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Assessing Student Teachers' Motivation and Learning Strategies in Digital Inquiry-Based Learning

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Abstract: Over the past two decades, teachers have adopted several teaching and learning strategies for motivating students to learn chemistry. Learning chemistry in context enables students to develop richer crosscutting learning experiences relevant to contributing to solving problems. A qualitative case study method was adopted to examine student teachers' experiences in digital inquiry-based learning. Questionnaires with closed-ended and open-ended questions were used to evaluate student teachers' motivational orientations and learning strategies during a general chemistry course for one month. The results show that student teachers utilized varied perspectives such as self-efficacy, task value, and intrinsic goals to elaborate their learning for knowledge construction and application when performing collaborative tasks. The approach enables students to receive maximum support and feedback from instructors who use pedagogical styles to self-direct them during class discussions, which enhances their active participation in learning with the learning materials. The findings provide a practical insight into instructional strategies in delivering chemistry concepts when students are motivated to use and adopt varied learning strategies.

Keywords: context-based teaching; inquiry-based learning; student teachers; motivation; digital learning; chemistry education

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1. Introduction

One growing challenge in chemistry education has been the issue of students usually perceiving organic chemistry concepts as challenging [1–3]. This negative perception and attitude is attributed to ineffective approaches, such as teachers' didactic approaches to deliver chemistry concepts [4,5]. Studies show teaching chemistry concepts with teacher-led approaches leads to students learning in isolation [4], resulting in weaker understanding of concepts due to low self-concept and critical thinking [6,7]. As a result, there are concerns that teachers do not utilize effective instructional approaches or learning strategies that help students develop critical thinking skills.

Focusing on the current crucial component of chemistry education research, learning chemistry is critical in helping students develop logical thinking and problem-solving skills [8] that allow students to make career decisions [9]. Researchers have identified effective instructional approaches and classroom teaching interventions to address this challenge to enhance students' critical thinking development [10–12] to prepare them for future employment. Recent science transformations have seen teachers shift from traditional chemistry teaching to active learning practices with relevant context-based approaches [13]. Delivering chemistry concepts in context enables students to connect their learning experiences to foster scientific literacy [14].

Current studies show that teaching chemistry concepts with context-based approaches improves students' attitudes towards chemistry [15] and makes them attain deep learning to "think critically, solve a problem, and transfer ideas, knowledge, and skills in new situations" [16–18]. Teaching chemistry in context-based approaches focuses on connecting the content to real-world situations so that students can understand the concept of phenomena or situations [19]. Further, King [20] reported that context-based learning enhances the development of understanding, enabling students to gain crosscutting learning experiences and relate them to real-life contexts.

One teaching approach that follows context-based learning experiences is inquiry-based learning [21]. Inquiry-based learning (IBL) is a multifaceted student-centered, self-directed teaching approach in which instructors guide learners to partake in a series of activities to take learning responsibilities [22] to construct knowledge from problem-solving activities. According to Lee et al. [23], IBL involves a series of techniques instructors use to promote students' active learning through problem identification, investigations, and solution generation. Through inquiry learning, students undergo scientific activities by observing, questioning, reviewing, gathering, analyzing, interpreting data, predicting, and drawing conclusions [24]. The IBL is reported to enhance students' conceptual understanding, leading to the development of new skills for knowledge acquisition of the nature of science [25,26]. Schwartz et al. [26] argue that an IBL approach emphasizes not entirely transferring knowledge but fostering inquiry skills and understanding the nature of science. A study by Orosz et al. [27] found that a guided inquiry-based approach helps students develop scientific skills as they scaffold through science learning activities. Due to the efficacy of the approach, several studies have been conducted to highlight several ways in which certain factors such as motivation and learning styles enhance students' learning success in IBL environments.

Students' Motivation and Learning Strategies in IBL

Several studies have investigated students' motivation to use learning strategies in IBL. A literature body has acknowledged the importance and value of motivation, goals, abilities, and learning styles in the IBL environment [28–30]. However, enhancing these motivational beliefs and learning strategies is facilitated by educators when designing their IBL lessons [31]. Research has shown that educators' role as facilitators in IBL empowers students to take responsibility for the learning process [32,33]. Educators guide students by creating opportunities that motivate students to learn and improve their scientific skills [34]. In the IBL, educators also provide resources and appropriate feedback that facilitates students learning progress to self-direct and elaborate their learning [22,35,36].

Studies show that students' motivation positively impacts their academic performance in science [37,38]. Oskarsson and Karlsson [39] argue that less motivated students see school science as less engaging, making them lose interest and see no relevance or connections of science learning to future jobs. Han [40] found that students' genuine interest in learning science involves activating and maintaining their affective enjoyment and cognitive engagement which enhances their motivation to learn. This shows motivation is vital in determining students' interests, scientific competence, and future science career choices. Addressing this challenge, teachers have adopted varied strategies to engage and motivate learners in their courses. Teachers use strategies such as collaborative learning to interact and explore information to construct knowledge [41]. In a collaborative learning environment such as IBL, teachers instruct and guide students to use prior knowledge to construct and apply new knowledge [42]. Researchers recommend that in thriving IBL environment requires collaboration and interaction among students and instructors to foster idea-sharing through discussions [43,44]. Studies show that students who self-regulate their learning can create learning goals and expectations to learn a task [29,30] and change their motivation and learning strategies to achieve such goals [45,46]. Researchers have argued that highly motivated students put much more effort into learning new tasks through self-efficacy and elaborating strategies compared with less motivated students [28,47]. Because demotivated students cannot concentrate on staying focused, they try to skip challenging tasks and finally give up, potentially affecting their learning. As such, instructors set up learning activities in a way that motivate students to seek information by interacting with peers to generate answers to problems [48]. Through IBL, students engage with peers in active learning that enhances their application of the knowledge to develop critical thinking skills for problem-solving [49]. Students in active learning environments are self-confident and usually seek solutions to problems to work out more complex tasks [17]. This indicates the importance of active learning environment enabling teachers to create opportunities for students to learn using different learning strategies.

A body of knowledge has emphasized the importance of motivation and learning strategies in learning [28,29,50]. These studies have hinted that motivational beliefs and learning strategies enable students to understand concepts that lead to learning success. How students use these motivational orientations and learning strategies in learning chemistry remains unknown. Therefore, this study explores how student teachers' motivational and learning strategies foster their organic chemistry learning. This study sought answers to the following research questions:

1. What are student teachers' dispositions towards motivation and learning strategies towards chemistry learning?
2. What are student teachers' views in learning chemistry in IBL classrooms?

2. Research Methodology

This study employed qualitative case study methods involving an in-depth inquiry of student teachers' experiences in digital inquiry-based learning. The design was appropriate as it enabled the researchers to collect in-depth data on implementing blended learning. Questionnaires with closed-ended and open-ended questions were used to collect data from the participants.

2.1. Participants and Sampling

During the pandemic, instructors faced many challenges, including engaging students to learn and learn specific subject matter. As such, the researchers aimed to recruit teacher educators using IBL to support students' digital learning practices. Convenient sampling was used to identify three classrooms of 143 student teachers from colleges of education enrolled in a general chemistry course. These student teachers were selected because of easy access and the availability of course instructors to participate in this study. The course content follows a blended learning approach (face-to-face lecture instructions and out-of-class online learning) to explore different chemistry concepts. The student teachers comprised 46 males and 97 females, aged 16 years to 30 years. The participants were enrolled in the Bachelor of Education programs, offering different major subjects with different study backgrounds and focusing on primary education, home economics, and early childhood streams.

2.2. Teaching and Learning Process

We adopted the 5E conceptual framework to design and plan the learning activities in an instructional sequence [51]. Through the framework, students were taken through the five phases, engage, explore, explain, elaborate, and evaluate, as shown in Table 1.

Table 1. Teaching and learning processes and activities in the 5E phases.

Phases of IBL	Teaching and Learning Activities
Engage	Students introduced organic chemistry concepts through questioning, scenarios, or problem-based to arouse their interest, e.g., classification of organic compounds, e.g., what are organic compounds and their uses

Table 1. *Cont.*

Phases of IBL	Teaching and Learning Activities
Explore	Educators guide students to construct their understanding of the naming of organic compounds by reflecting on guiding questions and principles, e.g., students follow and reflect on writing chemical formulas and naming of hydrocarbons and alcohols using the guiding rules
Explain	Students articulate their views on subject matter, e.g., share understanding during group discussions, e.g., participate in group discussions with peers on given tasks on naming, properties, hydrocarbons, alcohol, etc.
Elaborate	Educators review the lesson and provide more information through class discussions to brainstorm to build students' understanding of the subject matter, e.g., practice more examples of naming, reactions of hydrocarbons and alcohols, carboxylic acids, and aldehydes
Evaluate	Students complete individual and group tasks, and educators provide feedback, e.g., students take quizzes and conduct group presentations on naming organic compounds

2.3. Data Collection

The data were collected over a regular class session for four weeks through questionnaires. The purposely developed closed-ended questionnaire was adopted from the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich and De Groot [52]. The MSLQ test contained 81 multiple-choice items. To suit the purpose of this study, three factors (intrinsic goal orientation, task value, and self-efficacy) were selected from the motivation scales. In the learning strategies, critical thinking abilities, elaboration, and peer learning were selected. According to Pintrich and De Groot [52], defining intrinsic goal orientation in the MSLQ as a student's perception of participating in a course/task challenges them to enhance curiosity and a mastery of learning. Task value refers to students' assessment of their interest, the importance, and the usefulness of the tasks, leading to more participation in the learning. Self-efficacy is a self-assessment of a student's ability to master a task. Elaboration strategies help learners to keep "information into long-term memory through the building of interconnections to integrate and connect new information with prior knowledge". Help seeking refers to students learning how to manage their learning by seeking assistance from peers and instructors. Peer learning refers to collaborating with peers to dialogue to clarify course material and reach insights that one may not have attained on their own. The questionnaire was based on a Likert scale scored on a level of 1 as "Strongly disagree, SD" to 5 as "Strongly agree, SA" and open-ended questions. The open-ended questions enabled the researchers to collect varied views, perspectives, and understandings to supplement the information gathered from the questionnaire. According to the research questions, the questionnaire and focus group items were categorized to solicit views and experiences of the motivation, learning strategies, and general perceptions of their IBL. In validating the questionnaire, two experts from the colleges of education and the University of Cape Coast agreed on the content validity after adding some questions. The instrument was shared with participants via WhatsApp, and some parts were offered to be completed on paper to enhance a high response rate. In total, 125 (response rate of 87%) student teachers completed and returned the questionnaires.

2.4. Data Analysis

Responses to the questionnaire were analyzed using SPSS. Descriptive statistics were used, and the results of the findings and student teachers' views and experiences with IBL were presented in frequencies and percentages for easy visualization. The responses were scaled down by combining Strongly Disagree (SD) and Disagree (D) as disagree and Strongly Agree and Agree into *agree*. The Neutral (N) was not included in the analysis as it shows the students' indecision to either agree or disagree. The open-ended responses were analyzed manually using qualitative content analysis [53]. The responses were extracted, transcribed, defined, and emerged themes identified. The themes were coded and revised to remove any overlaps.

3. Results and Findings

3.1. Research Question 1: What Are Student Teachers' Dispositions Towards Motivational Orientations and Learning Strategies of Chemistry Learning in IBL Settings?

This research question sought to find out which motivational dimensions and learning strategies enhance chemistry learning.

3.1.1. Motivational Orientations

The perceptions of student teachers' disposition towards motivation and learning strategies in IBL chemistry are shown in Table 2. The table was constructed to present the frequencies and percentages facilitating the participants' perceptions regarding motivational orientations and learning strategies in the context of chemistry education.

Table 2. Student teachers' dispositions towards learning strategies.

Item	Responses n (%)				
	SA (%)	A (%)	N (%)	D (%)	SD (%)
Intrinsic goal orientation	51 (35.7)	41 (28.7)	24 (16.8)	14 (9.8)	13 (9.1)
Task value	49 (34.5)	33 (23.2)	37 (26.1)	17 (12.0)	6 (4.2)
Self-efficacy	67 (46.9)	25 (17.5)	30 (21.0)	8 (5.6)	13 (9.1)
Critical thinking	72 (50.3)	27 (18.9)	17 (11.9)	11 (7.7)	16 (11.2)
Elaboration	74 (51.8)	24 (16.8)	18 (12.6)	11 (7.7)	16 (11.2)
Peer learning and help seeking	49 (34.3)	39 (27.3)	30 (21.0)	13 (9.1)	12 (8.4)

Key: Strongly Disagree, SD; Disagree D; Neutral, N; Agree, A; Strongly Agree, SA.

Results from Table 2 show that 89 (62%) student teachers agreed to all the motivational orientations, indicating a positive disposition of motivation in learning chemistry, while 24 (17%) did not have stronger motivational beliefs. In comparing the individual motivational orientations, respondents' assessment of task value showed that 82 (58%) agreed that the learning materials, activities, and tasks were interesting, important, and useful to their learning. In contrast, 23 respondents (16%) disagreed that the learning activities were to the statement. Similarly, for respondents' opinions on intrinsic motivation, 92 (64%) responded that they believed the approach was more engaging and enhanced their curiosity to become active learners, while 27 (19%) disagreed with that statement. When asked how they used their self-efficacy, 92 (64%) agreed that the IBL approach enabled them to develop abilities, skills, and confidence to learn, understand, perform, and master the learning tasks including tests and assignments. In comparison, 21 (15%) disagreed that self-efficacy enhanced their learning.

3.1.2. Learning Strategies

Results from Table 2 show that 95 (64%) of the respondents agreed with most of the learning strategies orientations, indicating a stronger positive disposition towards the use of varied learning strategies, while 26 (18%) disagreed that they had stronger learning strategies beliefs. Respondents' assessment of peer learning and help seeking showed 88 (62%) of respondents agreed that collaborating with peers and seeking assistance enhanced their understanding of the subject matter, while 25 (18%) disagreed that peer learning and seeking was essential to their learning of chemistry. While 98 (69%) of the respondents believed their ability to retain "information into long-term memory through the building of interconnections to integrate and connect new information with prior knowledge", 27 (19%) respondents did not believe that the approach helped them to integrate and connect new information with prior knowledge to learn. When asked about how they used their critical thinking, 99 (69%) of the student teachers agreed they used their prior knowledge to link new situations to solve problems, while approximately 27 (19%) of the participants disagree with the statement, "Students could apply previous knowledge to new situations to solve problems". In facilitating a clear visualization of participants' perceptions regarding motivational orientations and learning strategies in the context of chemistry education, a graphical representation was used as shown in Figure 1.

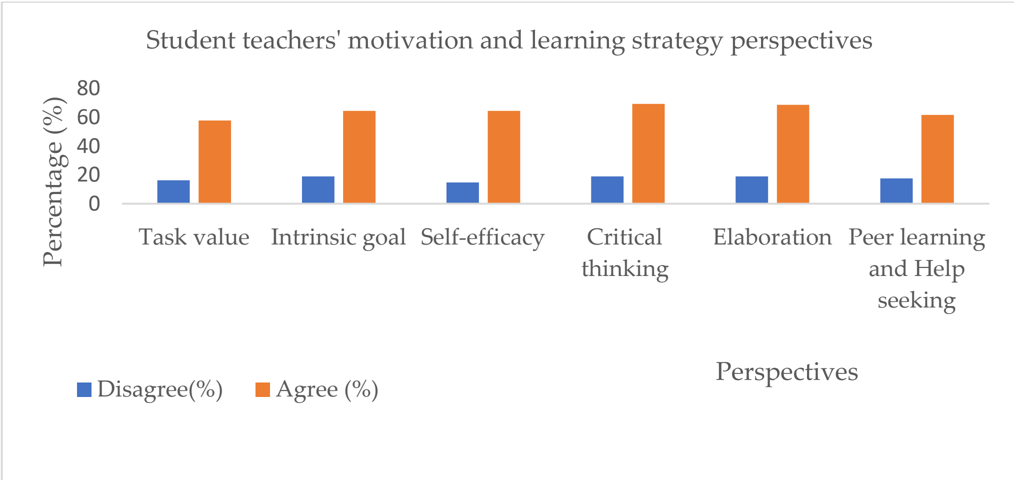

Figure 1. Percentages of student teachers' dispositions towards motivation and learning strategies.

3.2. What Are Student Teachers' General Views on Learning Chemistry in the IBL Classroom?

Participants were asked their views on the question: What did you like/not like most about learning in the online IBL environment? Their positive views about the approach were grouped into four themes, namely:

Category 1: Teachers' support

Regarding educators' support, 10 (8%) student teachers responded that they liked the presence of the tutors during the learning. They felt the presence of the tutors supported them during the class discussions and the out-of-class sessions. Most students agreed that the approach helped build good teacher–student relationships when interacting and communicating through the Google Docs platform. Through the learning platform, they could ask questions and receive feedback from tutors that enhanced their understanding of the subject matter. To strengthen this finding, one student stated,

> *The discussions and interactions with the tutor make the approach promotes learning support from the teacher-learner relationship.*

Another student added,

> *". . . the tutors identified students with learning needs and provided them with the support that motivated them to learn more."*

On the other hand, some (3%) student teachers could not utilize the platforms as regularly as expected, thus missing essential discussions and interactions with the tutors. One participant stated

> *there was a lack of effective communication and interaction since you can't ask questions when you don't understand, and the educator wasn't always available.*

Category 2: Collaboration and peer learning

Regarding students' collaboration and peer learning, 10 (8%) student teachers noted the approach was effective as they could interact and communicate with peers during the group learning activities. The student teachers felt they collaborated on work with peers, which helped establish a good rapport. Some comments from participants include,

> *I have a face-to-face interaction with colleagues, which helps me remember things that were taught.*

Doing the tasks as group work was good because we get help from our friends if you do not understand something.

Category 3: Use of the learning materials

Students (6%) had positive views and attitudes towards the video lectures. Findings from the survey showed that student teachers found the video lectures very helpful in enhancing their learning. One participant wrote that

. . .by watching the videos, a basic understanding of the subject matter was established and developed further, which helped students to review for examination.

In addition, the student teachers indicated that the materials, e.g., videos, were exciting and motivating, enhancing their learning. They explained that the video content was more prosperous. One student teacher indicated,

I believe there was more understanding in the video lessons, and it broadened my scope of learning I also got to know more examples vividly using this approach.

On the other hand, some students (4%) indicated that the video lectures were not helpful. They complained that some of the video activities were complicated and that,

Sometimes the videos were difficult, and unable to understand the concept of the lesson.

Besides students (2%) being unable to comprehend the video's content, the video quality was not appealing to some participants. One student teacher wrote,

The voice in videos was unclear, making it boring to watch and sometimes confusing me the most.

Category 4: Independent and active engagements for learning

The student teachers reported that learning was more engaging and made them active learners. Regarding their class engagement, 7 (6%) student teachers indicated that IBL enabled them to practice the learning content by reflecting on the learning materials. Student teachers believed that having more time to practice the content outside the classroom positively enhanced their active participation and confidence to learn. For instance, one participant argued,

I am more engaged and gain a deeper understanding of content instead of primarily memorizing and recalling facts and ideas.

Another student teacher said,

Learning chemistry in a blended learning environment increased my motivation to participate and engage in the class. We were encouraged to read the materials, ask probing questions, and discuss with peers to share ideas instead of having the tutor give us the facts.

Further, 6 (5%) student teachers also indicated how the learning activities were designed to allow them to decide what and how to learn. They argued that by having access to digital tools, they could review the learning materials and practice the learning tasks ahead of regular class time. This accessibility option enabled students to learn and practice more of the assigned tasks. Excerpts from their responses read,

Inquiry learning allows students to learn on their own time so you can have more time to read and practice the assigned tasks.

I feel comfortable learning in the inquiry settings because the learning activities in the videos were captivating which enabled me to prepare better for the topic.

4. Discussion

This study examines student teachers' perspectives on motivational orientations and learning strategies in a digital IBL chemistry course. Data on student perceptions of the IBL approach were collected through closed and open questionnaires. Findings from the data showed student teachers were motivated and used different learning strategies in the online IBL environment. This shows that the level of motivation students obtain determines the amount of effort placed into the learning.

Motivated students go into the classroom with a well-prepared mind, stay focused on the task, take responsibility for their learning, perform tasks on time, and deal with challenges. Some studies have argued that inquiry-based learning enhances students' learning efficiency, motivation, and interest in chemistry concepts [54]. Findings from this study showed that student teachers' higher task value beliefs see the subject matter as very meaningful and helpful. Student teachers' evaluation of the learning activities and tasks was measured by their interest, importance, and usefulness for their learning. They recognized that the learning materials and activities were helpful for their learning because they facilitated their understanding of the content. Most of the student teachers agreed that the video lessons and lectures were very helpful as they enhanced opportunities for individualized learning after reviewing them many times [17]. Similar findings are reported in the literature on how beneficial task value aids students' chemistry learning outcomes [29].

Research shows that students with higher intrinsic goal orientation place more importance on understanding learning tasks [30,55], changing attitudes towards their learning. Students' teachers believed their attitudes towards science learning and their intrinsic goal orientation enhanced their usage of blended learning. Similar findings have reported [40,56] that students' interest in learning science increases when they activate their active participation and maintain their affective enjoyment and cognitive engagement, which enhances their motivation to learn. Evidence shows that students' interest in learning is focused on capturing the cognitive attention that helps them to master science content taught in the classroom [40]. Students' ability to self-regulate their learning activities enables them to progress in their learning. These self-regulatory efforts develop into critical skills that enhanced students learning success [57]. It is therefore important for teachers to help students identify learning goals, needs, and materials and choose appropriate learning strategies to succeed. This indicates that ideas of active learning facilitate and improve a student's motivation to perform better.

Another interesting finding is the way student teachers use their self-efficacy abilities to master the tasks. The student teachers felt that their confidence in their abilities played a significant role in their learning and that they judiciously used the learning technologies and materials. One of the ideas of constructivist learning is for the learner to actively engage and participate in developing independent thinking in the learning process by coherently organizing facts and knowledge. The student teachers' positive thinking on their capabilities of learning the content and achieving success on the tasks enhanced their understanding of the subject matter. They believed that their self-efficacy influenced active participation and engagement, which helped them learn from their peers. Through their higher self-efficacies, they could accept challenging tasks, disregard distractions, control anxieties, and persist until goals were met for successive learning outcomes [58]. A critical characteristic of IBL is allowing students to self-account, make decisions, and feel responsible. This finding is consistent with prior research [59], that giving students such freedom of learning enables them to use their self-efficacy to utilize, set goals for themselves, and learn tasks successfully. This shows that the students improved their self-efficacies by using varied learning activities to manage their anxieties and change challenging situations.

Studies show that thrives in IBL environment through learning collaboration and interactions and discussions with peers and instructors to foster idea-sharing [43,44]. Peer learning and collaboration among students and teachers is supposed to develop when groups are exposed to problem-based learning. An interesting finding is that some students indicated that they could collaborate well with peers when discussing ideas systematically or managing aspects of their group work that interfered with the scientific content. Through active collaborative learning strategies, student teachers discussed problem-solving activities involving analyzing, synthesizing, and drawing conclusions. The findings show that digital integration in IBL enabled students to collaborate, interact, and explore information for knowledge construction and application [41]. Through the learning activities, student teachers were more engaged in activities to dialogue and brainstorm and clarify course materials. They felt that through the collaborative learning discourse with peers and sometimes teachers, they were enabled to reach insights that they may not have attained on their own. These situations enhanced their learning and thinking skills from the kind of support given by peers and instructors [17]. Again, students engaging in active learning activities were motivated to seek and understand new knowledge through learning collaborations to find solutions [23,49] and integrate new knowledge [60]. This shows that students' motivation promotes their active engagement to use varied learning styles when participating in an IBL class.

Another interesting finding in this study was students' ability to use cognitive and metacognitive strategies such as elaboration to construct new knowledge. Lynch [61] emphasized that individuals' beliefs in their abilities to elaborate and organize their tasks with peers for support enhances the development of critical thinking to be able to succeed in a course. Students' prior knowledge helped manage ideas by enabling them to connect prior knowledge and previous experiences to build new knowledge which served as the basis for subsequent learning. Since the student teachers came to class with some knowledge from the pre-class activities, they had opportunities to participate in discussions. This finding indicate that students had an opportunity to engage in individualized learning at their own pace and review pre-learning materials [17]. Studies show that when learners are engaged in inquiry-based activities several times, their reasoning about scientific phenomena changes through an inductive learning process [44]. This indicates that students' prior knowledge of a subject is critical and that instructors should identify and build on it to enhance the construction of new knowledge. Therefore, educators are encouraged to provide students with high-quality pre-class learning materials to support their learning sufficiently.

Learning science through inquiry is different in that it demands high active participation, intellectual effort, and personal responsibility from students to self-direct their learning [34,36,62]. Inquiry learning allow students to ask questions that have the potential to direct the learning for knowledge construction either through debate or discussion to help evaluate their understanding [63]. Miller et al. [64] assert that when students investigate and organize knowledge themselves, they better understand the knowledge built around them. This indicates that students higher cognitive questioning ability are essential in developing their critical thinking and problem solving since they can be used to diagnose students' understanding of the subject matter, which can be an improvement for future instructions. The choice of instructional pedagogical practice is motivated by specific intent. Using inquiry-based instructional approaches enables teachers to meet the diverse needs of students based on their cognitive levels [23,60]. Within an inquiry classroom, students ask questions, design investigations, collect data, and draw conclusions based on their investigation. In this study, the teacher facilitated the learning process by instructing students to use prior knowledge to construct new knowledge leading to the development of thinking skills. This suggests that to orient students towards inquiry, teachers need to guide students to develop the required skills to engage in scientific inquiry [42]. Therefore, the teacher becomes a facilitator, creating the necessary opportunities for students to learn effectively.

Educators use varied teaching strategies and aids in engaging students to learn as a way of motivating them. Teachers use motivation and engagement to help students learn science to improve their scientific skills. In the IBL environment, teachers guide students in organizing information and facts, assemble experiment results, and make reasonable claims and conclusions based on the data collected. Some studies have acknowledged that educators engaging in students' learning activities, technological tools, and interactions enhance students' success [65]. It is argued that teachers' active role in supporting students in using technology and participating in the classroom empowers and makes students develop positive attitudes by taking responsibility towards learning [32,33]. Similarly, other studies have reported that teachers' presence in an online learning environment motivates and provides intensive guidance and feedback to students to learn and accomplish tasks [35]. Student teachers felt that receiving positive feedback from educators when they experienced challenging situations helped them use their skills and capabilities to manage and overcome their anxieties. Similar findings were found [22,35,36] explaining that the vital role of teachers' provision of appropriate feedback facilitates students' learning progress to self-direct and elaborate their learning.

In addition, students' active engagement and learning occur when they develop knowledge through concept building and reflections on the discourse positively impacts their learning [66]. Positive learning engagements provide a good connection between students' prior knowledge, interests, and science learning experiences. Student teachers felt the flexible learning opportunities provided a strong foundation for students and teachers to participate in meaningful class discussions. By so doing, they could ask questions that connected what they learned and how to apply it. The student teachers had the opportunity to watch the videos more than once, provided many contributed to their understanding of the content as they could pause and reflect on their ideas. Aidoo et al. [17] argues that engaging students with digital inquiry learning provides opportunities of learning flexibilities which makes them active learners as they can take control of their learning at their own convenience. With flexible learning allowances, learners' can review learning activities and generate high-level factual questions from their prior knowledge. Consequently, teachers should provide opportunities for students to activate prior knowledge from learning experiences to make relevant connections with new information [33]. These findings are based on previous studies emphasizing the usefulness of high-quality prior learning activities and materials, e.g., videos for students' learning success [66,67]. This suggests that the effective use of an inquiry-based approach by students requires adequate knowledge and experience.

5. Conclusions and Recommendation

In conclusion, this study has indicated the importance of using different motivational and learning strategies to support students' chemistry learning in the IBL context. The descriptive analysis of this study shows the benefits of IBL in chemistry education and teacher training. This study has limitations in that it was conducted in only three sites, and the sample size does not represent most of the teacher education institutions in Ghana. Therefore, further research is recommended to investigate the effects of motivation and learning styles on students' chemistry learning. Such findings could provide comprehensive information on how motivational orientation and learning strategies influence students' chemistry learning.

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