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Present Status of Science Laboratories in Secondary Schools for Better Implementation of Experiential Learning

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Abstract

This research tried to discover the existing situation of science laboratories in secondary schools; analyze the mindset of teachers and students in using science laboratories; identify the challenges to keeping science laboratories functioning; and find ways to keep science laboratories operational for better implementation of experiential learning approach which has been introduced to classes 6 and 7 in 2023. In this qualitative study, the researchers employed observation, a semi-structure interviews methods to collect data from six head teachers of six different secondary schools; six Focus Group Discussions (FGDs) with 60 students of class 10; FGD with six groups of science teachers from the six secondary schools. The observation and the FGD data were developed over time and the interview data were transcribed. Then the transcribed data were coded and categorized based on the themes of the research objectives. The major findings revealed that the existing situation of science laboratories in secondary schools was not satisfactory; the required number of apparatus and amount of reagents were not there in the laboratories; apparently, the overall mindset of teachers and students was found positive regarding the use of the science laboratory and practical classes; the challenges included *shortage of science teachers, theory-focused science textbooks, lack of training on organizing practical classes, no practical classes set in the routine, and no monitoring and supervision from any corner; the possible ways to overcome the stated challenges included: laboratories needed to be modernized with apparatuses and chemicals, there needed a post of a Laboratory Manager with science background who would provide support to the teachers as well as the students in practical activities and manage the laboratory resources. Monitoring the practical activities and filling out the vacant posts of the science teachers was deemed necessary.*

Keywords: science laboratory, secondary schools, experiential learning, apparatus, chemicals

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Introduction

The paradigm shift in the secondary education system in Bangladesh is underway. Instead of a learning-outcomes-based curriculum, National Curriculum and Textbook Board (NCTB) launched a competency-based curriculum by introducing an experiential learning approach from 2023 academic year. NCTB formulated *the National Curriculum Framework 2021* (NFC 2021), and the philosophies in the NFC 2021 have started to be implemented from January 2023 in the 6th and the 7th grades of secondary level of education on an experimental basis. The same approach to teaching and learning is going to be introduced in other grades of secondary level from academic year 2024.

In the experiential learning approach, teaching-learning techniques such as hands-on learning, project and problem-based learning, cooperative learning, inquiry-based learning, and self-and-motivated learning strategies are used as per the need and context. In the experiential learning approach, a teacher plays the role of a facilitator, and the students play the role of proactive problem solvers. In other words, experiential learning is a learning strategy where a learner has to go through an experience, and going through experiences, learners reconstruct their previous knowledge based on the experiences they go through. David Kolb, an American Psychologist, introduced experiential learning theory in 1984 where he mentioned four stages for better learning to happen. Kolb's four stages are Concrete Experience, Reflective Observation of the new experience, Abstract Conceptualization, and Active Experimentation. According to him, learning is the process in which knowledge is constructed and reconstructed through the transformation of experience (Kolb, 1984).

Experiential learning can be best implemented in science subjects which occupies an important place in the education system of almost all the countries of the world (Abrahams and Reiss, 2012). Through science education, a student can gain in-depth knowledge of the world around them. It is through learning science that a student can accurately explain the causes and effects of various complex methods, processes, systems, etc., starting from the human body to everyday activities (TLRP, 2006).

As a practical-based subject, the key to science education is recurrent experimentation for better learning, achieving skills, and creating new knowledge. This learning through experimentation is a good example of experiential learning. Experimentation in science education consists of experimentation itself, observation, classification, inference, communicating (reporting the findings), scientific thinking, predicting, etc. (Millar & Driver, 1987). One of the major purposes of teaching science is to provide the learners with the ability to adapt to the rapidly changing and growing age and to benefit themselves and the nation from the latest technological innovations (Hancer et al., 2003; Duban et al., 2019). To adapt individuals to the rapid changes in societies and the environment, it is necessary to acquire practical knowledge of science (Woodley, 2009).

When science education is imparted in a descriptive way ignoring the practical activities, usually, the students' curiosity does not develop that much and they begin to think that science education, like all other subjects, is memorizing some pieces of information (NCTB, 1990). When science is taught using laboratory equipment, students can attain direct

experience with the contents by conducting experiments in the laboratories (Osborne, 1998; Duban et al., 2019). Practical activities in and outside laboratories play a key role in bridging the gap between theory and practice (Cullin et al., 2017).

Although science education is so important, Hussain (2021) and BANBEIS (2015) reported that science laboratories in secondary schools were deplorable; and the number of students in science education in Bangladesh was decreasing day by day (Kabir, 2017). In this context, the current research intended to examine the status of science laboratories, the mindset of science teachers and students in using science laboratories, the challenges of keeping science laboratories functional, and the possible ways to overcome the challenges for better implementation of experiential learning in secondary schools as functional science laboratories are important to implement philosophies of the experiential learning approach.

Rationale of the Study

Bangladesh National Education Policy 2010 (NEP 2010) stated that science education should be provided to students so that they can understand the close relationship between technology and humanity, and regular practical classes in science subjects and Mathematics should be arranged. NEP 2010 emphasizes the assessment of science subjects based on the practical knowledge and skills of students.

Experiential learning in science subjects require science laboratories in the educational institutions. However, it was reported that the overall scenario of science laboratories in secondary schools in Bangladesh is disappointing (Hussain, 2021; BANBEIS, 2015). At the advent of introducing experiential learning in all subjects at secondary level institutions, this research attempted to explore the present status of science laboratories in the secondary schools of Bangladesh; science teachers' mindset towards practical activities in the laboratories; challenges of keeping science laboratories operational; and find ways for better implementation of experiential learning through the best use of the school laboratories.

Objectives of the Study

The followings are the objectives of the study:

- to discover the existing situation of science laboratories in secondary schools;
- to explore the mindset of teachers and students in using science laboratories;
- to identify the challenges to keeping science laboratories functioning;
- to find ways to keep science laboratories operational for better implementation of experiential learning.

Scope and Limitation of the Study

As teacher educators and teacher trainers working at different Teachers' Training Colleges and National Academy for Educational Management (NAEM), the researchers have to deal

with secondary teachers. They had a positive and supportive relationship with the teachers. Therefore, the researchers were able to get easy access to research sites and the participants. Because of the reliable relationships between the researchers and the participants, it was possible on the part of the researchers to access the schools and the participants easily; and it was possible to delve deep into the research problem.

There were some limitations which included a small number of participants from secondary schools, and no secondary-level madrasahs and English medium schools were included in the study. Moreover, there was little literature related to the research problem in the Bangladesh context. Despite all these limitations, the study findings are expected to be reliable because of the rigorous nature of the study.

Review of Literature

The purpose of science education at the secondary level of education in Bangladesh is to develop students' knowledge of natural phenomena by increasing their power of observation (NCTB, 2012). Through learning science practically, students can acquire the ability to solve different problems in their lives as well as they can become more interested in different elements of the environment. NCTB (2012) asserts that rather than analyzing the theories and formulas of science in the classrooms, its use in everyday life to solve social issues is important.

Students can relate science to life through experimentation (NCTB, 2012). Therefore, experimentation in science laboratories is essential as appropriate laboratory activities or practical work can help students construct science knowledge better (Tobin, 1990; Gunstone, 1991). Science teaching devoid of worthwhile practical activities cannot be meaningful (Hofstein & Mamlok-Naaman, 2007). There is an attempt to change science teaching from traditional board and paper processes to practical-based ones. Practical-based learning is called experiential learning and experiential learning is gathering direct experience through doing (Bayineni, 2020; Gorghiu and Santi, 2016). Learning by doing provides students with knowledge and skills; they can reflect on those experiences to develop new skills, new perspectives, and new ways of thinking allowing them to develop a better understanding of the ideas at hand.

Although practical activities are important for science subjects, different reports reveal that laboratory work, project work, and other participatory activities are, in most cases, absent from secondary schools in Bangladesh (Jahan, Azim, & Ahmed, 2011). Babu (2016) claims from a mixed-method study with secondary teachers and students that learning by doing, demonstrating experiments, scientific inquiry, and analyzing cause-effect relationships are noticeably absent from science classrooms. Teachers teach science using a lecture method because of excessive workload and lack of apparatuses and reagents in school laboratories (Babu, 2016).

Science subjects are difficult to teach in the absence of well-equipped science laboratories (Nyanda, 2011). Choudhury (2009) reports that many students do not choose science subjects in the absence of qualified science teachers and well-equipped science laboratories in schools. According to Chaudhury (2009), the teaching approach and teachers' poor inspiring power contribute to the gradual decline in enrolment.

The alarming situation in schools is that most of the teachers are not aware of the curriculum expectations. A research report by BANBEIS (2015) reveals that very few head teachers and science teachers of secondary schools and madrasahs have studied the curriculum report 2012. According to BANBEIS (2015) report, on average about 15% of schools and 31% of madrasahs have no science laboratory though there is a small store of a little amount of equipment in a self or drawers of the headmasters/principals; 13.5% rural and 20.3% urban high schools and 23.1% and 13.6% urban madrasahs purchase equipment and reagents regularly more than 50% schools and madrasahs have no budget for laboratories.

Different studies (Babu. 2016; BANBEIS, 2015) reveal that science teaching-learning has never been satisfactory in Bangladesh and other countries (Kamba, Libata, and Usman, 2019; Zengele and Alemayehu, 2016).

Methodology of the Study

The current study employed qualitative research methodology as it is possible to delve deep into the research problem. The study used observation, FGD, and Semi-structure interview methods to collect data.

Six secondary schools were selected conveniently from Dhaka and Khulna divisions including government, non-government, and private schools. The researchers carefully chose the schools so that they comprised rural, urban, boys, girls, and co-education schools. 19 science teachers from six schools participated in this study. A total of 19 science teachers and 60 students participated in six FGDs. That is, the number of FGDs were 12, six with the students and six with the teachers. Six headteachers of the selected schools were interviewed with a semi-structured interview schedule. FGD guides were used for holding FGDs with students and the science teachers.

Data collected through different tools were developed, transcribed, coded, and then categorized based on the themes of the objectives of the research. Similar data were put together and they were logically organized. Findings of the study emerged during the transcription of the interviews, FGDs, and tabulation of the observation data.

The findings were presented descriptively and were supported with the excerpts from the participants. Data collected from different sources were triangulated for validating the findings. Again, the findings were interpreted in the light of existing literature.

Findings and Discussion

The findings of the study are presented under the heads such as the status of science laboratories in secondary schools; the mindset of teachers and students in using science laboratories; challenges to keeping science laboratories functioning; and ways to keep science laboratory functional for better implementation of experiential learning. The findings of the study have been presented below:

Status of Science Laboratories in Secondary Schools

The visits to the laboratories, FGDs with students and teachers, and interviews with head teachers revealed that the existing situation of science laboratories in secondary schools is not satisfactory. The visits to the laboratories revealed that there was a dearth of apparatuses and chemicals in the laboratories. The furniture and the space were insufficient; only one or two chairs and a table were there; the equipment and the chemicals were preserved in the almira and in two laboratories, they are seen in intact sealed boxes. It indicates that these laboratories and the equipment are not usually used for a longer period. One of the students in FGD-1 claimed:

Our science lab is smaller than any other typical classroom. There is not enough space to sit and work together. Moreover, the cupboards are very old and colorless. Our equipment is also less in number and they are quite old.

The science teachers in different FGDs claimed that there are not sufficient equipment and chemicals in the laboratory. One of the teachers in FGD-2 alleged:

The available space in the laboratory is not enough for the students; all the students having science cannot work together in the laboratory. When we take a class in the laboratory, some students have to keep standing.

The science teachers confessed that they teach science mainly through lecture method; there is little or no scope for engaging students in practical activities. One of the science teachers in FGD-4 claimed:

We usually do not take the students to the laboratory for practical work regularly throughout the year; so far as I know, almost no teacher does it throughout the country. We do not also take them for a field visit for practical purposes. Even though we conduct some classes in the laboratory, the mode of teaching is a lecture.

The opinion of a teacher in FGD-6 discloses that facilities for group work and practical activities in their science laboratories is limited; all the science students could not be accommodated in the laboratory. One of the teachers claimed:

Despite my willingness, I cannot put all the students together in our science lab for practical science exercises because the space is so small that there is no situation to accommodate the required number of students.

The science teachers in all the study schools have claimed that some practical classes are organized just before the SSC examinations; the students write laboratory reports just before the SSC examinations; practical classes are not held throughout the year. One of the teachers in FGD-5 claimed:

Our laboratories have never received attention of the authorities for a long time. We experienced the similar practice when we were students in secondary schools. There were still fewer science teachers; we had less access to science laboratories; and it is our culture not to use the science laboratories even though we have facilities.

The data placed above show that school science laboratories are not used properly because of dearth of facilities. The data above says that it is a nationwide culture to use the laboratories just before the SSC examinations.

The researchers got a checklist for each subject prepared by two prominent science teachers of two secondary schools. The schools have been given pseudonyms as school 1, school 2, school 3, etc. respectively. The data regarding the subject-wise existing apparatuses and chemicals in each school are given below:

Subject: Physics

Name of the device/ material	School name current number of students in classes 9 and 10					
	School 1 Nine: 60 Ten: 62	School 2 Nine: 37 Ten: 34	School 3 Nine: 114 Ten: 99	School 4 Nine: 80 Ten: 77	School 5 Nine: 165 Ten: 172	School 6 Nine: 45 Ten: 42
Slide calipers	01	01	01	01	01	01
Screw yar	12	03	01	02	02	01
Convex lens	12	05	08	05	08	09
Concave lens	12	O7	08	04	05	07
Convex mirror	08 set	04 set	08	06	06	09
Geometric Box	12	07	00	04 set	04 set	04 set
Concave mirror	00	00	08	00	08	07
Spring personality	10	06	00	03	04	02
Thermometer	04	03	08	05	09	20
Stopwatch	00	01	02	00	04	05
Magnetic compass	00	01	01	03	05	05
Prism	04	01	01	03	04	06
Magnet	00	01	08	04	05	04
Electronic scale	04	03	01	03	03	00
Ammeter	02	03	06	01	02	04
volt meter	01	01	02	01	01	01
tuning fork	00	00	01 set	01 set	00	1 set
Magnifying glass	00	02	01	01	01	04 03
Screwdriver	00	01	01	01	01)	03
Panel meter	00	00	01	00	01	00
Barometer	00	00	00	00	00	00

Electroscope	00	00	00	00	00	01
The liver	00	00	00	00	04	04

Subject: Biology

Name of the device/ material	School name current number of students in classes 9 and 10					
	School 1 Nine: 165 Ten: 172	School 2 Nine: 37 Ten: 34	School 3 Nine: 114 Ten: 99	School 4 Nine: 80 Ten: 77	School 5 Nine: 165 Ten: 172	School 6 Nine: 45 Ten: 42
Microscope (small)	01	01	00	01	01	00
Microscope (General))	02	01	00	01	01	01
Binocular compound	00	00	00	01	01	01
Microscope	02	01	02	01	02	01
Human skeleton model	01	01	01	01	01	01
Atomic model	00	04	01	02	06	10
RNA model	01	01	01	01	01	01
DNA model	01	01	01	01	01	01
NOSE model	00	00	01	00	01	00
PLANT CELL model	02	01	01	01	01	01
Animal cell model	02	01	01	01	01	01
The nucleus model	01	01	01	00	01	01
Mitochondria model	01	01	01	01	01	01
Plastid model	01	01	01	01	01	01
Chromosome model	01	01	01	01	01	01
Brain model	01	01	01	01	01	01
Eye model	01	01	01	01	01	01
Ear model	01	01	01	01	01	01
Sphygmomanometer Glass Slides	01	01	01	01	01	01
Stethoscope	01	00	01	00	01	01
Six types of slides	00	01	01	01	05	04
Dissecting tray	00	01	01	01	01	01
Glass coverslips	10	05	01	04	06	00
Dissecting box	01 set	01 set	01 set	01 set	01 set	01 set
Magnifying glass	00	01	01	01	03	03
Petridis	00	00	01	01	01	00
Small human skeleton	01	01	01	01	01	01
Oxide	00	01	00	02	04	03
Sodium Hydro-	00	01	01	02	03	03

Coper-sulphate	00	01	01	01	04	03
Naphthalene ball	00	01 box	01 box	00	03 box	02 box
Filter Paper	00	00	00	00	01 Box	03 Box
Hydro Caloric acid	00	01	00	00	04	03

Subject: Chemistry

Name of the device/material	**School name current number of students in classes 9 and 10**					
	School 1 Nine: 60 Ten: 62	School 2 Nine: 37 Ten: 34	School 3 Nine: 114 Ten: 99	School 4 Nine: 80 Ten: 77	School 5 Nine: 165 Ten: 172	School 6 Nine: 45 Ten: 42
Dissector with Plate	01	01	00	00	01	01
Stand and clamp	04	05	10	06	09	02
Woulf Bottle 500 ml	02	04	05	03	05	02
Filter Paper	10	05	10	04	05	05
Test tube stand	08	07	10	08	10	05
Three-foot stand	00	04	06	06	08	05
Wash Bottle	06	05	10	04	06	04
Regent bottle	08	04	08	03	06	05
Mesh	00	01	00	00	04	03
Cylinder 250 ml	00	01	08	03	04	04
Safe stove	00	00	00	01	01	00
PH paper	20	10	00	08	15	13
Wash glass 70 ml	00	01	00	00	03	05
The stopper	30	06	00	01	01	01
Pipette - plastic	30	04	00	00	01	01
Test tube holder	10	03	10	09	20	15
Red litmus paper	10 box	03 box	00	01 box	07 box	06 box
Blue litmus paper	02 box	03 box	00	00 box	05 box	06 box
Gas jar	00	01	30	01	05)	02
Cylinder 250 ml	00	03	10	00	04	03
Mortar and Pestle	10	04	02	00	06	00
Glass rod/tube	10	05	02	02	09	16
Pipet 25 ml	15	08	06	08	10	06
Beaker 250, 500 ml	00	04	05	06	13	17
Safety goggles	00	00	01	01	00	00
Calcium Carbonate	00	00	00	01	02	03

Calcium Hydroxide	00	00	00	02	06	04
Sodium Chloride	00	01	00	02	04	05
Sodium Sulphate	00	01	00	01	04	03
Calcium Carbonate	00	02	00	02	04	03
Calcium Hydroxide	00	03	00	00	00	02
Sodium Chloride	00	00	00	02	04	03
Sodium Sulphate	00	00	00	00	04	05
Ammonium Chloride	00	02	00	00	01	03
Calcium Oxide	00	01	00	01	04	02
Sodium Carbonate	00	01	00	01	04	04

The above tables reveal the existing situation of laboratory apparatuses and reagents. It is worth mentioning that the available equipment and chemicals are not used properly in most schools. The tables have been used to show the present status of the laboratories in the study schools, not to quantify the number of equipment and the amount of chemicals.

The Mindset of Teachers and Students in Using Science Laboratory

Both teachers and students were found positive toward the use of laboratories and doing practical activities. Students and teachers in the FGDs expressed their interest in using science laboratories and doing practical activities. Students claimed that they learned better when something was taught practically. Both the teachers and the learners in the study believe that using a science laboratory makes learning more interesting and fruitful. However, the frequency of laboratory use was small.

One of the students claimed in FGD-1:

Whenever we attend classes in the science laboratory, I feel like a science student. I can distinguish myself from others. If I can do a practical successfully, I feel confident inside.

Regarding the importance of using a science laboratory, a teacher in FGD-2 maintained:

Due to various issues including workload of teachers, students do not get enough hands-on activities in the science laboratory. However, I feel that the use of the science laboratory is essential for effective science learning. Again, there are some topics in science for which there is no alternative to using the science lab for teaching and learning.

One of the teachers in FGD-3 claimed:

We feel the necessity of practical work in science laboratories but we cannot organize it regularly because of workload. However, we organize some practical classes some days before the SSC examinations so that students can remember things better and answer questions in the viva voice examination.

One head teacher claimed that their science laboratories were used properly but they

could not show the practical classes in the routine. However, he claimed that although the laboratory work is not shown in the routine classes are held in the afternoon.

However, a teacher in FGD-4 expressed:

Despite the willingness to conduct classes using laboratories, we are not always able to conduct laboratory-based practical classes because we have to teach subjects other than the science subjects. As a result, it is not possible to organize practical classes using the laboratory. Sometimes, our head teacher asks us to organize practical classes after the school hours but we cannot do that as we become exhausted after the school hours.

One of the head teachers claimed in his interview that it is a longstanding cultural issue to organize practical classes only just before the SSC examinations.

The data placed above reveals that secondary science teachers should be given motivation so that they enjoy working in the laboratories and their workload can be minimized so that they can concentrate on science practical classes. Moreover, they need continuous monitoring and mentoring from the education authority to change their mindset and to change the longstanding and useless laboratory-use culture in the schools.

Challenges to Keeping Science Laboratories Functioning

According to data provided by the respondents, keeping the science laboratories functional in the schools is a big challenge for various reasons. One of the reasons is the shortage of science teachers. Moreover, there is no post of a Laboratory Assistant who can constantly and regularly provide support to the students alongside the teachers. Additionally, the current textbooks do not encourage teachers and learners to use science laboratories to learn a particular topic; most of the science books are theoretical, not practical-based. The science teachers in FGD-1 claimed:

There is no arrangement for the students to sit in the laboratory; there is a lack of apparatuses and chemicals in the laboratory. Load of classes each day and a lack of necessary resources in the laboratory discourage us from hands-on activities.

In this regard the teacher participants also informed the researchers that each science subject has three classes a week, which is insufficient for science subjects; and on the other hand, there is no practical class set in the routine. As a result, no teacher is interested to organize practical classes in the laboratories. The support of the stated data can be seen in the following excerpt stated by a teacher in FGD-3:

The number of classes for science subjects is not sufficient; there are usually three classes per week for each science subject, which is not sufficient. And there are no practical classes set in the daily class routine. There is no time for practical work in the laboratory.

Regarding the science theoretical and practical classes, a teacher in FGD-5 maintained:

Our science theoretical classes are mostly held in the 3rd, 4th, and 5th periods. Some

classes are also held in the sixth period. As a result, the chances of making those classes enjoyable are reduced due to tiredness of both teachers and students. And it is not possible on our part to organize practical classes after school hours.

Another teacher in FGD-5 claimed:

The biggest obstacle in our school is the limitation of classrooms. The room we are currently using as a science lab is now also being used as a library. The main reason for this is the limitation of our classroom. Therefore, no matter how much we are interested in conducting practical activities as teachers, we cannot use the laboratory due to a lack of required apparatuses.

The science teachers in FGD-6 have alleged that there is a lack of science teachers in their school; part-time teachers teach science; sometimes, teachers other than science background have to teach science. According to them, students are interested in taking part in practical activities but they cannot do that as required apparatuses and chemicals are not available.

The headteacher of school-1 opined that most of the students are demotivated and are not interested in taking part in practical activities; they look for the easiest way to get the pass marks in any examinations including the SSC examinations. A group of guardians are not interested in the practical classes and they discourage their children not to join the practical classes as they consider practical classes a waste of time.

The head teacher in school-3 mentioned:

It is my bitter experience that no one willingly agrees to take the responsibility to maintain the laboratory. They are quite demotivated as they claim they are loaded with classes every day.

The data placed above show that there are different kinds of challenges in the schools that hamper science practical activities. The major challenges include the inadequacy of the required number of science teachers, equipment, and reagents. The other challenges explored from the study comprise lack of motivation on the part of the teachers, monitoring and mentoring.

Keeping Science Laboratories Functional

The science teachers, and the head teachers maintained that the education authority should provide the schools with money to enrich the laboratories with apparatuses, reagents, and necessary furniture. There should be a post of a Demonstrator or a Lab Assistant to support the students alongside and in absence of the science teachers. They demanded training on how to organize practical classes and how to engage students in practical activities in a fun way.

Moreover, the science teachers in FGD-3 suggested reforming the present culture of practical examinations. According to them, “There should be enough time for each student to conduct a practical activity independently in the laboratory. And there should be all the required apparatuses and chemicals.”

A teacher in FGD-4 mentioned:

The way of present practical test of the SSC examination should be changed. I am sorry to say that the present practical test is nothing but mockery. Every student gets 24/25 out of 25 in practical tests without performing better in the practical work.

Teachers in FGD-5 claimed that guidelines for the use of science laboratories should be given centrally and the laboratories should be equipped with modern apparatuses, chemicals, and furniture. Moreover, a science teacher or a Laboratory Assistant can be recruited to look after the laboratory there should be a science teacher who will always help the students in doing practical activities in the laboratories.

A head teacher believes that the filling out the vacant posts of the science teachers in the schools can improve the situation. According to him, all the teachers should also be familiarized with the intention of the new curriculum; how to conduct practical classes inside-and-outside the classrooms in a joyful way; and how to take the learners through experiences.

Based on the data placed above, it can be said that the following steps can make the science laboratories functional: funding by authorities to schools to equip laboratories with the necessary apparatuses, reagents, and necessary furniture; creating the post of a Laboratory Assistant or Demonstrator; organizing training on laboratory management and effective practical classes in the laboratory; changing the final practical examination procedure and allocating sufficient time for each student to demonstrate practical skills; identifying skills for practice and assessing the students based on the pre-set skills; and increase monitoring and mentoring by the competent authorities.

Recommendation

Based on laboratory observations and data provided by the students, the science teachers, and the head teachers, the following measures are recommended:

- Apparatuses and chemicals in the laboratories must be provided in plenty and the use of the laboratories must be ensured.
- The laboratories should be rearranged with furniture, equipment, and chemicals so that the teachers and the students can work there comfortably.
- Provision should be made to use the laboratories from class six.
- As the integrated science education curriculum is being introduced, the demand of the facilities for practical activities is at rise. Therefore, the existing laboratories should be renovated and enriched with required resources and if necessary, new laboratories can be set up.
- There is no specific person for laboratory management. This is one of the reasons why the laboratories are not functional. Therefore, it is necessary to appoint a Laboratory Manager/Assistant or a Demonstrator to keep the laboratory functional.
- Practical classes should be there in the routine like the regular classes.
- Higher education authority should look after the science laboratory-related matters and take necessary measures to solve the existing problems.

Conclusion

It is evident from the study that the school science laboratories are not functional. Insufficient number of science teachers, laboratory resources; low motivation level of the teachers, and lack of monitoring and mentoring of the teachers made the science laboratory situation worse. The longstanding culture of practical work just before the SSC examinations need to be stopped and practical activities need to be throughout the year. If the authority provides the schools with necessary resources and people, and take necessary steps to overcome the challenges, the situation is expected to be better. By keeping the laboratories functioning, it would contribute to the smooth implementation of the experiential learning approach.

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