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# The Status of Secondary School Science Laboratory Activities for Quality Education in Case of Wolaita Zone, Southern Ethiopia

Ashebir Gogile Zengele* Bereket Alemayehu
Lecturers and researchers, Department of Biology, College of Natural and Computational Sciences, Wolaita Sodo University P. O. Box 138, Wolaita Sodo University, Ethiopia

**Abstract**
A high quality science education in primary and secondary schools contributes to developing scientific literacy and would be expected to predispose students to study the enabling sciences at university. The major purpose of this study was to assess the practice and problems in science laboratory activities in the secondary school of Wolaita Zone, Southern Nations, Nationalities and People's Region. This study was conducted in five government secondary schools from three Town administrative and two Woreda administrative from Wolaita Zone. The Woreda education offices and secondary schools were selected by purposive sampling techniques based on the proximity. The secondary school teachers were selected by systematic sampling techniques while principals, vice principals and Woreda education supervisor expert were selected purposely. Primary data were gathered from 114 teachers, 8 laboratory technicians, 10 principals and 235 students by questionnaire, interview and observation and secondary data were collected from documents such as annual plans and laboratory reports, annual reports. The data gathered through questionnaires were analyzed using percentages and mean. The findings of this study indicated that: - (i) The current status of laboratory works in secondary schools of Wolaita Zones is in a very low level where science teaching learning process is not supported adequately by laboratory works; (ii) The most determinant constraints of laboratory activities in secondary schools include lack of laboratory rooms, inadequate supply of lab equipments, reagents and facilities, absence of trained laboratory technicians/teachers, lack of commitment and interest of teachers, lack of regular schedule for laboratory activities, , poor management, monitoring and evaluations of laboratory activities, no system for grading and assessment of laboratory examinations.(iii) laboratory activities did not get the necessary concern in all schools investigated by this study. Therefore, to bring the progress of laboratory activities in schools and to play a great role in initiating and supporting science teaching in the class, there should awareness creation by all stakeholders of the education system. Current and regular workshops and short term trainings about laboratory activities should be given to science teachers in order to enhance and update their laboratory skills and capacities to carry out experiments and demonstrations more effectively and efficiently. The respondents agreed that the government should give special consideration and effective implementation strategies for the improvement and efficient ways of science teaching in schools in order to achieve the mission and goals of the new education policy.
**Keywords**: laboratory; laboratory activities; teacher, principals; secondary schools

## 1. Introduction

A high quality science education in secondary schools contributes to developing scientific literacy and would be expected to predispose students to study the enabling sciences at university. "Generating higher levels of participation in science-related studies at university appears to be partly dependant on strengthening science education in secondary schools" [1] and [6]. The report of [3] elaborated that Science education imparts a method of inquiry and a systematic way of processing knowledge about the physical world. For this reason, science education provides part of the foundation for any knowledge-based effort to improve health, nutrition, family planning, environment, agriculture, and industry.

Practical work has been defined as an experiment performed by the teacher for demonstrations, or series of experiments and observational exercises carried out by the students to relate theoretical knowledge with practical activities done in the laboratory, classroom, field or elsewhere [16, 17]. Science is a practical subject. Science curricula should give students the opportunity to practice the processes of investigation in authentic contexts, and in secondary schools this should involve working in well-equipped and supported laboratory environments. Practical activities are essential in all level of science education and in particular it is highly significant in secondary schools to help students in internalizing and understanding the theoretical knowledge of science fields such as Chemistry, Biology and Physics.

To accomplish the goal of practical activities in science, the equipment and experiments have to be carefully selected to give students a relevant experience and also the understanding is enhanced if the activities are coming from the daily life of the students. Provision of relevant equipment and reagents is a necessary, but not sufficient condition for successful science teaching. Other factors such as the absence of trained laboratory technicians, suitability of equipment, commitments of teachers and education sector administrations distribution, etc., influence the quality of practical activities [14].

 

In Ethiopian , the Government has recently introduce policy of 70:30 percent professional mix in annual enrolment, with 70% of intakes allocated in to science and technology streams and 30% in to the social science and humanity steams. The rationale behind this initiative is the belief that science and technology are the engines of development and that Ethiopia's prospect hinges on the availability of sufficient stock of national expertise in these fields by its higher institutions [5]. The country gave more emphasis to science fields and students are expected to gain adequate practical knowledge parallel to the theoretical knowledge of science disciplines. Science laboratory activities are importance to produce well qualified, scientifically literates and competent educated manpower.

Practical activities have a long distinctive and central role in the science curriculum and science educators have suggested that many benefits accrue from engaging students in science practical activities [8]. Specifically inquiry-type laboratories have the potential to develop students' abilities and skills such as: posing scientifically oriented questions [7] , forming hypotheses, designing and conducting scientific investigations, formulating and revising scientific explanations, and communicating and defending scientific arguments.

However, recent study in Ethiopia indicated that students beginning from lower grades have serious knowledge deficits in science and mathematics; this signifies that the quality of science education in primary and secondary schools, which is critical foundations for latter educational development, is at crisis. At this point it looks imperative to raise some questions related to the 70:30 professional mix proposed by MOE. How it is possible to place 70% of preparatory graduates to higher learning institution in science stream where students have low achievement in science subjects **[5].**

A number of reviews and reports on secondary science education e.g., [16] have highlighted problems with engaging students' interest in the study of science and the teaching-learning method is less inquiry-oriented, and also the students less engage in practical science investigations. The chalk and talk nature of secondary science education is the poor method of teaching in 21st century. Today Science is more based on inquiry-oriented [16]. Efforts to reform secondary science education through the implementation of practical and more inquiry-oriented pedagogy will only be effective if science teachers are supported with adequate laboratory facilities, science equipment and with high quality technical support. Higher levels of technical support will be required to implement a more inquiry-oriented and authentic science curriculum. Failure to implement a more engaging secondary science curriculum will see the continued drift of students away from the sciences in the secondary schools with serious consequences for university science enrolments and the quantity of trained professionals in science, engineering and technology that are needed to drive the country economy. Science laboratories are essential for the fulfillment of individuals needs as well as for the national growth. Science laboratories implementation requires above all qualified, well trained laboratory technicians, teachers and dedicated leaders; hence, assessing the resources and challenges in carrying out the science laboratory problems becomes unavoidable and necessary. Given that there has been no research conducted in Wolaita Zone on a zonal scale to investigate the status and quality of secondary school science laboratory status, there is a need to investigate the nature of technical support, the role of technicians, the teachers commitment, the presence of equipped laboratory and how they are working, etc. needs a research. The objectiveof the study was to investigate the current status of science laboratory activities in secondary schools in Wolaita Zone and to suggests possible solutions.

### 1.1. Statement of the problem

A number of reviews and reports on secondary science education e.g., [16] have highlighted problems with engaging students' interest in the study of science and the teaching-learning method is less inquiry-oriented, and also the students less engage in practical science investigations. The chalk and talk nature of secondary science education is the poor method of teaching in 21st century. Today Science is more based on inquiry-oriented [16]. Efforts to reform secondary science education through the implementation of practical and more inquiry-oriented pedagogy will only be effective if science teachers are supported with adequate laboratory facilities, science equipment and with high quality technical support. Higher levels of technical support will be required to implement a more inquiry-oriented and authentic science curriculum. Failure to implement a more engaging secondary science curriculum will see the continued drift of students away from the sciences in the secondary schools with serious consequences for university science enrolments and the quantity of trained professionals in science, engineering and technology that are needed to drive the country economy. Science laboratories are essential for the fulfillment of individuals needs as well as for the national growth. Science laboratories implementation requires above all qualified, well trained laboratory technicians, teachers and dedicated leaders; hence, assessing the resources and challenges in carrying out the science laboratory problems becomes unavoidable and necessary. Given that there has been no research conducted in Wolaita Zone on a zonal scale to investigate the status and quality of secondary school science laboratory status, there is a need to investigate the nature of technical support, the role of technicians, the teachers commitment, the presence of equipped laboratory and how they are working, etc. needs a research. To this end the following basic research questions

were set:

**Research Questions**

1. What is the present position concerning the organization of laboratory facilities and furniture in secondary schools
2. What was the status of secondary school laboratories look like?
3. How extensive are they in relation to the time tables for class teaching and practical work and also in relation to number of pupils?
4. What were the major challenges and what attempts have been made to address the challenges in laboratory in Wolaita Zone secondary schools?

### 1.2 Objective of the study

#### 1.2.1 General Objective

To investigate the current status of science laboratory activities in secondary schools and suggests possible solutions.

#### 1.2.2 Specific objectives of the study

1. To evaluate the current implementation practices of laboratory activities in secondary schools of Wolaita Zone.
2. To assess the preparations and experiences of schools in implementing practical activities as indicated in the student textbook.
3. To identify the major problems that hinders the implementation of practical work in secondary schools of the study area.

## 2. The Research Design and Methodology

This section deals with the research methodology; source of data; sample size and sampling techniques; instruments and procedures for data collection; and methods of data analysis that were employed to analyze the data gathered.

### 2.1. Research Design

In order to realize this study, descriptive research design was employed as it was the appropriate method to enable the researcher to describe and assess the implementation practice science laboratory activities in the zone. The study used a mixed research methods that enabled the researcher to use both quantitative and qualitative methods of data collection. Qualitative and quantitative methods were selected because not only they complement one another, but also help to minimize limitations that the research would have faced if only one of them was used. Furthermore, the method according to [4] enables the researcher to examine the present situation and identify some of the major problems in the area of the study. Moreover, the method is assumed to enable the researcher to find out the solutions for the existing problems. The laboratory technicians, teachers', the laboratory resources availability, school leadership commitment for the better attainment of science subjects and the challenges that encountered in science laboratory in secondary school level were evaluated.

### 2.2 The Sources of Data

The data were collected from two sources- primary and secondary sources of data. This helped the researcher get pertinent data related to the study at hand from these important sources.

#### 2.2.1 Primary sources

For the purpose of this study the data were gathered from different respondents that may have adequate information about the science laboratory situations in the secondary schools of Wolaita Zone. Accordingly, the Primary data was obtained from teachers, laboratory technicians, principals, vice principals, and students.

#### 2.2.2 Secondary sources

To substantiate the data obtained from the primary sources, documents such as annual plans and laboratory reports, annual reports, directives, journals and published and unpublished documents were reviewed and used as secondary sources of data.

### 2.3 Target Population, Sampling Technique and Sample Size

#### 2.3.1 Target population

There are three town administrations and twelve Woredas in wolaita zone. In order to gather sufficient and relevant data for the study students who are in secondary schools, science teachers, laboratory technicians, school principals and supervisors were selected as the target populations for this study.

#### 2.3.2 Sampling techniques and sample size

Out of twelve rural woredas and three town administration education offices, the researcher selected five woreda/town education offices that accounts for 33.3% of the total woredas/town having secondary schools in

the zone based on its relative proximity. From these woredas and towns the selected secondary schools were also five, namely Areka high and preparatory school, Bodit high and preparatory school, Sodo high and preparatory school, Humbo Tabala high and preparatory school and Gununo high and preparatory school. In all secondary schools, three science subjects (Biology, Chemistry and physics) were considered. The sampling of teachers was made based on systematic sampling, taking their names roll number from attendance sheet. Based on this from each school, the number of teacher respondents selected for biology was 8, chemistry was 8 and physics was 8 (a total of 5 school x (8+8+8) =120) were selected. The researchers were planned to take one laboratory technician for each subject from each school by purposively sampling techniques. But due to the absence of trained laboratory technicians in most schools, only eight technicians were taken. The school principals, vice principals and supervisors were included by using purposive sampling technique. This is because, these people are found to be highly relevant to give significant information for our study.

**Table 1:** Population and Sample Size of Respondents

| Selected secondary Schools | Respondents | | | | | | |
|---|---|---|---|---|---|---|---|
| | Teacher (B+C+P)* | Principal | V/principal | Supervisor | Laboratory Technician | Students | Total |
| Areka H&Ps** | 24 | 1 | 1 | 1 | 2 | 50 | 79 |
| Bodit H&Ps | 24 | 1 | 1 | 1 | 2 | 50 | 79 |
| Sodo prep | 24 | 1 | 1 | 1 | 2 | 50 | 79 |
| Humbo H&Ps | 24 | 1 | 1 | 1 | 1 | 50 | 78 |
| Gununo H&Ps | 24 | 1 | 1 | 1 | 1 | 50 | 78 |
| Total sample size | 120 | 5 | 5 | 5 | 8 | 250 | **393** |

*B=Biology, C=Chemistry, P=Physcis, ** H&P=High and Preparatory schools

### 2.4 Instruments of Data Collection

With the intention of maximizing the quality of the data, the researchers used different approaches in the data collection process. Hence, different kinds of data collection instruments which were questionnaires, semi-structured interviews, observations and document analyses were blended to capture genuine and exhaustive data. The instruments were prepared based on the research questions and the objectives.

### 2.5 Procedures and methods of data analysis

The data which were obtained from different sources were organized in a way appropriate for responding to the research questions. The researcher used excels software to calculate frequency counts and percentages to analyze the data from close-ended questions. The findings related to each research question were analyzed and discussed in relation to the review literature.

## 3. Findings and Discussions

### 3.1 Characteristics of the Respondents

The subject of the study were principals, vice principals, teachers, students, laboratory technicians and educational supervisors at woreda/town administrators. The data collection methods used was questionnaire, interview and observation in this study. A total of three hundred eighty five copies of the questionnaire were distributed to the respondents. Out of these questionnaires, one hundred twenty copies were distributed among teachers, eight were distributed to laboratory technicians, ten were distributed to key informants (Principals, V/principals and supervisors) and two hundred fifty copies were distributed to students among the five sample secondary schools in Wolaita zone. From all the distributed copies of the questionnaires 369 (96%) were filled in and returned back on time. Interviews were also conducted with key informants (Principals, Vice principals and supervisors (PVS) as an additional input for the study since they have direct contact with the teaching –learning process.

The result on the table 1 below showed that most of the teachers and school principals have experience in their work and majority of them have a qualification of B.Ed/Sc. Regarding to class size, most respondents indicated that the number of students within the class are 60-70.

 

Table 1 General characteristic of the respondents

| No | Item | | Respondents | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Teachers (N=114) | | PVS N=10) | | Students (N=237 | | Laboratory technicians (N=8) | |
| | | | No | % | No | % | No | % | No | % |
| 1 | Sex | m | 97 | 85.1 | 10 | 100 | 120 | 10 | 5 | 62.5 |
| | | F | 17 | 14.9 | 0 | 0 | 117 | 0 | 3 | 37.5 |
| 2 | Work experience( years) | <5 | 24 | 21.1 | | | | | 6 | 75 |
| | | 6-10 | 30 | 26.3 | 6 | 60 | | | 2 | 25 |
| | | 11-15 | 35 | 30.7 | 4 | 40 | | | - | - |
| | | >15 | 25 | 21.9 | | | | | - | - |
| 3 | Qualificati on | M.Ed (M.Sc) | 3 | 3.2 | | | | | - | - |
| | | B.Ed/Sc. | 79 | 84.0 | | | | | 7 | 87.5 |
| | | Diploma | 12 | 12.8 | | | | | 1 | 12.5 |
| | | | | | | | | | | |
| 5 | No of students in class | | <50 | | 0 | | 0 | | | |
| | | | 50-60 | | 24 | | 25.5 | | | |
| | | | 60-70 | | 38 | | 40.4 | | | |
| | | | 70-80 | | 30 | | 31.9 | | | |
| | | | 80-100 | | 2 | | 2.1 | | | |

**3.2 Analysis of Data on Implementation of laboratory activities in research schools**

This is the second part of this section that deals with the presentation, analysis and interpretation of data on the implementation of laboratory activities in the secondary schools of Wolaita zone. To this end, responses on the purposes of laboratory activities, equipments, chemicals and reagents availability, presence of trained laboratory technicians, observation of teachers' laboratory performance, and factors that affect practical laboratory activities are analyzed accordingly.

Table 2: To what extent do you agree or disagree with each of the following statements?

| No | Items | Choices (N=114) | | | |
|---|---|---|---|---|---|
| | | Strongly disagree | disagree | agree | Strongly agree |
| 1 | Students should practice in lab for better understanding of your subject | - | - | 29(25.4%) | 85(74.6%) |
| 2 | Science education is effective without laboratory activities? | 95(83.3%) | 19(16.7%) | - | - |
| 3 | Science is a primarily a practical subject for addressing real situations. | - | - | 23(20.2%) | 91(79.8%) |

The result on the Table 2 above showed that all respondents (100%) reacted positively that laboratory activities are important for better understanding of science subjects. Similarly, the respondents agreed that science education is ineffective without laboratory activities. Generally science is a practical based subject that needs real environmental practice for better understand it. The result justified that promoting laboratory activities in science subjects provides students with increased access to understand the nature effectively.

In similar to this study [8] indicated that laboratory work in science education is important for the attainment of the cognitive, affective and psychomotor domains. Furthermore; laboratory activities are important for students to acquire core subject knowledge as well as the skills of collaboration, critical thinking, creativity and problem solving abilities. As [11] explained that laboratories are important educational facilities in schools for various reasons. Emphasizing on laboratory activities in science subjects at secondary school level is importance to build a strong foundation in science subjects. Similarly [2] quoted that "the best way to learn science is by doing practical activities in the laboratory." This makes science learning and teaching more tangible, interesting, live and unforgettable and it contributes to widen the skill and knowledge of students.

So it is possible to say that laboratory activities in science fields are paramount relevant to make science learning more practical and observable to internalize the theoretical knowledge about natural processes and phenomena. Generally many researchers indicated that if the amount of practical work increases the quality of science subjects' and students' achievement will increase.

 

### 3.3 The current status of laboratory activities in secondary schools

**Table 3:** Analysis of respondents' response on Facilities and Functions of Science Laboratories.

| Item no | Description | Alternatives | Students (N=235 | Teachers (N=114) | PVS (N=10) |
|---|---|---|---|---|---|
| 1 | Is there a separate room for biology, chemistry and physics laboratory works in your school? | Yes | 174(74.0%) | 97 (85.1%) | 9(90%) |
| | | No | 61(26.0%) | 17 (14.9%) | 1(10%) |
| 2 | The quality of science laboratory buildings and furniture in secondary schools | Very good | 17(14.9%) | 13(5.5%) | - |
| | | Good | 36(31.6%) | 17 (7.2) | 8(80%) |
| | | Unsatisfactory | 65(57%) | 61 (26)% | 2(20%) |
| | | Poor | 11(9.7%) | 144(61.3%) | - |
| 3 | Does your school science laboratory well equipped with chemicals, apparatus and reagents based on the student text book? | Yes | 67(28.5%) | 31(27.2%) | 2(20%) |
| | | No | 168(71.5)% | 83(72.8%) | 8(80%) |
| 4 | When is lab session carried out in your school? | In its arranged period | 46(19.6) | 27(23.7%) | 2(20%) |
| | | In opposite shift as make up class | 189(80.4%) | 87(76.3%) | 8(80%) |

The data in table 3, item 1 showed that 174 (74%) students, 97 (85.1%) teachers and 9(90%) PVS revealed the presence of separate laboratory rooms for Biology, chemistry and Physics laboratory activities. It is clear that when there is a separate and large class it is suitable for both teachers and students to carry out laboratory activities as much as possible rather than sharing one room with other departments in science. To the contrary 61(26.0%) students, 17 (14.9%) teachers and 1(10%) PVS responded that their schools have no a separate room for biology, chemistry and physics laboratory works and the departments share common room to carry out laboratory activities. So, there is no significance difference among students, teachers and school PVS response regarding the presence or absence of separated classes for laboratory activities of each science field. This indicates that most schools have separate lab rooms for laboratory activities of each science subject.

As shown in table 3 item 2 above, teacher respondents rated the quality of building and furniture as very good in 14.9%, good in 31.6 %, unsatisfactory in 57%, while it was in 9.7% was poor of the laboratories in secondary schools of wolaita zone. For similar questionnaire, most of the student respondents said that the science laboratory buildings and furniture are poor (61.3%) and 26% respondents result showed unsatisfactory in secondary schools of the study area. In contrast to this, most of school PVS (80%) were satisfied on the status of their school science laboratory conditions.

The interview and observation result confirmed that there were poor standards of laboratories and design in the school. Moreover the interviewee added that the existence of one common laboratory room for all sections (grade 9-12 in most schools) creates an overcrowding and clashing of laboratory programs and hence, there is limited period to carry out laboratory activities based on the schedule of each science discipline and this restricts teachers and students to perform laboratory session on an extended period of time. Furthermore; the observation result indicated that laboratory furniture such as tables, cabinets, shelves, sinks, etc., were absent totally in some schools and not properly setup in other high schools. Therefore, one of the constraints for implementation of science laboratory activities is lack of quality laboratory room and furniture for Biology, Chemistry and Physics subjects.

Regarding whether the school science laboratories were well equipped with chemicals, apparatus and reagents based on the student text book, most of the respondents gave similar response. As table 3, item 3 showed 168(71.5%) students, 83(72.8%) teachers and 8(80%) PVS responded that their school laboratories were not well equipped with chemicals, apparatus and reagents based on the student text book. Only very small number of students 67(28.5%), teachers 31(27.2%) and principals 2(20%) responded that the teaching and learning process was not affected by the shortage/inadequacy of laboratory equipments and materials in their school. In similar to most respondents the interview result with technicians and supervisors indicated that due to lack of adequate equipments and chemicals/reagents, most of the time their school laboratories are non-functional and no practical activities at all. So, theoretical knowledge of science is not supported by practical activities in these schools and this makes science learning incomplete and students could not get practical skill and experience which is the core point in science to determine their destination. Therefore, one of the constraints for implementation of science laboratory activities is lack of sufficient laboratory equipments and materials in the study schools.

A study done by [13] showed that there was inadequate availability of instructional materials

(laboratory equipment's) in Wolaita and Dawuro Zone secondary schools. This result indicated that most laboratories in secondary schools are not performing their laboratory activities based on objectives set on the curriculum. Therefore; improving school laboratories is improving the quality of education in science.

Concerning whether there was regular arranged time schedule or not for laboratory activities in the secondary schools, the respondents were asked and interviewed. As shown in the table 3, item 4 above, most of the respondents i.e., 80.4% students, 76.3% teachers and 80% PVS responded that the laboratory activities were done in opposite shift from the normal class time as a makeup class. A few number of respondents result showed that the laboratory activities have its own period at normal students shift. The interview result with school principles and supervisors showed that teachers were recommended to do laboratory activities in opposite shift due to it has value for continuous professional development (CPD).

According to the interview with department heads and school principals the reason why laboratory activities were not performed as the normal schedule was due to: large class size, over crowdedness of the periods, lack of sufficient time for the laboratory, lack of enough rooms and lack of laboratory technicians to conduct different laboratories at one time in different sections.

### 3.4 Analysis of Data on laboratory technicians' cases

This section of the analysis deals with an assessment on the presence or absence of laboratory technicians for science subjects, the way the schools tried to solve the problems associated with it in the secondary schools of Wolaita zone.

Table 4 the presence of trained laboratory technicians in secondary schools of the study area

| Item no | Description | Alternatives | Teachers (N=114) | PVS (N=10) |
|---|---|---|---|---|
| 1 | Is in your school laboratory technician for biology, physics and chemistry? | Yes | 28(24.6%) | 3(30%) |
| | | No | 86(75.4%) | 7(70%) |
| 2 | Reasons for not having laboratory technicians | Lack of trained laboratory technicians | 97 (61.0%) | 10 (76.9%) |
| | | Budget constraints | 46 (28.9) | 3 (23.1%) |
| | | Unwillingness of schools/education units to recruit laboratory technicians | 16(10.1%) | |
| | | Total responses * | 159 (100%) | 13(100%) |
| 3 | Who is responsible for performing the duties of a laboratory technician? | Science Teacher | 97(85.1%) | 10(66.7%) |
| | | Other staff member | 13(11.4%) | 3 (20%) |
| | | Student | 4(3.5%) | 2 (13.3%) |
| | | Part-timer | - | - |
| | | Total responses * | | 15 (100%) |
| 4 | Do Laboratory technicians and teachers get regular training on laboratory activities? | Yes | 43(37.7%) | 3(30%) |
| | | No | 71(62.3%) | 7(70%) |
| 5 | The respondents' satisfaction on laboratory activities of the secondary schools | Very high | 9 (7.9%) | - |
| | | high | 19 (16.7%) | 2(20%) |
| | | Medium | 42 (36.8%) | 7(70%) |
| | | Low | 28 (24.6%) | 1(10%) |
| | | Very low | 16 (14.0%) | - |

*Respondents gave more than one response

The result on table 4 item 1 showed that 75.4% teachers and 70% school PVS represented that there were no trained laboratory technicians in some schools at all whereas in other schools, there was shortage of trained laboratory technicians in secondary schools of Wolaita Zone to carry out the laboratory activities. Only about 24.6% and 30% of teachers and school principals respectively indicated that they have trained laboratory technicians. This shows that most of the secondary schools did not have laboratory technicians. But laboratory activities need a trained laboratory technician for its material managements and safety. Within the laboratory, there are hazardous chemicals, flammable liquid etc. These chemicals and reagents management needs a trained laboratory technician. Many of the interview participants indicated that it is hard to find qualified and experienced laboratory technicians' in secondary schools. Laboratory technicians have diverse and demanding roles that include preparing resources for and supporting the teaching of science practical work in their schools; and have significant responsibilities for health and safety, first aid, operating budgets, training [13].

As table 4 item 2 above indicated that 61.0% of teachers and 76.9% of principals mentioned that the major reason given for having no technicians in secondary schools was lack of trained laboratory technicians in

 

the market. Only a small number of schools gave budget constraints and unwillingness of schools/education units to recruit laboratory technicians as reason for having no technician. Most schools responded that they were advertised when they required technicians but the people applying were not necessarily suitable. These schools without technicians were asked to know who is responsible for performing the duties of a laboratory technician, such as preparing for practical work. The result on similar table Item 3 showed that in majority of schools that did not have laboratory technicians; the most junior science teachers perform the duties of the laboratory technician. This leads that laboratory work was done by untrained teachers in the secondary schools. The absence of trained laboratory technicians in secondary schools can directly decrease the quantity and quality of laboratory work.

According to [9], the knowledge and skills required to be a technician are quite different to those possessed by teachers and technical tasks cannot "be safely and efficiently carried out by an untrained person". Given the pressures on teachers' time, it is likely that teachers in these circumstances can only prepare limited resources for practical work and the quality of the curriculum is compromised.

The result on Table 4 Item 4 showed that 71(62.3%) of teachers and 7(70%) of school PVS said that laboratory technicians and teachers did not get regular training in laboratory rules and regulations in secondary schools of Woliata Zone. They were in need of further support or training to competently perform a number of tasks related to laboratory practices. Laboratory work is the task to be carried out by someone who is experience with the activities. Therefore; continuous professional development training is necessary to fulfill the need of trained human resources in laboratory technicians. Lack of trained laboratory technicians in schools is one s of the major reason for basic knowledge, skill and aptitude gap on the students on science subjects. Research in Ethiopia indicated that students beginning from lower grades have serious knowledge deficits in science and mathematics; this signifies that the quality of science education in primary and secondary schools, which is critical foundations for latter educational development, is at crisis [5].

However; the Ethiopian Government has recently introduce policy of 70:30 percent professional mix in annual enrolment, with 70% of intakes allocated in to science and technology streams and 30% in to the social science and humanity steams. The rationale behind this initiative is the belief that science and technology are the engines of development and that Ethiopia's prospect hinges on the availability of sufficient stock of national expertise in these fields by its higher institutions [5]. Therefore; to equip the future 70% science enrolling students with practical activities is mandatory to met the countries goals.

Teacher and PVS respondents were asked about how far they were satisfied on the laboratory activities they were doing in their schools. The result indicated that most of the teacher and principal's satisfaction was medium with values 42 and 7 respectively. 28 (24.6%) of teachers satisfaction was low whereas 2(20%) of school principles satisfaction was high as shown in Table 4,item 5 above. From this it is possible to conclude that teacher's low or medium satisfaction can affect directly or indirectly the teaching learning process. The teachers' skills in assessing their students' learning depend also on how deeply they themselves satisfied on all the process in the school.

The National Science Education Standards [11] clearly presented a vision for quality teaching and learning of science that includes: students learning of science is greatly determined by how they are taught by teachers; teachers' perceptions of science as a discipline and as a school subject to be learned by the students greatly influenced their actions and its teach ability; students' understanding of science is achieved through their engagement and active construction and teachers' understanding of and relationship with their students have a great influence on their actions.

### 3.5 Factors that Affect laboratory activities in secondary schools

This part of the analysis was to assess the views of the teacher and school PVS responses on the factors that affect laboratory activities in the secondary schools of Wolaita zone. Hence, the following items have been identified in the study and the responses of teachers and school PVS were presented, analyzed and interpreted below.

Table 5**:** Factors that Affect laboratory activities in secondary schools in Wolaita Zone

| Item | Descriptions | Teachers (N=114) | PVS (N=10) |
|---|---|---|---|
| 1 | Absence of reward | 42(11.0%) | 7(16.7%) |
| 2 | Lack of appropriate laboratory time/schedule | 95(25%) | 9(21.4%) |
| 3 | Lack of adequate equipments and materials | 106(27.9%) | 7(16.7%) |
| 4 | Lack of teachers commitment | 26(6.8%) | 8(19.0%) |
| 5 | Lack of students interest | 48(12.6%) | 6(14.3%) |
| 6 | Teachers lack of training | 63(16.6%) | 5(11.9%) |
| *Total responses | | 380(100%) | 42(100%) |

*Respondents gave more than one response

As shown in table 5 in item 3 and 2 teachers responded that lack of adequate equipments and

 

materials and lack of appropriate laboratory time/schedule share the highest points, 27.9%) and 25% respectively as factors that affect laboratory activities in secondary schools of the study area. Whereas as school principals and vice principals rated lack of appropriate laboratory time/schedule as the highest factor 9(21.4%) that affects laboratory activities in their school. In regard to lack of teachers' commitment, teacher respondents rated it as the least factor (6.8%) but the school principals and vice principals rated it as the second highest factor with percentage of nineteen that affects the practical activities in secondary schools of Wolaita Zone. Teacher's lack of training, lack of students' interest and absence of reward for practical activity were also taken as factors that affect the effective laboratory activities in the study area. This implies that the major factors that affect teachers' performance in practical activities were lack of appropriate laboratory time/schedule, absence of reward, lack of necessary equipments and materials, teachers' lack of training and commitment.

Moreover, in responding to interview and open-ended questions, as replied by respondents, there were a number of problems that encountered in practical activities. The major once were lack of appropriate tables and chairs in the laboratory rooms, the large number of students per class and section and lack of experience sharing were additional factors that hinder the activities of practical work. Specifically because of lack of the reward/motivation, highly devoted teachers for practical activities were lacking motivation to their work as they thought no difference between those who performing well and poor. Moreover, most teachers and principals didn't have deep insight that laboratory activities could bring quality education.

On the other hand, the laboratory activities requires setting up appropriate standards or laboratory manual that should have strong relationship to the teaching and learning activities, but schools were not given mandate of setting relevant and appropriate laboratory manual that could effectively leads teachers and students to follow in laboratory session. Most teachers are working in two shifts and occupied by the classroom period without scheduled laboratory session. Eventhough; learning by doing is the most appropriate for students to understand, in many secondary schools of Wolaita zone, this part was not treated in appropriate manner. Similarly a study done by [13] on physics subject showed that inadequate space for lab or lab facilities outmode and insufficient equipment and supply within laboratory were the main problems that encountered in the teaching and learning science.

Table 6: The rank of Suggested solutions to the problems

| Items | Teachers' response (N=114) | PVS (N=10) |
|---|---|---|
| Training of laboratory technicians | 22(19.6%) | 1(10%) |
| Awareness training for teachers, principals and supervisors on laboratory activities | 28(24.8%) | 3(30%) |
| Material support (furniture, chemicals, reagents) | 14(11.9%) | 2(20%) |
| Preparing schedule for laboratory per week | 23(20%) | 1(10%) |
| Setting up a well equipped laboratory | 27 (23.7%) | 3(30%) |

Respondents were asked to rank the possible solutions to the problems of laboratory activities in secondary schools of Wolaita zone. Table 6 above shows the numbers and percentages of the respondents suggesting each type of solution. Both teachers and PVS were indicated that awareness training for teachers, principals and supervisors on laboratory activities and setting up a well equipped laboratory respectively were the high value sharing solutions for the laboratory problems. Training of laboratory technicians and material support (furniture, chemicals, and reagents) were also mentioned as important things to solve laboratory related problems in secondary schools of the study area. It is noticeable that teachers and principals roughly agree on the solutions to be used. However; there were some practical suggestions such as preparation of time table for practical activities is important. The schedule for the laboratory activities is not only a problem of secondary schools of Wolaita Zone but it is country wide problem which needs policy decision .

## 4. Findings and Conclusion of the Study

- The result of the current study have shown that all respondents (100%) reacted positively that laboratory activities are important for better understanding of science subjects in the classroom.
- Some of the respondents agreed that there is a separate laboratory room for science subjects whereas other has a contrasting idea. The existence of one common laboratory room for all sections (grade 9-12 in most schools) creates an overcrowding and clashing of laboratory programs and hence, there is limited period to carry out laboratory activities Furthermore; the observation result indicated that laboratory furniture such as tables, cabinets, shelves, sinks, etc., were absent totally in some schools and not properly setup in other high schools.
- Most of the respondents notified that school science laboratories were not well equipped with chemicals, apparatus and reagents based on the student text book. The school science laboratories were very poor arranged. So, these schools need to take urgent actions to fulfill the basic required laboratory facilities and should organize their laboratories in the way that they would be in the right track to start implementation of experiments and activities.

- Greater than 80% of respondents showed that there was no regular arranged time schedule for laboratory activities in the secondary schools.
- Most of the respondents (greater than 70%) indicated that the secondary schools have no trained laboratory technicians to handle the laboratory activities due the absence of trained human resource and budget constraints. As the result laboratory activities were carried out by the most junior science teachers' in the school. Most secondary schools without technicians indicated that having a technician would improve the amount and quality of practical work in the science curriculum.
- 62% teachers and 70% school PVS showed that laboratory technicians and teachers did not get regular training in laboratory rules and regulations in secondary schools of Woliata Zone. As the result most teacher, principals and supervisors were not satisfaction on their duties.
- The major factors that affect laboratory activities in secondary schools in Wolaita Zone were absence of reward, lack of appropriate laboratory time/schedule, lack of adequate equipments and materials, lack of teachers commitment, lack of students interest, and teachers lack of training
- The rank of suggested solutions to the problems were training of laboratory technicians; awareness training for teachers, principals and supervisors on laboratory activities; material support (furniture, chemicals, reagents) and preparing schedule for laboratory per week are the most frequently mentioned ideas for the problems.

## 5. Recommendations

From the research findings of this study conducted in Wolaita Zone, it is vividly evident that the quality of teaching and learning of science without laboratory is a parlous state. Importantly, considerable gaps exist between actual science teaching and learning and a realistic ideal. Achieving scientific literacy for citizens therefore, requires closing the gap between actual science teaching and learning and the gap in laboratory activities by making realistic recommendations to address the limiting factors that constrain the quality of science education. Based on the findings of the study and conclusions drawn, the following recommendations were forwarded.

- Only theoretical teaching for science subjects is not effective. Therefore; it should be encompass a combination of lecture, accompanied by practical demonstrations and range of laboratories activities.
- In order to develop competence in the area of laboratory skill, training for science teachers, laboratory technicians and school principals shall be actively given for effective and efficient laboratory activities.
- Science teachers should be motivated and supported by colleagues, school administration, parents and the larger community. Providing incentives for those technicians and teachers who work in laboratory effectively and efficiently is important to motivate themselves and to initiate other teachers too.
- Resource allocation for science laboratory should be improved. To meet the 70:30 science-technologies to social science proportion in Ethiopia, government must give great attention for school laboratory buildings, laboratory equipments, chemicals and reagents.
- All schools should have laboratories for science with adequate supplies of equipment and reagents for practical work in science. Also there should be laboratory assistants in all schools to help with the proper maintenance of laboratory facilities and equipment and also to assist in the preparation for practical experiments so that teachers include more inquiry-based practical work for students in science.
- There should be regular monitoring of all teachers in the school system to ensure accountability and quality education.

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