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Practices and Challenges of Teaching-Learning of the Practical Parts of Science in Preparatory Schools in Wollega

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Abstract

This study was intended to examine the practices and challenges of teaching-learning of the practical parts of science subjects in preparatory schools in Wollega zones. Probability sampling method was used for sample selection and questionnaire, interview and observation were the instruments used for data collection. Quantitative and qualitative methods of data analysis were employed for analyzing and interpreting data. Plasma-TV Simulations and Teacher's laboratory demonstrations were the methods frequently used in preparatory schools in the study area. Students conducting practical activities themselves (being in group or individually) is none existent. Imported/industrial laboratory materials are widely utilized than the local products. Lack of facilities, lack of resources (both human and material) and skill gap are among the bottleneck challenges of the preparatory schools to use laboratory in the teaching-learning of science practical parts. To this end, updating and upgrading short and long-term trainings and provision of support by different stakeholders were strongly recommended in order to facilitate the teaching-learning of the practical parts of science subjects in preparatory schools.

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INTRODUCTION

Provision of quality education is one of the major concerns of the country's educational goals as indicated in the new education and training policy of Ethiopia. One of the critical issues with regard to the teaching-learning of science subjects is the methods and techniques employed for class room instruction.

The new Education and Training policy of Ethiopia targets at improving educational access, quality, equity, efficiency and relevance, as these were the major educational problems of the country before 1994 (EETP, 1994). As stated in the policy, objectives of the secondary school curriculum focus at enabling students to solve real life problems and to be creative and productive citizens (EETP, 1994). Subsequently, to achieve these learning objectives the role of educational materials and facilities and the using of desirable approaches, strategies and methods are indispensable. As stated in the education policy, in order to ensure quality education, there have to be adequate workshop and laboratory materials, especially in secondary schools and vocational institutions (MOE, 2002). More often than not, the intended learning outcomes could be achieved when methods that improve active engagement of learners in the process of teaching-learning are employed. Different scholars put forward the importance of using methods which encourage students' engagement in the process of teaching-learning. For instance, Schaap (2012) stated that, when students' involvement in the educational process is enhanced, the students will be able to recognize and accept responsibility for learning and development. One of the possible strategies that may help students to realize this practice is their using of different methods of active learning approaches in the actual processes of teaching-learning.

Active learning methods allow students to engage in the process of teaching and learning; and these engagements help the learners to acquire the necessary knowledge and skills easily and retain or consolidate permanently what they learned. According to Silberman (1996), active learning constitutes the collection of instructional strategies that make students do most of the works which help them to construct their own knowledge, skill and to bring attitudinal changes.

Practical work is one of the active learning methods required widely to be used in the teaching-learning of science. Different scholars have suggested that practical work is more important for teaching science and other subjects as it allows students to use more of their senses. According to Abrahams (2012), Practical work includes all teaching and learning activities in science that involve learners at some point in handling or observing the objects or materials they are researching. Therefore, practical work is indispensable for teaching science; and it should not be missed as scholars of the field suggest. For example, as stated by Mittal (2004) activities and experiments are tremendous assets to science lessons. This statement stresses not only the importance of activities and experiments for teaching science but also how much they are crucial to acquire the required learning objectives of science lessons. On the other hand, Nayak and Roa (2004) suggest what could happen when students are not allowed to learn science by doing themselves.

…students cannot learn to think critically, analyze information, communicate scientific ideas, make logical arguments, work as part of a team, and acquire other desirable skills unless they are permitted and encouraged to do those things over and over in many contexts.

Thus, learning by doing is considered as a requirement for science lessons as such methods enable the learners to think critically, analyze information, and communicate scientific ideas as recommended by scholars.

Theoretical Frameworks of the Study

Constructivist Theory of Learning

Constructivism is the most important theory of learning that plays prominent role in the process of teaching and learning in general and that of science education in particular. Slavin (2011), points out that constructivist theory sees learners as constantly checking new information against old rules and then revising rules when they no longer work. This view has profound implications for teaching, as it suggests a far more active role for students in their own learning than is typical in many classrooms.

The Constructivists believe as indicated by Mergle (1998) that learners construct their own reality or at least interpret it, based upon their perceptions of experiences; and an individual's knowledge is a function of one's prior experiences, mental structures, and beliefs that are used to interpret objects and events.

According to constructivist view of learning, students must construct knowledge in their own minds and teacher's role is to facilitate this process by teaching in ways that make information meaningful and relevant to students (Slavin, 2011). In other words, teacher should provide students opportunities to discover or apply ideas themselves, by teaching them to be aware of and consciously use their own strategies for learning. In general, this theory stresses the significance of learners' active involvement in the process of teaching and learning to make learning easy and to enable students to construct their knowledge.

Scientific Literacy

Scientific literacy is the term that has had so many interpretations that it is now means virtually everything to do with science education; and that it had come to be an umbrella concept to signify comprehensiveness in the purposes of science teaching in schools (Poole 1995). According to Poole, the term looked more like a slogan used by scientists and science educators to elicit support for teaching science in schools. Hence, scientific literacy has become a key concept in thinking about science education; and its promotion as the goal of science teaching, has found its way in curricula worldwide (Norris, 1997). Yuenyong and Narjaikaew (2009) also define scientific literacy in terms of a framework consisting of four aspects. These are (1) the knowledge of science, (2) the investigative nature of science, (3) science as a way of thinking, and (4) interaction of science, technology and society.

Yuenyong and Narjaikaew (2009) also define scientific literacy based on the seven dimensions of a scientifically-literate person. As they suggest a scientifically-literate person is expected to: (1) Understand the nature of scientific knowledge; (2) Apply appropriate science concepts, principles, laws, and theories in interacting with his universe; (3) Use the process of science in solving problems, making decisions, and furthering his own understanding of the universe; (4) Interact with values that underlie science; (5) Understand and appreciate the joint enterprises of science and technology and the interrelationship of these with each and with other aspects of society; (6) Extend science education throughout his or her life; (7) Develop numerous manipulative skills associated with science and technology."

Methods of Teaching

The methods of teaching can be defined as the manner in which teachers impart knowledge and skill in the process of teaching and learning. Thus, method implies the teaching-learning process involving both teaching and learning activities. Mohan (2007) define teaching methods as patterns of teacher behaviors those are recurrent, applicable to various subject matters, characteristic of more than one teacher, and relevant to learning.

There are several types of methods of teaching used for the purpose of teaching and learning both in schools and out of schools. Current literature shows the various methods can be used under different circumstances depending on the nature of the subject matter, objectives of the lesson, the interests, capacity and understanding level of the learners, etc.

The teaching methods can generally be classified into traditional (teacher-centered) and progressive or constructivist (learner-centered) methods depending on the involvement of the students in the process of teaching and learning. In the traditional methods, direct instruction takes place (Borich, 2007) and such methods are more suitable for the teaching of facts, rules, action sequences, etc. Constructive methods or indirect instructions are best employed for teaching concepts, skills, inquiry, and problem solving.

Statement of the Problem

In spite of the importance of laboratories, workshops and other methods required to teach the practical parts of the science subjects effectively, several research findings show that the practices of schools in using these methods is unsatisfactory due to different reasons.

In many countries of the world, science education is suffering from a scarcity of appropriate facilities and supporting materials, including the equipment (World Bank, 1993). The World Bank research document further explains that the experiences from many developing countries demonstrate that the quality of science education is often unsatisfactory due to not only the low supply of equipments but also due to local conditions/climatic conditions in many tropical countries (high temperature and humidity) which affect some of the materials to get corrode very fast. Over such tropical areas, the supply of the most valuable facilities such as water, electricity and gas are often nonexistent. To improve these situations, many national, regional and international projects have been launched, although their success was, in many cases, far below the expected.

The inadequate use of these methods for teaching the practical parts of science (i.e., the using of laboratory, workshops and others) in the secondary schools in Ethiopia was revealed by the studies conducted so far. However, the problem is still escalating these days more than ever in the secondary schools in Wollega particularly in preparatory schools where students are required to acquire necessary skills and practical experiences.

Thus, this study targeted at investigating the issue in detail to determine the level of using the required methods and to identify factors that hinder preparatory schools from using the methods and ultimately to come up with possible solutions that may help minimize the challenges if not to avoid them.

MATERIALS AND METHODS

The Research Design

To achieve the intended objective, mixed (quantitative and qualitative) research method was used concurrently as this approach is concerned with explaining the actual experience of the schools. This mixed-approach is also chosen with the notion that any inherent weaknesses of the quantitative method would be offset by the qualitative method and vice versa. Thus, in this study, although both quantitative and qualitative methods were used concurrently, the qualitative part had the larger portion as deep interviews and closed observations were used to gather the required information.

Sources Data

The sources of data for this study were preparatory school students, preparatory school science (Biology, Chemistry and Physics) teachers, and science subjects department heads of the schools. Moreover, the preparatory schools science laboratories involved in the study.

Samples and Sampling Techniques

In this study, samples were selected from the identified population (source of data), using different probability and non-probability sampling techniques. As presented in (section 1.7), this study is delimited to public (government) preparatory schools in the four zones of Wollega. Then, two secondary schools were selected from each of the four zones using random sampling method. Accordingly, eight schools were chosen for the study. To get information from the side of the students, 25 percent of the science stream (grade 11 & 12) students from each school were selected randomly to allow them take part in the study. Accordingly, 400 students were chosen from the eight schools. Moreover, 50 percent of the three science subject teachers who were teaching grade 11 and/or 12 were selected randomly for the study. Furthermore, the department heads of the three science subjects were selected by available sampling technique. Thus, 48 science teachers and twenty-four department heads were selected for the study.

Data Gathering Instruments

The data gathering instruments used in this study were questionnaires, interview and observation. The combination of open-ended and close-ended questionnaire was used. The first set of questionnaire was used to collect data from preparatory school students and the second set of the questionnaire was used to collect data from preparatory school science subjects (Biology, Chemistry and Physics) teachers. Both sets of the questionnaires have similar structures in possessing two parts. The researcher also used semi-structured interview to gather information from preparatory school science subject (Biology, Chemistry and Physics) department heads.

Methods of data analysis

As the study employed mixed-method research design, both quantitative and qualitative data analysis methods were used. The quantitative data, the data collected using questionnaire, from the secondary schools students and the science subjects teachers, was analyzed using the descriptive statistical methods; mainly frequency counts, percentages and mean values and presented using tables. The qualitative data, the data gathered by interview and observation, was analyzed using different qualitative data analysis techniques.

RESULTS AND DISCUSSIONS

The Status of Science Laboratory in Preparatory Schools

Laboratory method is among the methods commonly used for the teaching-learning processes of science practical parts. These methods have significant pedagogical advantages as advocated by different scholars. For instance, Hofstein and Lunetta (2003) explain the position of these methods in the teaching-learning of science practical parts as follows.

Laboratory activities are designed to engage students directly with materials and phenomena, simulations can be designed to provide meaningful representations of inquiry experiences that are often not possible with real materials in many science topics .In such cases, simulations engage students in investigations that are too long or too slow, too dangerous, too expensive, or too time or material consuming to conduct in school laboratories.

However, some of the schools under study have no laboratory for the three science subjects. Some of the schools use plasma-TV instead of laboratory. Still some of them do not have both the plasma-TV and laboratories. The secondary schools' possessions of Plasma TV and laboratory are summarized in Table 1.

Table 1 presents that only 12.5 percent of the schools has both plasma-TV program and laboratory for the three science subjects; 25 percent of them have plasma-TV program; 50.0 percent of them have laboratory and 37.5 percent of the schools have no both Plasma-TV Program and Laboratory. As indicated in Table 1, only 50 percent of the schools under study have functional science laboratories. Although, 50 percent of the schools have laboratories, status or quality of the services they are rendering is another important issue that requires due attention. On the other hand, only 25 percent of the schools have functional Plasma-TV program. This is another trivial challenge of the schools under study.

Table 1

Plasma-TV and Laboratory Possessions of selected Preparatory schools

No	School Name	Service	Subject Area Biol.	Chem.	Phys	Remarks
1	S1	PTVP	X	X	X	
		Laboratory				
2	S2	PTVP	X	X	X	
		Laboratory	X	X	X	
3	S3	PTVP				
		Laboratory	X	X	X	
4	S4	PTVP	X	X	X	
		Laboratory	X	X	X	
5	S5	PTVP	X	X	X	
		Laboratory				
6	S6	PTVP	X	X	X	
		Laboratory				
7	S7	PTVP	X	X	X	
		Laboratory	X	X	X	
8	S8	PTVP				
		Laboratory				

Source: Data gathered from the schools in 2015(key: √=exist, X=not exist)

In general, the lack of plasma-TV program and laboratory in most of the schools under study is the bottleneck challenge for the teaching-learning of science practical parts as such situations usually force the schools to teach all the science subjects contents theoretically.

Methods/Techniques Used for the Teaching-Learning of Science Subjects Practical Parts

To make the science knowledge and skills easy to understand and consolidate permanently, different methods and techniques are suggested by different scholars. Laboratory method in which students conduct activities and experiments individually or in group is one of such techniques. Teacher's demonstration is the other method employed when the teacher shows some activities doing her/himself in laboratory, in workshop or on field. Simulation method (Computer/Plasma-TV simulations) can be also used to show activities in an artificial environment. These different methods/techniques have their own unique advantages and disadvantages. Moreover, there are circumstances under which each of these methods/techniques serves effectively.

Examining the practices of the preparatory schools under study using of the above methods/techniques in the teaching-learning of practical parts of the science subjects was one of the intentions of this study. Accordingly, the responses of the students and teachers regarding these practices are depicted in Table 2 to 4. Majority of the students (64.9%) indicated their schools have been using Plasma-TV simulations for the teaching-learning of biology practical parts. But, majority (56.3%) of the teachers revealed their never using Plasma-TV simulations for teaching biology practical parts (see Table 2). in line with this, as indicated in table 1, 87.5% of the schools under study have no functional Plasma-TV program as of the period of data collection for this study. Since very large proportion (87.5%) of the schools have no functional Plasma-TV program, it is logical to conclude that the usage of Plasma-TV simulations for teaching-learning purposes including that of biology practical parts is very limited. The result of interview with biology department heads also strengthens this limited usage of Plasma-TV simulations for the teaching-learning of biology in most of the schools under study. Using teacher's laboratory demonstration for the teaching-learning of biology practical parts was recognized by 53.4% of the students and 62.5% of the teachers (see Table 2). Moreover, the interviewed department heads of biology revealed the relatively wide usage of teachers' laboratory demonstration in most of the schools under study by indicating some of the reasons for which the method preferred over the others.

Table 2

Methods/techniques used for teaching Biology Practical Parts

No	Methods/Techniques	Respondent	Response Never %	Rarely %	Sometimes %	Usually %	Always %
1	Plasma-TV simulation	Students	35.1	16.8	31.9	13.6	2.6
		Teachers	56.3	12.5	25.0	6.3	0.0
2	Teacher's laboratory demonstration	Students	46.6	34.0	14.7	3.7	1.0
		Teachers	37.5	12.5	43.8	6.3	0.0
3	Students' conducting PA in group in laboratory	Students	90.1	8.4	1.0	0.5	0.0
		Teachers	43.8	37.5	12.5	6.3	0.0
4	Students' conducting PA individually in laboratory	Students	96.3	2.1	1.0	0.5	0.0
		Teachers	81.3	12.5	6.3	0.0	0.0
5	Students' conducting PA in workshops	Students	96.3	3.7	0.0	0.0	0.0
		Teachers	93.8	6.3	0.0	0.0	0.0
6	Students' conducting PA on fields	Students	84.8	9.9	4.7	0.5	0.0
		Teachers	50.0	37.5	12.5	0.0	0.0

For instance, department head of biology in school (S5) mentioned the degree to which they were using demonstration method indicating the rationale behind it as follows:

I and my department teachers commonly use demonstration method for teaching biology practical parts. One of the reasons for our using demonstration method frequently is the shortage of chemicals in my school biology laboratory; and hence, this situation forced us to widely rely on this method when we go to laboratory to teach practical activities.

Other biology department head from school (S8) mentioned the reasons for which they use demonstration method frequently.

The biology teachers in my school usually use demonstration method since most of the laboratory materials such as chemicals and apparatus are not adequate to allow students to the activities themselves. Moreover, the absence of adequate working benches with sink for students, lack of water, and lack of power sources (gas/electricity) on different working benches forced us to use demonstration method widely than other methods.

Thus, demonstration is the widely used method by biology teachers in many preparatory schools from those included in the study. However, since about 50 percent of the schools under study have no functional laboratory, it is obvious that biology teachers in about half of the schools under study have limited opportunity to the demonstration method itself.

Thus, schools having limited opportunity to use demonstration methods may leads to lose several pedagogical advantages. As shown in Table 2, very large proportion of the preparatory school students involved in the study designated the none existent of practical activities (PA) in group, individually, in workshops and on fields during the teaching-learning of the practical parts of biology. Accordingly, 90.1%, 96.3%, 96.3% and 84.8% of them indicated their never using PA in group, individually, in workshops and on fields respectively. Similarly, 43.8%, 81.3%, 93.8% and 50% of the teachers revealed their never using PA in group, individually in laboratory, in workshops and on fields respectively. Moreover, department heads of biology interviewed confirmed the absence of practical activities conducted by students in laboratory (individually or in group), in workshop and on fields for the teaching-learning of the practical parts of the subject.

Therefore, most of the preparatory schools under study were not in a position to exploit all the advantages of practical works recognized by different scholars, since about 50 percent of the schools under study had no functional biology laboratory/workshop where students can conduct practical/hands-on activities and the rest 50 percent of the schools under study (those who have laboratory) have no the practices of allowing students.

Table 3

Methods/techniques used for teaching Chemistry Practical Parts

No	Methods/Techniques	Respondent	Response: Never %	Rarely (2) %	Sometimes %	Usuall %	Always %
1	Plasma-TV simulation	Students	42.9	16.2	16.2	7.3	1.6
		Teachers	58.8	11.8	11.8	11.8	0.0
2	Teacher's laboratory demonstration	Students	41.4	33.5	33.5	4.2	0.5
		Teachers	58.8	35.3	35.3	0.0	0.0
3	Students' conducting PA in group in laboratory	Students	86.4	10.5	10.5	0.0	0.0
		Teachers	70.6	11.8	11.8	0.0	0.0
4	Students' conducting PA individually in laboratory	Students	95.8	2.6	1.3	0.3	0.0
		Teachers	94.1	5.9	0.0	0.0	0.0
5	Students' conducting PA in workshops	Students	95.3	4.2	0.5	0.0	0.0
		Teachers	94.1	5.9	0.0	0.0	0.0
6	Students' conducting PA on fields	Students	96.3	2.6	1.0	0.0	0.0
		Teachers	70.6	29.4	0.0	0.0	0.0

Table 3 shows that majority (58.8%) of the chemistry teachers revealed their schools were never using plasma-TV simulations for the teaching-learning of chemistry practical parts. Similarly, significant proportion (42.9%) of the students indicated that their schools were not using Plasma-TV simulations for the teaching-learning of chemistry practical parts. Most of the chemistry department heads interviewed revealed that their teachers were not using plasma-TV simulations by indicating that Plasma-TV program was not functional in most of the schools under study. For instance, chemistry department head in school (S4) explained the issue of his school Plasma-TV program as follows:

Currently, we are teaching in a newly constructed school compound which has no *functional plasma-TV program and laboratory. Therefore, we are suffering to teach chemistry practical parts as designed in the curriculum. This problem is common for all science subjects' teachers and other subjects those having practical activities.*

Similarly, chemistry department head interviewed from school (S7) explained the status of Plasma-TV program service of his school saying:

Plasma-TV program was not functioning in my school for the last two years. Thus, currently we have no the opportunity to use Plasma-TV simulation for the teaching-learning of chemistry practical parts.

However, 58.1% of the students and 29.4% of the teachers indicated their using plasma-TV simulations rarely and/or sometimes (see table 3). In the same vein the chemistry department heads interviewed from the schools those have functional plasma-TV program (that is department heads in school S3 and S8) did not deny their using it sometimes. Thus, plasma-TV simulations were in use for the teaching-learning of practical parts of chemistry in few preparatory schools only. In general, since the number of schools under study those have functional plasma-TV program as of the period of data collection for this study were very few in number (see Table 1), it is obvious that most of them are not in a condition to use plasma-TV simulations for the teaching-learning of chemistry practical parts .

As indicated in Table 3, large proportion (58.8%) of the teachers responded that their schools were never using teacher's laboratory demonstration for the teaching-learning of chemistry practical parts. similarly significant number (41.4%) of the students shared the teachers' response indicating they were never using teacher's demonstration for the teaching-learning of chemistry (see Table 3). In contrast, the chemistry department heads interviewed from some of the recognized their teachers using demonstration method commonly. For instance, the chemistry department head interviewed from school (S1) explained how his school chemistry teachers use laboratory as follows.

In my school, chemistry teachers mostly use teacher's demonstration method for teaching chemistry practical parts as allowing students to do the activities themselves are impossible due to inadequate facilities and laboratory materials.

On the other hand, chemistry department head from school (S5) explained his school practice regarding the use of demonstration method as indicated below.

Chemistry teachers in my school use teacher's laboratory demonstration rarely since there is high scarcity of some chemicals and apparatus in my school chemistry laboratory.

Another chemistry department head interviewed from school (S6) clarified his school practice regarding the use of teacher's demonstration method for teaching chemistry practical parts saying:

The chemistry teachers in my school almost always use demonstration method whenever they go to laboratory for practical activities, since the laboratory room facilities such as space, working benches and seats are not convenient to allow students to conduct the activities themselves besides the shortage of some chemicals and lack of skill to use some apparatus. But, my school chemistry teachers using of the demonstration method itself is very limited for the reasons mentioned above.

As indicated in Table 1, about 50 percent of the schools under study have no functional chemistry laboratory as of the period of data collection for this study. On the other hand, schools those have functional laboratory are not using the demonstration method properly due several reasons as mentioned above. Hence, the usage of teacher's demonstration method for the teaching-learning of chemistry practical parts in the schools under study is very limited. From this result one can conclude that most of the schools under study are not exploiting the numerous advantages of demonstration method as mentioned by different scholars. For instance, Petty (2006) suggested that the aim of demonstration is to provide students with a concrete example of good practice to copy adapt or learn technique. According to Petty, it is so vital for learning physical and intellectual skills: it shows how the task is carried out, what the task achieves, to what standard it should be carried out, the indicators that the task has been carried out successfully, and so on.

Moreover, Table 3 also depicts the responses of the students and chemistry teachers regarding the practices of students conducting practical activities in laboratory, in workshop and on fields. Accordingly, most of the students (86.4%, 95.8%, 95.3% & 96.3%) of them replied that they were never conducting practical activities (PA) in laboratory being in group, in laboratory being individually, in workshop and on fields respectively. Similarly, most of the teachers that is 70.6%, 94.1%, 94.1% and 70.6% of them supported students' responses regarding the none existent of students conducting the practical activities themselves during the teaching-learning of chemistry practical parts (see Table 3). The result of interview with chemistry department heads agrees with the students' and teachers' responses. Therefore, there is no practice of allowing students conducting practical activities themselves in the teaching-learning of chemistry practical parts almost in all of the schools under study. Hence, the preparatory schools under study are deficient of the several advantages that can be obtained when students conduct chemistry practical/hands-on activities. According to Jenkins (2003) the aims of practical works are to develop manipulative skills and techniques; to encourage accurate observation and description; to discover or illustrate a concept, law or principle; to experience scientific phenomena; to motivate by stimulating interest and enjoyment; to develop certain ‘scientific attitudes’ such as open-mindedness and objectivity; to develop an understanding of experimental procedures and evidence and to get a “feel” for what it is like to be a problem-solving scientist.

Methods/techniques used for teaching Physics Practical Activities

Significant proportion of the students (47.6%) indicated their schools haven't been using Plasma-TV simulations for the teaching-learning of Physics practical parts. Similarly, majority (60%) of the teachers supported students' responses, although 40% of them did not deny their using it rarely (see Table 4). Since very large proportion (87.5%) of the schools have no functional Plasma-TV program as indicated in Table 1, it is logical to conclude that Plasma-TV simulations is serving rarely in the preparatory schools under study for the teaching-learning of physics practical parts.

The result of interview with Physics department heads also strengthens this limited usage of Plasma-TV simulations for the teaching-learning of the subject in most of schools under study. The physics department head in school (S3) said, “We use Plasma-TV simulations rarely for the teaching-learning of physics practical parts, since there is continuous interruption of the program in my school. *“Under such conditions we usually teach all physics contents theoretically*."

Physics department head in school (S8) explained his school practice in using Plasma-TV simulations for teaching physics practical parts saying:

The physics teachers in my school have been using Plasma-TV simulations effectively for physics practical activities. However, currently the service is less frequent as there is continuous program interruption.

In general, Plasma-TV simulations is rarely used for the teaching-learning of physics practical parts in the schools under study and this situation strongly affects the teaching-learning of physics as the schools fail to exploit the advantages.

As shown in Table 4, 61.3% of the students and 53.3% of the teachers replied their never using teacher's laboratory demonstration for the teaching-learning of Physics practical parts. However, 30.4% of the students and 33.3% of the teachers recognized their using the method rarely (see Table 4).

Table 4

Methods/techniques used for teaching Physics Practical Activities

No	Items	Respondents	Responses Never (1) %	Rarely (2) %	Sometimes (3) %	Usually (4) %	Always (5) %
1	Plasma-TV simulation	Students	47.6	17.8	25.1	7.9	1.6
		Teachers	60.0	40.0	0.0	0.0	0.0
2	Teacher’s laboratory demonstration	Students	61.3	30.4	6.8	1.0	0.5
		Teachers	53.3	33.3	13.3	0.0	0.0
3	Students' conducting PA in group in	Students	91.1	7.9	1.0	0.0	0.0
	laboratory	Teachers	73.3	20.0	6.7	0.0	0.0
4	Students' conducting PA individually in	Students	97.4	2.6	0.0	0.0	0.0
	laboratory	Teachers	93.3	6.7	0.0	0.0	0.0
5	Students' conducting PA in workshops	Students	88.5	9.4	1.6	0.5	0.0
	Students' conducting PA on fields	Teachers	66.7	33.3	0.0	0.0	0.0
		Students	96.3	3.1	0.5	0.0	0.0
6	Students' conducting PA on fields	Teachers	80.0	20.0	0.0	0.0	0.0
		Students	47.6	17.8	25.1	7.9	1.6

The interviewed department heads of Physics revealed the relatively wide usage of teachers' laboratory demonstration in about 50 percent of the schools under study. For instance, Physics department head in school (S8) has mentioned the degree to which they have been using demonstration indicating the rationale behind it as follows:

For teaching Physics practical parts, we commonly use demonstration method, since the materials and facilities in my school are not adequate to allow students to do the practical activities themselves.

Similarly, physics department head in school (S6) enlightened the utilization of Plasma-TV simulations for physics practical parts that in his school physics teachers use demonstration method sometimes since some materials are scarce in the school.

Very large proportion of the secondary school students and Physics teachers involved in the study designated the none existent of practical activities (PA) in group, individually, in workshops and on fields during the teaching-learning of the practical parts of Physics (see Table 4). As presented in the table, 91.1%, 97.4%, 88.5% & 96.3% of the students indicated the absence of the practice of conducting practical activities in laboratory being in group, individually, in workshop and on fields respectively. Large number of the physics teachers that is 73.3%, 93.3%, 66.7% and 80.0% of them supported students' responses respectively. The result of interview conducted with Physics department heads is also in line with the responses of the students and the teachers. As heads in most of the schools have indicated their schools Physics laboratories are not in position to use other methods than demonstration due to a number of constraints. For instance, lack of appropriate room, laboratory technician, apparatus and equipments were among the common constraints of the schools those forced them to limit themselves to demonstration method.

The Kinds of Materials Used in Secondary Schools Science Laboratories

The materials (chemicals and apparatus) which are commonly serving for laboratory practical works can be classified into industrial and local products depending on the ways they produced and place of production. Hence, using locally produced laboratory materials may enable schools to teach science practical parts more effectively. This implies that the materials we use in school laboratory determine the degree to which schools can use laboratory for teaching science subjects practical parts.

To examine the practices of the schools under study regarding the kinds of laboratory materials they were using, a question was posed for both students and teachers and their response is presented in Table 5 below.

Table 5

The kinds of Materials used in Preparatory Schools Science Laboratories

No	Material	Subject	Responses									
			Never (1)		Rarely (2)		Sometimes(3)		Usually(4)		Always (5)	
			S %	T %	S %	T %	S %	T %	S %	T %	S %	T %
1	Industrial	Biol	38.2	31.3	14.1	0.0	33.	43.8	12.	25.0	2.1	0.0
		Chem	39.3	29.4	10.5	29.4	38.	29.4	8.9	11.8	2.6	0.0
		Phys	43.5	13.3	15.2	53.3	30.	33.3	8.9	0.0	1.6	0.0
2	Local	Biol	58.6	31.3	30.9	56.3	5.8	12.5	4.7	0.0	0.0	0.0
		Chem	60.2	76.5	29.3	23.5	7.3	0.0	2.6	0.0	0.5	0.0
		Phys	63.4	60.0	29.8	40.0	5.2	0.0	1.6	0.0	0.0	0.0

Table 5 designated the responses of both teachers and students regarding the kinds of materials used for the teaching-learning of the practical parts of the three science subjects separately. The usage of both industrial and local materials is very limited for all the three subjects as large proportion of the respondents indicated. For biology, 52.3% of the students and 31.3% of the teachers indicated that they never/rarely use the industrial materials. Similarly, 89.5% of the students and 87.6% of the teachers revealed that they never/rarely use the locally produced materials for teaching-learning of biology practical parts (see Table 5). According to the responses of both teachers and students, the utilization of local materials is lower than that of the industrial one. The responses of Biology department heads interviewed are in line with the responses of the teachers' and the students'. For instance, Biology department head in school (S5) stated his school situation as given below.

In my school biology laboratory, we usually use chemicals and apparatus imported from industrial countries; and the practices of producing and utilizing local chemicals and/or apparatus is very limited.

Similarly, Biology department head from school (S6) explained his school practice regarding the kinds of materials they were using for biology practical activities as follows.

Currently, we are not using the chemicals and apparatuses we have effectively due to the lack of skilled laboratory technician and teachers lack of adequate knowledge & skill to use the materials. The effort of producing and utilizing local laboratory materials is almost nil.

Therefore, the practice of producing and utilizing chemicals and apparatus locally is less familiar as compared to the usage of industrial materials for the teaching-learning of biology practical parts in the preparatory schools under study.

As shown in Table 5, 49.8% of the students and 58.8% of the teachers indicated their never/rarely using industrial materials for teaching chemistry practical parts. However, larger proportion of the respondents, that is 89.5% of the students and 100% of the teachers revealed their never/rarely using the local materials. According to students' and teachers' responses, the utilization of local materials is less than that of the industrial one.

The results of interview conducted with chemistry department heads from schools S1, S5, and S6 also revealed the absence of the practices of producing and utilizing chemicals and apparatus locally for the teaching learning of chemistry practical parts mainly due to the lack of skill and experience. As shown in Table 5, 58.7% of the students replied their never/rarely using industrial materials. Majority (66.6%) of the physics teachers indicated their never/rarely using industrial materials in their school physics laboratory. The Physics department heads interviewed also revealed their using industrial materials better than the local one although that of the industrial itself is not satisfactory.

Majority (93.2%) of the students and (100%) of the teachers indicated their never/rarely using the local materials for the teaching-learning of Physics practical parts in the preparatory schools under study. The teachers and students responses were supported by the interviewed physics department heads. Thus, both the industrial and local materials were not used adequately for the teaching-learning of Physics practical parts.

Factors Affecting Preparatory Schools Using of Laboratory

Laboratory is one of the familiar methods used for the teaching-learning of science practical parts. It has multiples of goals as different scholars have suggested as indicated in section 2.4.1.4. In spite of its multiple purposes and vital roles, there are a number of factors affecting the using of laboratory for the teaching-learning of science subjects practical parts. The responses of science teachers and students regarding these factors are presented in Tables 6 and 7 as follows.

As presented in Table 6, majority of the teachers recognized that most of the proposed factors were affecting their schools' using laboratory. However, “teachers' lack of interest" was not recognized as a factor by majority (56.3%) of the biology teachers and 52.9% of the chemistry teachers. Similarly, “laboratory technicians' skill problem" was not recognized by 56.3% of the biology teachers and 53.3% of the physics teachers (see Table 6).

Table 6

Teachers' responses regarding the Factors Affecting Preparatory schools using of science laboratories

No	Factor	Subject	Responses				
			Never (1) (%)	Rarely (2) (%)	Sometimes (%)	Usually (4) (%)	Always (%)
1	Lack of laboratory room	Biol.	56.3	12.5	6.3	12.5	12.5
		Chem.	35.3	11.8	11.8	11.8	29.4
		Phys	26.7	26.7	13.3	6.7	26.7
2	Lack of chemicals in the laboratory	Biol.	0.0	12.5	31.3	25.0	31.3
		Chem.	17.6	0.0	23.5	35.3	23.5
		Phys	13.3	26.7	20.0	20.0	20.0
3	Lack of apparatus/equipments	Biol.	0.0	6.3	31.3	37.5	25.0
		Chem.	11.8	11.8	23.5	35.3	17.6
		Phys	0.0	6.7	46.7	20.0	26.7
4	Lack of electric light in the laboratory	Biol.	6.3	6.3	62.5	12.5	12.5
		Chem.	0.0	17.6	35.3	29.4	17.6
		Phys	0.0	6.7	13.3	53.3	26.7
5	Lack of water in the laboratory	Biol.	6.3	0.0	25.0	12.5	56.3
		Chem.	0.0	11.8	0.0	35.3	52.9
		Phys	0.0	0.0	13.3	13.3	73.3
6	Lack of students' seats in the lab.	Biol.	12.5	43.8	6.3	18.8	18.8
		Chem.	35.3	5.9	29.4	17.6	11.8
		Phys	13.3	6.7	26.7	6.7	46.7
7	Lack of working bench in the lab.	Biol.	12.5	18.8	25.0	18.8	25.0
		Chem.	35.3	0.0	47.1	5.9	11.8
		Phys	20.0	6.7	33.3	6.7	33.3
8	Teacher's lack of skill	Biol.	37.5	18.8	37.5	0.0	6.3
		Chem.	35.3	17.6	23.5	11.8	11.8
		Phys	40.0	26.7	20.0	6.7	6.7
9	Lack of laboratory Technician in the school	Biol.	0.0	0.0	6.3	25.0	68.8
		Chem.	23.5	0.0	11.8	29.4	35.3
		Phys	6.7	6.7	0.0	6.7	80.0
10	Lab. Technician low skill	Biol.	56.3	12.5	6.3	6.3	18.8
		Chem.	35.3	17.6	17.6	11.8	17.6
		Phys	53.3	13.3	0.0	6.7	26.7

Majority of the teachers under study recognized that lack of laboratory room, lack of chemicals, lack of apparatus/equipments, lack of electricity, lack of water, lack of students' laboratory seats, lack of working benches, teachers' lack of skills and lack of laboratory technicians are among the affecting factors(see Table 6). As shown in the table, the teachers indicated different levels or degree to which the different factors affect schools using of laboratory. Moreover, the effect of the different factors is different for the three science subjects under study.

Table 7

Students' responses regarding factors affecting secondary schools using science laboratories

No	Factor	Responses				
		Never(1) (%)	Rarely(2) (%)	Sometimes (3) (%)	Usually(4) (%)	Always (5) (%)
1	Lack of laboratory room	25.7	14.1	17.8	12.0	30.4
2	Lack of chemicals in the lab.	7.9	10.5	18.3	22.0	41.4
3	Lack of apparatus/equipments	7.3	6.3	21.5	24.6	40.3
4	Lack of electric light in the lab.	14.7	19.9	20.9	16.8	27.7
5	Lack of water in the lab.	11.0	9.9	19.4	18.8	40.8
6	Lack of students' seats in lab.	21.5	18.3	25.1	13.1	22.0
7	Lack of working bench in lab.	22.0	23.6	25.1	9.4	19.9
8	Lack of convenient time for the	37.2	25.1	16.2	9.9	11.5
9	Teacher's work load	42.9	23.0	7.3	6.3	0.5
10	Teacher's lack of skill	34.0	31.4	22.0	5.8	6.8
11	Teacher's lack of interest	45.0	23.6	19.4	8.9	3.1
12	Students' lack of interest	49.7	22.0	16.2	7.3	4.7
13	Lack of laboratory Technician	12.0	12.0	23.0	17.8	35.1
14	Lab. Technician's low skill	16.8	15.7	26.2	13.6	27.7
15	Lack of support from different body	13.6	13.1	22.0	16.2	35.1

Majority of the students involved in the study replied that most of the proposed factors listed in Table 7 were affecting secondary schools using of laboratory. As indicated in the table, most of the students recognized that three-fourth of the proposed factors were affecting the preparatory schools using of laboratory. The students replied saying the factors affect "sometimes/usually/always.

Accordingly, lack of laboratory room identified as a factor by 60.2% of the students involved in the study. Similarly, lack of chemicals denoted by 81.7%, lack of apparatus/equipment's by 86.4%, lack of electricity by 65.4%, lack of water by 79%, lack of student's seats by 60.2%, lack of working benches by 54.4%, lack laboratory technicians by 75.9%, lab technician low skill by 67.5% and lack of support by 73.3% of the students.

On the other hand, majority of the students did not recognize one-third of the proposed factors. Hence, “lack of convenient time for the students", "teacher's work load", "teacher's lack of skill", "teacher's lack of interest" and "students' lack of interest" were not identified as affecting factors since majority (62.3%, 65.9%, 65.4%, 68.6% and 71.7%)of the students chosen "never" or "rarely" for each of the above proposed factors respectively (see Table 7).

Tables 6 and 7 depicted that both teachers and students involved in the study have recognized lack of laboratory room, lack of chemicals, lack of apparatus/equipments, lack of electricity, lack of water, lack of students' laboratory seats, lack of working benches, lack of laboratory technicians and lack of support were affecting the preparatory schools under study using of laboratory for the three science subjects. The interviewed science subjects' department heads supported the teachers and students regarding the factors they have identified. However, most of the department heads suggested that teachers' lack of skill and laboratory technicians' skill problem should also be the parts of the factors affecting secondary schools using of laboratory for the three science subjects.

For instance, biology department head in school (S6) explained his school situation as follows:

In my school there are chemicals and apparatuses which we failed to use since none of the teachers know how to use them. Similarly, the technician couldn't manage the issue. So, currently we have some materials in our laboratory which we are not using them.

Similarly, Physics department head in school (S8) mentioned his school issues as given below.

The person serving us as a laboratory technician in my school has no more role than unlocking and locking the laboratory room. He didn't take any training that helps him to give technical supports in laboratory. Moreover, some of our teachers have no adequate knowledge and skill to use the laboratory materials properly. So, such lack of knowledge and skill is hindering us not use laboratory to teach the practical parts in laboratory.

CONCLUSIONS

Some of the preparatory schools in all the four zones of Wollega use plasma-TV simulations alone to teach science subjects practical parts where as some other of them use teacher's laboratory demonstration. These two methods were alternatively serving in schools those have no both plasma-TV program and science subjects laboratory simultaneously. The other methods which have high pedagogical advantage for teaching science practical pats such as students conducting practical activities in laboratory individually and being group, in workshops and on fields were used almost by none of the schools. This result implies that the preparatory schools in the area of the study are far lag behind in using the methods which are pedagogically acceptable.

Most of the preparatory schools in this study area, especially those have functional laboratory were using the industrial/imported chemicals and apparatus widely instead of those produced locally. Thus, teachers' lack of skill and experience to produce and utilize materials from the locally available resources is an additional challenge that affects the teaching-learning of science practical parts.

This study reveals that the preparatory schools in this study area are with multiples of sever challenges. Therefore, almost all of the preparatory schools in this study area are with most of these deficiencies. Although, laboratory is one of the well-liked methods for teaching science subjects practical parts, this large gap prevailed in this area need due attention and strong effort to reverse the condition.

The preparatory schools are recommended to urge the science subject teachers to use their level best efforts and creativity in producing and utilizing locally available materials instead of waiting for the industrial products.

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