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Exploring Current Practicing Scenario and Investigating the Influential Factors of Practical Work in Secondary Chemistry Education in Bangladesh

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Abstract

Teaching-learning of chemistry has undergone continuous changes over time. The emphasis is being shifted toward more hands-on and inquiry-based activities. Practical activity in science education is deemed vital to foster a knowledge of science's nature and concepts. However, in the context of Bangladesh, practical chemistry is still not sufficiently applied in secondary schools, and a variety of influential elements are embedded there. Thus, the goal of this study is to explore the current scenario of chemistry practical work and to investigate the influential factors for practicing it in secondary school. The study approached a qualitative technique. Four chemistry teachers, three chemistry education specialists selected purposively, and two groups of secondary school students selected with maximal variation technique were included in the study's sample. The data were gathered through focused group discussions and interviews and then analyzed using the theme analysis technique. The study's findings indicate that a lack of physical facilities, teachers' lack of knowledge about practical work, excessive workload, insincerity for practical classes, school administration's lack of awareness and motivation, and unsafe working environments all have a significant impact on current practice of secondary chemistry practical work. Additionally, the absence of a separate chemistry laboratory, a lack of laboratory equipment, an insufficient amount of time allocated for practical work, students' negative attitudes toward chemistry practical work, and teachers' low level of expectation for the development of information and communication technology were identified as major influencing factors affecting chemistry practical work. The study has significance for all chemical educational professionals, but particularly for teachers and policymakers, who serve as important implementers.

Keywords: Practical work, laboratory, content knowledge, skill development.

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1. Introduction

Chemistry, as a fundamental branch of science, is viewed as a practical discipline concerned with the study of matter and its change through processes such as heating, electrolysis, and other chemical reactions (Twoli, 2006). For teaching-learning purposes, this subject is typically separated into two major components: theory and practice. The theory components are concerned with acquiring and processing knowledge in a variety of forms, most notably laws, principles, facts, and concepts.

These theoretical components are mostly focused with abstract notions and principles, which makes them challenging for pupils to conceptualize. Thus, practical activity assists students in making the academic side more concrete. Besides, considering the purpose of science education, practical activity at all levels is seen as a critical component of science education. This aids in the grasp of scientific concepts and theories. Practical activities in science are well acknowledged to increase student involvement and passion. It teaches students to understand the spirit of science while also developing their analytical, problem-solving, and generalizing talents (Ausubel, 1968). Additionally, it is recognized that engaging in beneficial practical activities strengthens their abilities, concept growth, and knowledge of sustainable science (Science Community Representing Education [SCORE], 2007).

Chemistry is a hands-on science that teaches the learners to theoretical principles. It is concerned with a range of invisible and abstract concepts, including molecules, chemical bonds, and reactions. In the majority of cases, theoretical explanations and lecture-based lessons are insufficient to deliver meaningful learning for students. Miller (2004) asserts that teachers cannot simply communicate abstract concepts to learners; rather, students must actively participate in utilizing these concepts to generate their own notions. By demystifying the subject of chemistry, giving students with real-world experiences can aid in their comprehension.

Practical exercises are pre-planned opportunities for students to observe circumstances through the use of tools (Hofstein, 2004). Practical work in chemistry is primarily conducted in laboratories, where students can learn by observing, experimenting, and manipulating chemicals and equipment. To summarize, laboratory activities have historically been an integral part of the science curriculum, and science educators have claimed that involving children in science laboratory activities can result in a range of benefits (Hofstein & Lunetta, 2004). Through these activities, students are meant to hone their analytical skills and increase their scientific knowledge. Practical laboratory activities help students grasp the nature and methods of science while also developing their problem-solving and analysis skills. Additionally, according to Woolnough and Allsop (1985), if we want students to develop abilities that are used by practicing scientists and if we want to teach science skills, practical engagement appears to be crucial in this situation. As a result, practical activities are viewed as vital for teaching and learning about chemistry.

Effective practical work has become a widespread difficulty in many countries, particularly in poor countries, due to numerous constraints. Modern chemistry curricula require a significant number of activities, and a teacher shortage complicates science education (Motlhabane, 2013; Bekalo & Welford, 1999; Hodson, 1996). Inadequate teacher training and implementation of instructional plans are key barriers in this profession. The absence of a suitable environment, instruments, and laboratory supplies, as well as financial resources for teaching practical science, are all identified as barriers. Again, rather than engaging in open inquiry and experimentation, the majority of laboratory activities and experiments are guided by a 'recipe-style' approach. Students need just to follow a sequence of steps in a recipe-style lecture to illustrate and validate previously learned scientific principles (Hodson, 1996). On the other hand, Woodey (2009) underlined the need of designing the aims and objectives of practical work in such a way that students may use scientific information while also becoming adept in the procedures. Because simply following recipes during practical exercises puts students at danger, it has been criticized for encouraging rote learning rather than genuine inquiry-based learning. It prohibits learners from handling instruments and experiments and prevents them from developing their own knowledge based on their own experiences and associated scientific notions (Hodson, 1996; Hofstein & Maalmlok-Naaman, 2007; Domin, 1999; & Shiland, 1999).

Chemistry education and learning have seen considerable changes in Bangladesh over time. When establishing chemistry education, the objectives, curriculum components, textbook material, teaching-learning methodologies, and assessment types are all considered. According to the study of Babu (2016) in Bangladesh the science curriculum was not being followed accordingly in the classroom. In general, teachers lectured during lessons. Experiential learning, experimentation, scientific inquiry, reasoning, and causal analysis are all encouraged. Excessive workloads and a scarcity of reagents were given as justifications beyond ineffective use of instructional aids. Students don’t have opportunities for creative expression in scientific classes.

Bangladesh's 2010 National Education Policy stressed the necessity of pupils developing problem-solving abilities and placed a high premium on practical activities. Students will benefit from the process's incorporation of educational content, curricular structure, and strategy. Additionally, the 2012 Secondary Education Curriculum in Bangladesh places a high premium on pupils acquiring practical knowledge. They can apply these abilities to address personal and societal concerns while also contributing to national prosperity. As a result, it has become critical to prioritize practical chemistry teaching-learning activities in order to foster the development of competent problem solvers as well as experienced and knowledgeable citizens.

However, in Bangladesh and many other countries, disciplines such as physics, chemistry, biology, and mathematics are frequently taught more theoretically than practically. Additionally, less emphasis is placed on and enough practice is undertaken in secondary schools, particularly when it comes to chemistry practical.

Additionally, Bain and Siddique (2016) noted that, while curricula and textbooks give opportunities and direction for stressing practical work in these topics, effective practice is still lacking to a large extent. As a result, pupils face increased difficulties in understanding chemistry and become less motivated to study. It has been determined that the number of science students is declining, and one of the primary reasons for this is that students are learning science theoretically without considering appropriate practical exercises (Rahman, 2011).

The current problems with insufficient and ineffective chemistry practical practice are complicated by a number of interrelated elements and issues. Additionally, these key elements impede students' ability to solve problems independently by limiting them to recipe-based chemical practical practice. As a result, it appears critical to ascertain the existing condition and explore the primary influencing factors affecting secondary chemistry practical practice.

2. Research purpose and objectives

The purpose of the study is to enquire current practicing scenario and explore the influencing factors of secondary chemistry practical work in Bangladesh context. The specific objectives are to look for the following key points according to stakeholders' perspectives.

- To explore the current status of chemistry practical work in secondary level
- To investigate the influential factors that are being confronted in practicing chemistry practical activities

3. Methodology

In this study, the research objectives are exploratory types that deals with the central phenomena of exploring the current practicing scenario and the influential factors of practical work in secondary chemistry education. To explore these central phenomena,in the line of constructivism research paradigm this qualitative research is explained that qualitative research is the most suitable for exploring and developing a detailed understanding of central phenomena(Creswell,2015).

The data sources of this study are basically the chemistry educational stakeholders of our current educational practice. The stakeholders included four (04) secondary chemistry teachers, two (02) groups of students where each consisting of eight and seven participants and three (03) chemistry education specialists. The research instruments for this study are combined with in-depth interviews and focused group discussions. The four chemistry teachers and three chemistry education specialists for in-depth interviews were selected through purposeful sampling technique following Creswell (2015) suggestion as participants were required with possessing adequate information and previous orientation. Then two groups of students for their FGDs were selected following maximal variation sampling technique in which a wide range of participants were deliberately selected to obtain variety of perspectives as suggested by Johnson and Christensen (2017).

The data analysis for this study is conducted following thematic analysis technique. According to Braun and Clarke (2006) qualitative approaches are incredibly diverse and complex, and thematic analysis should be seen as a foundational method for qualitative analysis. Besides, thematic analysis involves developing themes from data consists of answering the research questions and forming in-depth understanding of the central phenomenon (Creswell, 2015).

4. Ethical Consideration

The study was conducted basing on the consent of the participants explaining the objective of the study, which is purely for academic purpose only. Prior to the study's conduct, all participants signed a consent form. After obtaining consent and informing each respondent on the purpose of the survey, we begin data collecting. Additionally, participants may withdraw from the study at any time. All respondents were asked to provide all their responses voluntarily.

5. Results

The data collected from participants via interview and focus group discussion are themed and analyzed in accordance with the research objectives, taking into account the opinions of instructors, students, and chemistry education specialists. The data set is presented here in line with the steps outlined below.

i. Exploring current practicing scenario
ii. Assessing the influential factors

5.1 Current practicing scenario of chemistry practical work

5.1.1 Teachers' perspectives

Concerning chemistry practical work, the first respondent indicated that if students can practice the experiments associated with each chapter, they will grasp the concepts more properly and easily. Students' proclivity for memorizing every topic can be reduced. This manner, learning can have a greater impact. As a result, practical

knowledge will enable them to more easily respond to innovative questions. He mentioned,

Practical helps the students to understand the topic better and inspire them not to memorize everything. This even helps them to answer creative questions more accurately.

In discussing the current situation, the chemistry teacher stated that the school possesses nearly all necessary equipment. However, because there is no laboratory, it is often difficult to apply those in class. Experiments are conducted only in preparation for the final tests. In the interview he said,

We have almost all the necessary equipment but can't practice much because of not having any laboratory.

Then, the second respondent teacher from another school, highlighted how the school's current status has improved significantly in recent years. Due to the school's remote location, it lacks in adequate functioning of a laboratory. Despite this, the children practiced rather frequently with the instruments they received. In his word,

We have received many instruments this year and students also worked with them. But as we do not have laboratory, students have faced some problems to do experiments properly.

According to another interviewee, chemistry is primarily concerned with chemical reactions in this or that direction. Thus, if students are given the opportunity to do experiments based on what they learn in textbooks, they will have a better understanding of that particular subject. As a result, their education will become more sustainable and effective. Teacher said in the interview,

By doing practical experiments, learning becomes effective. And in contrast to subjects like chemistry it is more important and need proper emphasis to be given on.

Later, when discussing the current status of practicing chemistry practical, the fourth participating teacher indicated that because his working institution is a combination of a school and a college, the college's practical classes are given priority over the school's. Whereas college students have the opportunity to practice once a week, school kids typically only have the opportunity to practice on exam days. Because there is no demonstration, teachers must hold class for an extended period of time. The teacher uttered in her interview,

College practical are given more importance than School. Shortage of teachers and demonstrators create some problems to practice regularly.

5.1.2 Students' perspectives

During the discussion on the practical situation in Chemistry, the majority of students indicated that practical classes are solely focused on the week before exams. On the other hand, several students stated that they had attended regular practical classes that included a proper laboratory and instruments. One participant student of first FGD said,

We had subject wise different laboratories. From the beginning of year, we did practical classes regularly with the guideline of our teachers.

On the other hand, another student in the second FGD reported,

We had all the materials but did not have any laboratory. The teacher used to show the experiments by doing once.

Given the relevance of Chemistry practical, the majority of students in the first FGD agreed that it is critical to understand the applicability of what they are reading, as these chemicals are present in their daily lives. Although students simply read chemical names, experimenting with them enables them to see and grasp their properties. Similarly, students can easily comprehend equations. One of them mentioned,

Doing practical helps us to relate the theories more conveniently. For chemistry it works even better.

Students from the second FGD had a similar discussion. They realized that practical employment enables kids to accumulate experience on their own, which instills in them a desire to learn more. A participant student claimed that,

Learning becomes more sustainable and impactful by doing practical experiments. Chemistry practical makes our learning effective contrasting the theoretical contents.

5.1.3. Chemistry education specialists' perspectives

Chemistry education specialists were observed emphasizing the value of practical work in topics such as chemistry. According to the first interviewee, we employ chemistry on a daily basis, from sunrise to night. Thus, students should understand the relevance of the material they are reading in their textbooks. He claimed,

Students must know the real-life applications of text book contents. In this case chemistry practical play significant role to understand and apply theoretical chemistry knowledge.

In response to the current scenario, the second interviewee stated that Chemistry practical lessons are not held on a consistent basis. Even if it occurs occasionally, it does not occur appropriately. He reported,

Practical classes are not regular here. To some extent the situation with practicing practical class seems being compromised in many senses. Sincerity is a serious issue here.

Then the other professional participant explained how the practical and theoretical aspects of chemistry are inextricably linked. Thus, if someone want to perform well on the theoretical portion, he must also practice the practical portion appropriately. Students have the option to conduct experiments using appropriate instruments during practical lessons. They are given the opportunity to experiment with acids, bases, and a variety of other compounds in order to gain practical knowledge about them. Thus, students can enjoy their study while still comprehending the value of science education. In his word,

Doing practical is very important for the students to understand the true nature of science. As subjects of science areas are much related to practical knowledge, so practical work is considered to be a prerequisite in order to understand science effectively.

5.2 The influential factors of chemistry practical work

5.2.1 Teachers' perspectives

There are a number of influential aspects that the participant teachers have identified. They appeared to identify the critical influencing factors based on their past and current employment status. Almost certainly, the first participant teacher regarded physical amenities as the most influential aspect influencing chemistry practical work. As of his explanation,

It was mentioned earlier that there is no laboratory in my school. So the instruments for the practical gets confined in the shelves. Then when teachers want to practice in the class it becomes difficult to schedule the classes properly. Because the instruments are kept in the shelves and permission of the Head teacher is required to take them. Moreover, it is a trouble to carry the instruments from one place to another for the practical. There also remains a risk of those to get broken somehow or someone to get injured with harmful chemicals.

Then the second interviewee teacher suggested some possible ways that can help to mitigate the influential factors of secondary chemistry practical education. In his word,

As the main limitation is the absence of laboratory, so if the laboratory is set in the school, it will become much more convenient for the practical situation. Therefore, the teachers need to become more responsible in this matter. The appropriate authorities should also monitor whether the practical classes are being practiced regularly or not.

Later on the third participant teacher expressed that the major problem of proper implementation of chemistry practical is the lacking of proficiency of the teachers. In his word,

Most of the teachers of rural schools are not skilled enough to do the experiments properly. They are not updated enough according to the students need. Deficiency of demonstrator also increases this problem. That's why we face problems while doing practical classes.

As the teacher stated that the primary issue is a lack of teacher skill, he believes that the issue can be resolved by good teacher training. Teachers' training programs are increasingly focusing exclusively on teaching-learning methodologies. In this sense the fourth interviewee teacher explained that,

It has commonly been assumed that as they are teachers, they don't need content knowledge anymore. That is why they are not being updated on text book related topics. If the training programs include some practical lessons related to the subject, the teacher thinks that it can be very beneficial for the teachers as well as for the students. If possible, the training can also include some special techniques that will help them to make the practical easier and enjoyable for the students.

The next responding instructor also stated that there is no laboratory available for students to conduct practical in a safe atmosphere. There are no demonstrators who can assist lecturers during classes and demonstrate the practical to students through demonstration. That is why it can be quite challenging for teachers to conduct practical sessions with a big number of students at times. They are required to attend classes for up to 5/6 hours at times. He claimed that,

There is even deficiency of enough teachers for the subject. It becomes difficult to run the practical classes

properly. Sometimes there also remains shortage of enough chemicals and required instruments. So, it becomes difficult for us to conduct regular practical classes.

5.2.2. Students' perspectives

When discussing the aspects that influence Chemistry practical, the students' initial FGD focused on the laboratory's inadequacy, teachers' inadequacy, and supplies' inadequacy. Additionally, they cited a lack of safety materials in laboratories due to the presence of hazardous substances. One of them said,

Our teachers seem to be sincere with their works and intention. But having no laboratory created problems for us to go for performing chemistry practical works.

On the other hand students of second FGD reported newer aspects regarding influential factors. A participant from the group stated that,

The teachers are not sincere about taking the classes regularly and in terminal examinations practical numbers are given on the basis of the mark they get in theoretical part. Sometimes teachers don't monitor properly so the students copy experiment results from one another.

While students were interrogated about their perspectives on evaluating the factors and potential solutions to the problems, they explained that a properly equipped laboratory with the necessary materials, a sufficient number of teachers, and demonstrators would all contribute to improving the situation. A participant student from first FGD claimed,

The practical should be done chapter wise so that we can learn more conveniently. We often find inconsistency of theory and practical contents.

Another participant from second FGD described that,

Sometimes weak students face problems for the lack of proper guidance. Practical experiments should be done in small groups so the teachers can give proper attention.

5.2.3 Chemistry education specialists' perspectives

In their discussions with chemistry education specialists, they identified many critical components that could aid in resolving the institution's practical challenges. In words of the first interviewee,

The first thing required for the betterment of chemistry practical situation is laboratory. Then sufficient apparatus and chemicals should be provided to do proper experiments. Required number of demonstrators and teachers should be appointed for proper practical classes. We need sufficient teachers, demonstrators, chemical supply and instruments for the betterment of our practical situation.

The second participating specialist discussed several of the challenges inherent in doing chemistry practical. As of his description,

Firstly, there is insufficiency of laboratory rooms in the College. Secondly, there are also some shortages of necessary instruments for practical. Moreover, there remains problems of proper electricity and water supply. Sometimes they need to face financial problems as well. Lastly, in some case they do not get proper cooperation from the head of the institute. More so, we do not have enough facilities required for the laboratory rooms.

Besides, there are some suggestions that the third interviewee chemistry education specialists thought should be implemented for the betterment of chemistry practical. He explained that,

In addition, with the importance of theoretical knowledge, the importance of practical knowledge should also be highlighted to the students. Practical classes should be taken regularly. The higher authorities should monitor the practical classes regularly to see whether the demonstrator is doing proper experiments or not. Sufficient instruments and materials have to be provided for the experiments of practical classes.

6. Discussion

In light of the purpose of science education, practical practice in science serves a variety of purposes. It entails honing abilities, acquiring specialized scientific knowledge, and gaining a grasp of scientific inquiry's methods. SCORE (2008) asserts that practical activity has the ability to contribute to meaningful science learning. However, the study's conclusions took into account the current practicing environment and a variety of elements affecting secondary chemistry practical work in the Bangladesh context. The findings indicated that the majority of participants explained that chemistry practical is closely related to the theoretical portion and that practicing helps students grasp the concepts more easily. Due to the intimate connection between chemistry and daily life,

students should be able to apply their topic knowledge in real-world settings. While conducting practical experiments, students gain hands-on experience with chemicals and materials. Thus, via fun learning, they develop a greater interest and curiosity in the subject. It is a proven fact that we recall more of what we do than what we read or hear. Thus, by conducting experiments, pupils' proclivity for memorization is diminished. Additionally, practical exercises assist students comprehend the fundamental nature of science and the value of science education.

Then, based on the study's findings, some critical characteristics of the current practice scenario for secondary chemistry practical work were deduced. They mostly criticized the absence of a distinct chemical laboratory, the lack of knowledge and enthusiasm on the part of school administrations, the late start of practical classes, and the insufficient time allotted for practical work. Additionally, teachers and chemistry education professionals expressed worry about several aspects affecting the practice of chemistry practical. They highlighted that unsafe working conditions, teachers' lack of knowledge about practical work, full-time occupancy of theoretical classes, absenteeism in practical classes, a lack of equipment, and chemistry teachers' unfamiliarity with new technologies are all key influencing factors. These variables contribute to the practical limitations of effective chemistry procedures.

The participants primarily regarded the lack of enough laboratory space as one of the most significant barriers to efficiently executing chemistry practical work. Many rural institutions lack a laboratory, or if they do, it is deficient in terms of adequate instruments and the required amount of chemicals. These findings are bolstered by research by Soyibo (1986) and Ajayi and Julius (2008), which indicate that the majority of secondary schools lack science laboratories, while those that do have them are underequipped and badly maintained. Additionally, the teachers recognized a lack of chemicals and materials in laboratories as significant influencing factors in the inability to undertake adequate practical work. The absence of demonstrators and supplies exacerbates the situation. Krajick, Mcneil, and Reiser (2007) asserted that materials can serve as a major guide for teachers in terms of how to teach science practical. Again, findings indicated that some teachers are unconcerned with the effective execution of practical work, and those who are occasionally unable to design lessons properly due to a lack of abilities. As a result, students do not have enough opportunity to engage in inquiry-based activities and, in many circumstances, remain uncertain about the objectives and consequences of their practical work. Tobin and Gallagher (1987) asserted that science teachers rarely, if ever, engage in behavior that encourages students to reflect on the nature of scientific inquiry and the meaning and purpose of their particular investigation while engaging in laboratory activities.

While conducting practical sessions, the number of students becomes a major concern. It becomes difficult to conduct classes with 70/80 students at a time, and students also struggle to comprehend the experiments in this setting. Regular classrooms become tough for teachers, whereas effective laboratory learning occurs when students are given appropriate time and chances for interaction and reflection (Gunstone & Champagne, 1990). Teachers are then required to take additional classes, and many become unwilling to exert much effort. Additionally, the data indicated that secondary school chemistry teachers lack fundamental computer and software application skills necessary to support practical chemical practice. It is difficult for them to educate using computer-assisted teaching and learning methods, whereas effective use of technology enables chemistry educators to see a broad array of resources (Kozma & Russell, 1994). Again, because the role of current technology in education is frequently associated with the process of educational innovation, technology integration into classrooms appears to be a need nowadays.

As a result of all of these factors, teachers tend to focus on theoretical classes and, to a lesser extent, on recipe-style practical activities. According to Motswiri (2004), the majority of secondary school chemistry lectures are conducted via chalk-and-talk with little practical work. In a recipe-style lesson, students simply follow provided directions without thinking or comprehending the activities. They rarely get opportunities to contextualize their practical learning. Tasker (1981) demonstrates that secondary school students make little connections between practical work classes and other science lessons.

While evaluating the generated influencing elements, participants also suggested some possible actions for improving the chemistry practical scenario. They frequently stated that a properly equipped laboratory with sufficient resources could be beneficial in this case. One of the chemical education professionals requested sufficient oversight from higher authorities in order to conduct the classes effectively. A teacher response emphasized the importance of providing adequate training to teachers who lack the necessary abilities to make practical sessions more effective. Additionally, teachers must be more consistent in their practice of practical work. Participants then discussed how, while a big class size is an impediment, students can be separated into small groups and classes can be held on alternate weeks days. They underlined the need of having enough

teachers and demonstrations to make the classes more suited. Additionally, students highlighted the need of a properly equipped laboratory with the essential resources for adequate practical activities. They asserted the importance of receiving adequate laboratory facilities and the attention of their teachers. Weaker pupils must be given additional attention, and monitoring by higher authorities must be increased to ensure positive outcomes from practical classes. Tafa (2014) stated that necessary attention and direction should be provided because simply having students accomplish things in the laboratory is insufficient. Laboratory experiences must be designed in such a way that they capture students' interest.

7. Conclusion

It has been evident that the situation of Chemistry practical varies considerably amongst universities. While many institutions are attempting to establish a suitable environment for students in practice, they are fewer in number than the number of institutions that are not in a satisfactory state. Authorities should take this situation seriously, as appropriate education of pupils is inextricably linked to adequate facilities for practical employment. Numerous problems and concerns must be addressed in order to improve the situation in the Chemistry practical.

To facilitate meaningful teaching and learning of chemistry through practical activity, teachers should devise activities that engage students in scientific analysis. By introducing students to science process skills, these will focus their minds on the action and its outcome. Teachers and school administrators alike must cultivate a good attitude toward practical work at the secondary school level. Various monitoring bodies can be established to keep an eye on the practical situation and work toward overall betterment. To improve the skills of teachers and demonstrations, training programs can be created. These should be reserved for training exercises in which proper technique will be taught to them. Teachers should receive adequate training on how to conduct a practical lesson effectively by paying attention to all pupils. When teachers have large classrooms and limited laboratory space, they might use the grouping or shifting method of instruction to support effective practical work practices. Increased funding is required to provide universities with adequate labs and equipment. It is necessary to protect the safety and security of chemistry laboratories. Due to the potential for information and communication technology to influence practical science in a variety of ways, chemistry teachers must also develop their skills using current technology. Additionally, policymakers and authoritative authorities should employ qualified and professional teachers and support staff to facilitate effective chemistry practical classes. Additionally, sufficient emphasis must be placed on the preparations for constructing the overall scenario for chemistry practical practice.

8. Limitations & Implications

As a study with a small sample size (chemistry teachers, chemistry education specialists, and students), the findings may have limitations. However, because the findings are consistent with previous findings internationally, they can be seen as a valuable addition to the discussion of practices and scopes for change in undertaking practical work in science, particularly in the Bangladesh context.

The study's conclusions may be beneficial to a variety of stakeholders in the education system. Chemistry teachers, Chemistry students, school principals, school laboratory workers, curriculum developers, and future researchers are among them. Additionally, because research on chemistry practical work in secondary education in Bangladesh is still insufficient, the outcomes of this study will aid in a variety of ways. This study has the potential to contribute to national policy and planning at the outset, and then to facilitate different perspectives on secondary chemistry practical work among policymakers and developers. Additionally, it may serve as a useful consideration for curriculum developers and experts in chemistry education.

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