PBL [38,39,41,65]. The educators further indicated that the large class made supporting individual or small groups of students impossible during experimental lessons. Similar findings have been reported in previous works [34,63,66,67], that implementing PBL in large classes makes it difficult for teachers to provide feedback and support to individual or small groups of students. According to [68], the risk of performing problem-based experiments makes it difficult to reduce the risk of accidents, particularly in chemistry, where safety issues relating to the use of chemicals are involved. In such situations, teachers fear controlling the huge class in performing actual experiments and instead rely on YouTube videos.

Finally, the teachers believed time was an essential factor when implementing PBL. Teacher educators classroom practices focus mainly on guiding students to learn facts, concepts, and theories, without adequate opportunities to practice what is learned due to the limited time available. They found it frustrating, and despite their zeal to adopt PBL, stated it was challenging to adopt the approach due to the complexity of other school

activities, limiting the time to design and develop inquiry learning activities effectively. Similar findings have been reported in other studies, where educators felt they had limited time to prepare and implement PBL [34,42,43,67]. According to Romero-Ariza et al. [42], teachers are usually confronted with challenges relating to lack of time, a high demand in the curriculum and assessments usually frustrate them from adopting PBL. This finding indicates that inflexibility, inadequate time allocation, and curriculum demands limit educators zeal to implement problem-based instructions.

5. Conclusions and Implications for Practice

This research examined teachers views and experiences using PBL in their classrooms. The results showed that the educators had positive beliefs about including the PBL approach in the curriculum. They believed the adoption of PBL is geared towards changing learning roles to allow students to play actively and take responsibility for their learning. The educators felt it would allow the student teachers to learn independently to construct knowledge. The educators also perceived that implementing PBL would allow the student teachers to collaborate with their peers and instructors to gain skills for communicating and learning that can enhance their conceptual understanding. Despite the positive views, the educators indicated that adopting PBL requires better understanding, attitudes, and competence. The findings of this study address teacher educators' concerns about the adoption of PBL in the curriculum. Teachers in Ghana know the rationale of the integration and benefits of using PBL. However, most teachers are not adopting the approach due to misunderstandings, teacher competence, inadequate resources, and inadequate time allocation. Most educators lack the skills to plan, design, and manage the learning activities, leading to them developing negative attitudes towards the approach. They also face challenges with large class sizes, affecting the available resources and limited time, making it challenging to utilize the approach effectively. To harness educators classroom practices to adopt PBL, it is therefore vital for institutions to make extra time available for science lessons. It is also vital to consider continuous professional development activities for science teachers to re-examine their teaching and how to use PBL to teach effectively. Addressing these issues could enable teachers to build their professional learning and focus on the need for continuous professional development to understand the ideas and strategies for implementing PBL.

6. Limitations

In the study, some limitations were identified, which can lead to improvement in future studies. For example, the research was limited to only three teacher educators from three different colleges, and, since the sample size was small, the results cannot be generalized. It is also vital to indicate that the advantages of the PBL approach for students learning, as claimed by the educators, were not measured independently in terms of grades or performance. This indicates a limitation of the method on teachers self-assessment and reflection that does not always conform to actual performance. Despite this limitation, the general information provided by the teacher educators could help them improve their professional growth and practice. Therefore, I recommend further studies to include more educators and measure students actual performances to complement the findings of this study.

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Data Availability Statement: Data is available and can be provided upon reasonable request.

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