

Quality of Science Teaching in Secondary Schools of North Gondar Zone in Ethiopia

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ABSTRACT This study assessed the quality of teaching in science in North Gondar Zone's Secondary Schools, Ethiopia. Descriptive survey design was used for the study. One hundred and thirty-two science teachers and six hundred and fifty students of eight purposefully were selected schools selected through comprehensive and stratified random sampling technique, respectively. Eight school principals were selected through comprehensive sampling and participated in the interviews. To triangulate the data collected through questionnaire and interview, observation lessons were conducted. Quantitative and qualitative analyses depicted that teacher-centered activity predominates in lessons and there is less frequent independent student practical works in lesson, written tests are commonly used assessment strategy in lessons, factors limiting the quality of teaching include insufficient funding of science laboratory facilities, and qualified teachers. Finally, continuous professional development put in place to perform their day-to-day professional task and the management of the schools equip with necessary facilities by generating resources through mobilizing communities.

INTRODUCTION

Ethiopia is one of the developing countries in the world, which follows a federalism government system. Through this system, the country has experienced rapid economic growth since recent years. Currently, the government of Ethiopia set a long-term vision to transform the country, within 15 years, into a middle-income country, at least keeping this rate of growth.

Achieving the vision of transforming Ethiopia into a middle-income country, in 2025, demands transformation of the economy through application of science and technology as instruments to create wealth. Realizing this fact, the Ministry of Education gives special attention to provide quality science and mathematics education in primary and secondary schools, efficiently implement the TVET 2 outcomes and/or competency based strategy, and effectively promote the policy of 70:30 higher education intake ratios in favor of science and technology under Education Sector Development Program (ESDP) IV (MoE 2010). The researchers of this study

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also argued that the outcomes of TVET and promoting the policy of 70:30 higher education intake ratios in favor of science and technology depends largely on the quality of science education in secondary schools particularly in first cycle secondary schools (Grade 9 and 10). For science to play this role, they need to meet minimum quality standards. The researchers of this study also believed that improving the quality of science education through improving the teaching-learning process with special emphasis to teaching methods and assessment techniques is assumed to be cost-effective than through improving system inputs, which is more difficult for countries like Ethiopia. It is therefore, critical for science teachers, in every parts of the country, to employ active learning-teaching methods and continuous assessment in teaching and learning of science at secondary schools.

Science teachers in the North Gondar Regional State, as in any parts of the region and the nation, are claimed to be implementing various teaching and learning and assessment strategies in secondary schools. The quality of teaching and learning of science in this area are also limited by different factors, which require serious attention for improvement. However, there is no any sufficient evidence or empirical studies that support this claim.

It is cognizant of aforementioned issues that the researchers of this study initiated to assess the quality of teaching and learning of science

in North Gondar Regional State secondary schools.

Statement of the Problem

To make the key priorities of the current Growth and Transformation Plan (GTP) a reality, a large demand is expected from middle and high level human resources, who are well trained in Science and Technology. Thus, the Ministry of Education has developed the fourth Education Sector Development Program (ESDP IV) in 2010 to enhance the quality of education in Science and Technology through introducing high quality of curricula for science education at secondary schools. Similarly, the researchers of this study argue that the quality of Science and Technology education at Universities and the quality of TVET outcomes depend largely on the quality of teaching and learning of science at secondary schools especially in first cycle secondary schools (grade 9 and 10). Because enhancing the quality of teaching and learning of science at grade 9 and 10, initiate students to prefer Natural Science stream than Social Science when they join Preparatory Schools and help to achieve the policy of University intake ratios 70:30 in favor of Science and Technology with the necessary quality. However, there is scarce evidence that confirms whether the teaching and learning of science is given with the required quality in North Gondar Regional State secondary schools.

Therefore, a research study should be conducted on the quality of teaching and learning of science in North Gondar Regional State secondary schools by focusing on the teaching and learning methods, assessment strategies, factors limiting the quality of teaching and learning of science, and strategies for improving the quality of teaching and learning of science.

Objectives

The objectives of this study were to:

- ♦ Identify the teaching and learning methods of science in North Gondar Regional State Secondary Schools.
- ♦ Identify the assessment strategies of science in North Gondar Regional State Secondary Schools.
- ♦ Find out factors limiting the quality of teaching and learning of science in North Gondar Regional State Secondary Schools.
- ♦ Suggest strategies to improving the quality of teaching and learning of science in

North Gondar Regional State Secondary Schools.

Operational Definitions

- ♦ **Assessment:** The various ways that science teachers used to determine the students' learning and academic performance in North Gondar Regional State Secondary Schools.
- ♦ **Quality:** Fitness to the purpose of science education.
- ♦ **General Secondary School:** Schools of two years duration that are from grade 9-10, which will enable the students to identify their interests for further education, for specific training and for the world of work (MoE 1994).
- ♦ **Science:** The three subjects such as biology, physics and chemistry.
- ♦ **Limiting Factors:** Issues that adversely affect the quality of teaching and learning of science in North Gondar Regional State Secondary Schools.
- ♦ **Teaching Methods:** The various ways that teachers applied in science lessons and the ways students study science in North Gondar Regional State Secondary Schools.

Defining Quality

In its modern usage it means to indicate a high (being a relative term) degree, character or nature attributed to a person, thing, process or event. Quality has been described in different ways, although, often in an intuitive manner (Reeves 2002). Aminu (1995) refers to quality of education as "the principal measure of the effectiveness of education and the most vulnerable attribute that suffers when anything goes wrong with the system" (p. 13). Literatures describe quality as "the degree of excellence at an acceptable cost" (Broh 1982: 3). For the purpose of this study, quality could be referred to as a process whereby teaching and learning are continuously improved and maintained with a view to bringing about desirable educational goals in the school system.

Quality in Teaching and Learning of Science

Quality teaching of science is crucial for developing scientifically literate citizens and improving the economic productivity for sustainable development (UNESCO 2000). Darling-Ham-

mond (1999) notes that quality teaching is crucial for enhancing students' achievement and strengthening public confidence in schools. Other reports and researchers (for example, Darling et al. 1997) emphasize that quality teaching helps students attain a deep conceptual understanding.

Adegbamigbe (2002) defines quality teaching as a series of dynamic processes and activities of teachers' actions within the educational context with a view to enhancing quality of students' learning and promoting job satisfaction.

Polland and Tann (1993) argue that quality teaching involves teachers who are competent with adequate knowledge and skills needed for effective classroom management, pupil assessment, subject teaching, and those who engage in regular professional learning. Also, Vant Hooft (2005) claims that quality teaching encompasses prior knowledge activation, hands-on learning and continuous reflection.

The Methodology of Instruction

There can be no teaching-learning process without the systematic selection and application of methods and techniques in the overall strategy of implementing curriculum. An individual reviewing written material on the area of instruction could come up with varied classification of instructional methods, such as teacher-centered versus student-centered methods, direct instruction versus indirect instruction, conventional versus non-conventional methods and traditional versus modern methods of instruction. Out of the above mentioned classifications of instructional methods, the most popular and dominantly used by many educators is the teacher-centered versus the student-centered instructional methods (Miller and Linn 2005).

Teacher-centered Method

The learning process depends on the talking of the teacher where the learner becomes a passive listener. Moreover, it inhibits active participation of the learner and encourages him/her to be submissive. Being dominated by a teacher's lecture, the teacher-centered approach creates many problems for learners. According to World Bank (1997), in teacher-centered methods, the emphasis is on theory rather than prac-

tice and the successful students are those who can display their knowledge of the facts that have been fed to them. In addition to this, in this kind of education there is little time for practical activities, discussions, group work, experiments or other alternative methods. Since the emphasis is on memorizing the maximum amount of information, there is no time for activities (Plass 1998).

Student-centered Method

In this approach students have a chance to interact, discuss, debate and ask questions, explore, experiment and observe their own knowledge through active participation. The underlying assumption here is that learning becomes meaningful when learners use it and relate it with their lives (Deci and Ryan 1991).

According to Temechehn (2001), learning in a student-centered method setting is not purely individualistic. Rather, students learn through cooperation, active involvement and participation. The central issues of student-centered instruction are methods of teaching, which fosters reflection, autonomy and active learning. Student-centered methodology emphasizes the process rather than the product and is activity-based on different teaching methods.

Students Assessment and Quality of Education

Assessment is the process of collecting, synthesizing and interpreting information to aid classroom decision-making. Assessment includes all methods and procedures that teachers use to collect information on what is happening in their classroom and the effect it has on learners' achievement. As Njabili (1995) described, the assessment is a way of observing, collecting information and making decisions based on information. Good assessment of student learning provides valid and reliable evidence of student performance to take appropriate decisions.

Types of Students Assessment in Secondary School

As Miller and Linn (cited in Desalegn 2004) pointed out, the types of assessment with their descriptions as follow:

- ♦ Formative assessment: Determines learning progress, provides feedback to reinforce learning and correct learning errors.
- ♦ Performance assessment: Refers to students' engagement in tasks that require them to be active participants such as manipulating materials, demonstrating skills, solving a multistage problem or participating in a debate.
- ♦ Summative assessment: Determines end-of-course achievement for assigning grades or certifying of objectives.

Purpose and Practices of Assessment in Science Teaching and Learning

Assessment is an integral and essential component of quality teaching and learning in science (Goodrum et al. 2001) and for enhancing the achievement of scientific literacy (National Research Council 1996). Assessment for many is regarded as a way of grading and reporting students' performances to their parents (Goodrum et al. 2001; Ogunjobi 2000). Cooper (1997) notes that assessment is not just about grading and reporting. The Education Department of Northern Territory Australia (2003) describes assessment as the collection and interpretation of information and making judgments about students' learning outcomes. Basically, assessment in science education serves a variety of purposes. These include to monitor national standards, to compare standards of students' achievement with those of other countries, to give information through which teachers, educational administrators and also politicians can be held accountable to the larger society, to sort and classify students for education and training and for career placement by employers, and to determine the route a student takes through the differentiated curricula that are on offer in school (Black 1993; William 2000).

Factors Limiting Quality Science Teaching

Currently, achieving quality teaching and learning in science for developing scientifically literate citizens is a worldwide problem facing many nations (Goodrum et al. 2001).

In the review of science education, Okebukola (1997) identifies the following five factors as inhibiting science education in the country:

1. Student-related factors such as, poor attitude to work, apprehension that science is naturally difficult to learn, difficulty associated with learning science symbols and difficulty in learning the language of science.
2. Teacher-related factors such as, poor preparation of science teachers, lack of motivation of many science teachers, inadequate knowledge of subject matter by teachers, and lack of skills/competence required for teaching.
3. School-related factors such as, overcrowded classrooms, overloaded examination syllabus, lack/inadequate laboratory and workshops, poorly equipped library and lack of vital instructional materials such as textbooks, teacher's guide and audio-visuais.
4. Home-related factors such as, imposition of science subjects by parents on children despite poor attitude to science especially at the secondary level, non-monitoring at home of students' progress in science and lack of provision in many homes for the educational needs of students in science.
5. Curriculum-related factors such as, overloaded syllabus and insufficient time allotted to teaching of science in schools (p. 3-4).

It is cognizant of aforementioned issues that the researchers of this study initiated to assess the quality of teaching and learning of science in North Gondar Regional State secondary schools.

Science Education in Ethiopia

Ethiopia has a population of over 90 million, eighty-five percent of which is rural and dependent on rain fed subsistence agriculture. Presently, rapid economic growth is being witnessed in the various sectors of the country. Such an ongoing economic growth of the country demands highly qualified and competent professionals in the field of science and technology. As a result, the government of Ethiopia has placed a great emphasis on the importance of science education as an essential component for development needs of the society.

Moreover, the country has recognized that the development of the country very much de-

depends on the development of science and technology, and hence on science and mathematics education.

Ethiopia has recently designed a strategy through which seventy percent of the university enrollment would be in science and technology. This scenario has created a unique and challenging situation whereby science and mathematics secondary education is put in the spotlight. On the other hand, science and mathematics secondary education faces numerous challenges that call for immediate improvements (Eshetu et al. 2009).

METHODOLOGY

This part of the study presents the design of the study, the sources of data, instruments procedures of data collection and methods of data analysis.

Study Design

Descriptive survey design was employed in this study with the purpose of obtaining information concerning the quality of teaching and learning of science in lower secondary schools. More specifically, the study assessed the teaching and learning methods, the assessment strategies that teachers regularly used in their lesson, the factors that inhibit quality of science teaching and the strategies to improve the limiting factors.

Sources of the Data

This study was conducted in the North Gondar Region. This was due to the researchers' workplace, and this was further assumed to be helpful for the researchers to easily access the necessary data. The most important thing was the crucial nature of the issue in this zone, the region, and throughout Ethiopia.

Populations

The target populations of this study were government secondary school students, teachers and school principals in North Gondar Regional State mainly in Secondary Schools in Gondar Town, Debark, Chilga, Dabat, and Metema Woredas. In these areas, there were a total of 791 lower secondary school teachers and 21,225 students. So, the samples of this study were

drawn from lower secondary schools science teachers, students and principals.

As data in Table 1 shows that the total sample frame of students was 14,532. Of this, 13.7 percent and eleven percent were from Fasiledess Secondary School and Debark Secondary School, sixteen percent and 11.8 percent were from Chilga Secondary School and Dabat Secondary School, 13.9 percent and thirteen percent were from Azezo Secondary School and Maksegnit Secondary School, 10.2 percent were from Metema Secondary School and 10.4 percent were from Meqdela Secondary School. Across grade level, 58.3 percent of the sample frame comprised grade 9 students, whereas 41.7 percent of the sample frame comprised grade 10 students.

The total number of science teachers in the eight secondary schools was 132, whereas the total number of school principals was 8.

Samples and Sampling Techniques

In this study, eight lower secondary schools such as Fasiledess Secondary School and Azezo Secondary School in Gondar town, Debark Secondary School in Debark, Chilga Secondary School in Chilga, Dabat Secondary School in Dabat, Metema Secondary School in Metema and Meqdela secondary school in Meqdela were purposively selected. All the 8 principals and 132 science teachers of these schools were taken as the samples of this study through comprehensive sampling technique. 1,000 students were selected as the sample of the study through stratified random sampling technique using the eight schools as the strata. However, 249 students did not return the questionnaire, and 201 students did not answer all the questions and filled the questionnaire carelessly and hence were rejected from this study. Finally, the total sample size of students who participated in this study was reduced to 650.

Instrument and Procedure

Teachers' Survey Questionnaire

The teachers' survey questionnaire contained 21 items, which comprised both closed-ended and open-ended items. From these items, three items required the respondents to provide their background information, whereas the remaining 18 items required the respondents to answer questions about the variables to be mea-

sured. The close-ended items were used mainly to assess the teaching and learning methods and assessment strategies that science teachers employed in their lessons. The open-ended items were used to assess the factors that hinder the quality of teaching and learning of science and the strategies to improve limiting factors.

Students' Survey Questionnaire

The students' survey questionnaire contained 25 items, which comprised both close-ended and open-ended items. From these items, two items required the respondents to provide their background information, whereas the remaining 23 items required the respondents to provide answers the variables to be measured. The close-ended items were used mainly to assess the teaching and learning methods that science teachers employed in their lessons. The open-ended items were used to find the strategies to improve the quality of teaching and learning of science.

Interview and Observation

The interview was conducted with 8 school principals so as to collect data about the frequently employed teaching and learning and assessment strategies by science teachers in their lessons, the factors that hinder the quality of teaching and learning of science, and the strategies of improving limiting factors.

Observations of some selected science lessons were conducted by the two researchers, so as to triangulate the data collected through questionnaires and interviews. Thus, checklists were used during the process of observation.

Data Analysis Procedure

In analyzing the data, both quantitative and qualitative methods were used. Percentage was used to analyze the data obtained from both teachers and students survey questionnaires regarding the teaching and learning and assessment methods that science teachers frequently employed in their lessons. Rank order analysis was used to analyze the data obtained from both teachers and students survey questionnaires regarding the factors hindering the quality of teaching and learning methods and strategies of improving these factors. Finally, the data ob-

tained through observation checklists and interviews were analyzed thematically.

RESULTS

The primary purpose of this study was to explore the quality of secondary science teaching and learning in North Gondar Region. Specifically, the study emphasized the teaching learning activities in science, the assessment methods in science, the factors that hinder the quality of teaching and learning of science, and strategies to improving the quality of teaching and learning of science.

The entire population of 132 science teachers was surveyed, and all completed and returned questionnaires. The distribution of teachers according to name of school and major subject area of teaching is presented in Table 1.

Table 1: Student sample frame (N=14,532)

<i>Variables</i>	<i>N</i>	<i>Percent</i>
<i>Name of the School</i>		
Fasiledes Secondary School	2001	13.7
Debark Secondary School	1604	11
Chilga Secondary School	2319	16
Dabat Secondary School	1709	11.8
Metema Secondary School	1481	10.2
Azezo Secondary School	2017	13.9
Maksegnit Secondary School	1891	13
Meqdela Secondary School	1510	10.4
<i>Grade Level</i>		
Grade 9	8472	58.3
Grade 10	6060	41.7
Total	14,532	100

As Table 1 reveals that of the total 132 science teachers, 18.2 percent and 12.1 percent were from Chilga Secondary School and Dabat Secondary in Chilga and Dabat Woreda respectively, 14.4 percent and 12.1 percent were from Fasiledes Secondary School and Debark Secondary School in Gondar Town and in Debark Woreda, 12.9 percent and 11.4 percent were from Azezo Secondary School in Gondar Town and Maksegnit Secondary School in Maksegnit Woreda, 10.6 percent were from Meqdela Secondary in Meqdela Woreda, and 8.3 percent were from Metema Secondary School in Metema Woreda, respectively.

Concerning, the major subject area of teaching, 42.4 percent science teachers majored in biology, 28.8 percent in chemistry and 28.8 percent in physics. The summary of the science

teachers' and school principals' years of teaching experience is presented in Table 2.

Table 2: Percentage distribution of the science teachers by name of school and major subject area of teaching (N=132)

<i>Variables</i>	<i>N</i>	<i>Percent</i>
<i>Name of the School</i>		
Fasiledes Secondary School	19	14.4
Debark Secondary School	16	12.1
Chilga Secondary School	24	18.2
Dabat Secondary School	16	12.1
Metema Secondary School	11	8.3
Azezo Secondary School	17	12.9
Maksegnit Secondary School	15	11.4
Meqdela Secondary School	14	10.6
<i>Major Subject Area of Teaching</i>		
Biology	56	42.4
Physics	38	28.8
Chemistry	38	28.8
Total	132	100

Data in Table 2 depicts that 24.8 percent of science teachers were between the service years range of 1-5 years, 28.6 percent were between the experience range of 6-10, and 18.4 percent were between the experience ranges of 11-15 years. The remaining respondents, 14.7 percent and 13.5 percent of science teachers were between the range of 16-20 and above 21 years of experience, respectively. Because qualified, experienced and knowledgeable teachers are significant for enhancing quality of teaching and learning of science, it creates the chance to share experience among them.

Moreover, regarding the service year of interviewees, 12.5 percent, twenty-five percent, 37.5 percent and twenty-five percent of the school principals have served 6-10, 11-15, 16-20 and above 20 years of work experience, respectively. This indicated that the school principals

were assigned from well-experienced teachers. Therefore, they are in a good position to critically identify the challenges encountered to promoting quality of teaching and learning of science. The summary of the secondary school students according to name of school and grade level is presented in Table 3.

The data revealed that of the total 650 lower secondary school students, sixteen percent and 11.7 percent were from Chilga Secondary School in Chilga Woreda and Dabat Secondary School in Dabat Woreda, 13.8 percent and thirteen percent were from Azezo Secondary School in Gondar Town and Maksegnit Secondary School in Maksegnit Woreda, 13.7 percent and 11.1 percent were from Fasiledes Secondary School in Gondar Town and Debark Secondary School in Debark Woreda, 10.5 percent were from Meqdela Secondary School in Meqdela Woreda, and 10.2 percent were from Metema Secondary School in Metema Woreda.

With regards to grade level, of the total 650 lower secondary school students, 58.3 percent were grade 9 students, whereas 41.7 percent were grade 10 students.

Teaching and Learning Strategies

The science teachers were asked for an estimate of time used for science teaching/learning activities in weekly science lessons. A summary of these data is presented in Table 4.

As Table 4 reveals that in weekly science lessons, on average, 76.7 percent of weekly science lesson time is devoted to teacher-centered activities (explanation, demonstration, whole-class discussion and giving notes) while only 23.3 percent of weekly science lesson time is devoted to student-centered activities (individual work, and small-group practical work).

Table 3: Percentage distribution of science teachers and school principals by year of teaching/work experience

<i>Variables</i>	<i>Science teachers (N=132)</i>		<i>School principals (N=8)</i>	
	<i>N</i>	<i>Percent</i>	<i>N</i>	<i>Percent</i>
<i>Year of Experience</i>				
5 years and below	33	24.8	-	-
6-10 years	38	28.6	1	12.5
11-15 years	24	18.4	2	25
16-20 years	19	14.7	3	37.5
Above 20 years	18	13.5	2	25
Total	132	100	8	100

Table 4: Percentage distribution of students by name of school and grade level (N=650)

<i>Variables</i>	<i>N</i>	<i>Percent</i>
<i>Name of the School</i>		
Fasiledes Secondary School	89	13.7
Debank Secondary School	72	11.1
Chilga Secondary School	104	16
Dabat Secondary School	76	11.7
Metema Secondary School	66	10.2
Azezo Secondary School	90	13.8
Maksegnit Secondary School	85	13
Meqdela Secondary School	68	10.5
<i>Grade Level</i>		
Grade 9	379	58.3
Grade 10	271	41.7
Total	650	100

Students were asked to estimate the amount of time they spent on each of five categories of teaching-learning activities in a typical weekly lesson. Students also indicated how often they engaged in various teaching-learning activities in a typical weekly lesson. The summaries of their responses are presented in Table 5.

Table 5: Teachers estimates of mean percentage time spent on various teaching-learning activities in weekly science lessons (N=132)

<i>Teaching and learning strategies</i>	<i>Mean percent</i>
Teacher explaining /or demonstrating to whole class	33.7
Whole class discussion	16.4
Teacher giving notes to students	26.6
Students working individually including working from the text	12.7
Students doing practical and activity in small groups	10.6

Table 5 reveals that above half of the total time devoted to teaching and learning in weekly science lessons was allocated to teacher explanations and demonstrations and note copying by the students. Twenty-one percent of the time is used to engage students in whole class discussion with the teacher while only thirteen percent of the weekly lesson time is used for students taking part in group practical activities. The students' rating of the frequency in which various teaching learning activities occur in science lessons is summarized in Table 6.

From the data in Table 6, students listen to the teacher explaining ideas all or most of the time (86.1%), copy notes all or most of the time (89.3%), and watch the teacher do an experiment

Table 6: Students estimates of average percentage of time allocated to various teaching-learning activities in weekly science lessons (N=650)

<i>Teaching and learning strategies</i>	<i>Mean percent</i>
Teacher explaining /or demonstrating to whole class	29.1
Whole class discussion	21
Notes copying	22.9
Students working individually including working from the text	14
Students doing practical and activity in small groups	13

all or most of the time (72.2%), and all or most of the time they follow the teacher's instructions in practical work (78%). However, fewer students indicated that they read the textbook and made their own notes (45.3%), carry out practical experiment on their own all or most of the time (49.9%) and only 40.1 percent indicated they planned their own experiment all or most of the time.

The frequencies of group work (44.2%) and discussion with other students (42.1%) were also quite low. In addition, about two-thirds of students believe that science deals with what they are concerned with (66.9%) but does not relate much to their life (38%). It could be inferred from this data that instruction is highly teacher-centered, students are passive listeners to teachers' instruction and there are limited opportunities for students to perform hands-on activities. Table 7 summarizes the amount of time spent estimated by teachers and students on different teaching learning strategies.

Data in Table 7 showed a strong agreement between teachers' and students' estimates of the amount of time spent on teaching-learning activities. Teachers indicated that about 33.7 percent of the weekly science lesson time was spent on explanation and demonstration to the whole class and the students gave estimate of about 29.1 percent of the lesson time. Teachers also indicated that they spent about 26.6 percent of the lesson time giving notes to students and this correlates with 22.9 percent of the lesson time estimated by students. In addition, teachers' estimates of about 12.7 percent of the lesson time spent on students working individually including working from text agrees with students' estimates of fourteen percent of the lesson time. Teachers' estimates that about 10.6 percent of the lesson time was spent on stu-

Table 7: Students rating of the frequency of various teaching-learning activities in science lessons (N=650)

<i>In my science class</i>	<i>Percent of responses AL+MT</i>	<i>Percent of responses NO+NE</i>
I listen to the teacher explaining ideas	86.1	5.6
I copy notes the teacher gives me	89.3	2.9
I read science textbooks and form my own notes	45.3	17.6
I watch the teacher do an experiment	72.2	11.1
I carry out science experiments	49.9	23.4
I follow instructions in practical work	78.0	9.1
We plan our own experiments	40.1	23.4
I work in groups with other students	44.2	20.0
I have class discussions with other students on various topics	42.1	13.1
I find science interesting to learn	75.9	5.5
I get excited about what we do in science	76.8	8.2
I am bored with the science we do in class	40.0	35.0
Science lessons deal with things I am concerned about	66.9	14.3
Science is not related to my life	38.0	46.1
I learn about scientists and what scientists do	61.3	13.0
I ask questions on what is not clear to me	60.0	7.2

Note: AL= All of the time; MT= Most of the time; NO= Not often; NE= Never

dents doing practical and activity in small groups further agrees with students’ estimates of thirteen percent of the lesson time spent on practical and activity work. However, there is a variation in the teachers’ estimates, which indicated that about 16.4 percent of the lesson time was spent on whole-class discussion as against students’ estimates of twenty-one percent of the lesson time.

Assessment Strategies

The questionnaire asked teachers to rate the relative importance/weightage for assessment strategies used in science with emphasis on the learning outcomes, strategies and purpose for assessments in teaching and learning activities. Table 8 presents a summary of teachers’ ratings of the average percentage weighting for assessment of various learning outcomes.

Table 8: Teachers and students estimates of the percentage of time spent on different teaching learning activities in weekly science lesson

<i>Teaching and learning strategies</i>	<i>Amount of time spent in percent</i>	
	<i>Teachers (N=132)</i>	<i>Students (N=650)</i>
Teacher explaining /or demonstrating to whole class	33.7	29.1
Whole class discussion	16.4	21
Teacher giving notes to students	26.6	22.9
Students working individually including working from the text	12.7	14
Students doing practical and activity in small groups	10.6	13

As Table 8 depicts that on average, science teachers gave a higher assessment weighting for understanding of science content (49.2% weighting) than for skills and processes (29.1%) and for attitudes (21.7%). Table 9 presents teacher’s average percentage weighting for various assessment strategies.

Data in Table 9 reveals that science teachers gave a higher assessment weighting to written tests and quizzes (56.1%) than to assignments/projects (20.3%) and for practical work (11%) or practical tests (12.6%). Table 10 presents teach-

Table 9: Average percentage weighting for assessment of various learning outcomes (N=132)

<i>What do you assess?</i>	<i>Mean percent</i>
Understanding of science content	49.2
Science skills and processes	29.1
Science attitudes	21.7

ers' mean percentage weightings for various assessment purposes.

Data in Table 10 revealed that science teachers gave a higher weighting to assessment for marking and reporting (52%) than for student feedback (27.4%) and for identifying students' misunderstandings (20.6%).

Table 10: Average percentage weighting for various assessment strategies (N=132)

<i>How do you assess?</i>	<i>Mean percent</i>
Tests, quizzes or examinations	56.1
Assignments/projects	20.3
Practical work	11
Practical tests	12.6

Factors Limiting the Quality of Teaching and Learning of Science

Teachers were asked what factors limited the quality of science teaching in their schools. The percentage of teachers mentioning each factor is listed in Table 11.

As depicted in Table 11, the six most important factors limiting the quality of teaching and learning of science mentioned by the respondents include insufficient teaching and learning resources, lack of well-equipped laboratories, poor students' attitude towards science, non-conducive classroom environment, insufficient time for teaching science and large class sizes. Teachers' lack of subject matter knowledge and

inadequate motivation were also mentioned as factors that limit the quality of teaching and learning of science.

Table 11: Average percentage weighting for various assessment purposes (N=132)

<i>Why do you assess?</i>	<i>Mean percent</i>
For marking and reporting	52
For student feedback on their learning	27.4
For identifying students' misunderstanding	20.6

Suggestions for Improving the Quality of Teaching and Learning of Science

Finally, the questionnaire asked science teachers to suggest various strategies for improving the teaching and learning of science. Table 12 provides a summary of the various suggestions given by teachers.

As Table 12 depicts that the most common suggestions for improving science teaching and learning by the respondents include providing more or better equipment and facilities (81.3%), better curriculum resources (76.5%), need for students to develop interest and better attitudes towards science (58.9%), improved maintenance of classrooms (50.6%), need for better quality science textbooks for students and in school library (46.3%), additional funding for new laboratories and classrooms (40.6%), more and better timing for science in the school timetable

Table 12: Factors limiting the quality of secondary science teaching

<i>Factors</i>	<i>N</i>	<i>Percent</i>
<i>Resources</i>		
Insufficient teaching resources including equipment, textbooks, specimens, charts		
Lack of well-equipped laboratory	123	93.4
Non-conducive classroom environment	108	81.6
Large class size	91	68.7
Lack of funds for school building and maintenance	64	48.3
Insufficient time for teaching science	49	37
<i>Teachers</i>		
Teachers' lack of subject matter knowledge	19	14.5
Inadequate teachers' motivation	17	12.9
Lack of professional development for teachers	21	16.2
Insufficient qualified and dedicated teachers	15	11.4
<i>Support</i>		
Lack of support from school administrators, parents and community	14	10.6
Poor remuneration and irregular payment of salary	12	8.9
<i>Curriculum and Pedagogy</i>		
Overloaded science curriculum	16	12.1
Poor teaching skills and approaches	13	9.8
<i>Student</i>		
Poor students' attitude to science	101	76.8
Students' poor communication skills	12	9

(37.9%), employing more qualified and dedicated science teachers (30.5%), more professional development programs for teachers (28.5%), and need for regular assessments and feedback for students (26.6%).

Students were also asked to respond to the item about what do they suggest to improve the quality of teaching and learning of science. Summaries of students' responses are presented in Tables 13.

Many science teachers made more than one suggestion for improving the quality of teaching and learning of science. The 132 science teachers made a total of 751 suggestions for improvement.

Many students made more than one suggestion for improving the quality of teaching and learning of science. The 650 students made a total of 1489 suggestions for improvement.

The four most common suggestions for improving science were sufficient science facilities and equipment (57.2%), more student group work (47.5%), having qualified, competent and interested teachers (38.3%), and students being actively engaged in learning (31.6%).

Suggestions for improving science teaching and learning mentioned by teachers and students are compared in Table 14.

Data in Table 14 reveals that the most common suggestions by teachers for improving the

Table 13: Percentage of students mentioning various strategies to improving the quality of teaching science (N=650)

<i>The study of science can be improved when.....</i>	<i>N</i>	<i>Percentage</i>
<i>Resources</i>		
Resources for learning are available (laboratories, science facilities, equipment, access to textbooks)	372	57.2
There is a conducive school environment (not noisy, well ventilated, good lighting system, and not polluted)	55	8.4
Students have their own materials to study at home (textbooks, writing materials, charts)	40	6.1
<i>Teachers</i>		
There are good teachers (qualified, competent and interested)	249	38.3
Teachers use good teaching approaches (from simple to complex, discuss new ideas and demonstrates)	52	8
Teachers are friendly and respond to students problems	35	5.4
<i>Curriculum and Pedagogy</i>		
Students do group work (assignments, practical and projects)	309	47.5
Students are engaged in learning (being attentive, reading notes, doing homework, carrying out own observation, asking and responding to questions)	205	31.6
Students engage in career talks, field trips, excursions, and science clubs	46	7.1
Science is related to the learners environment using concrete examples	31	4.8
Tutorials and extra lessons are organized for students	37	5.7
More time is allotted to science teaching-learning	37	5.7
<i>Community Support</i>		
Society is educated more about the importance of science (orientation and awareness about science)	21	3.2

Table 14: Percentage of teachers and students mentioning various strategies for improving the quality of teaching science education

<i>Category</i>	<i>Suggestions for improving science in percent</i>	
	<i>Teachers (N=132)</i>	<i>Students (N=650)</i>
<i>Resources</i>		
Provision of resources and equipment	81.3	57.2
Improved maintenance of classroom	50.6	8.6
<i>Teachers</i>		
Employing more qualified and dedicated teachers	30.5	38.3
<i>Curriculum and Pedagogy</i>		
Need for more and better timing for science in the school timetable	37.9	5.7
Need to engage students in hands-on activities	12.4	47.5

teaching and learning of science include provision of resources and equipment (81.3%), improved maintenance of classroom (50.6%) and create more and better timing for science in the school timetable (37.9%). However, 38.3 percent of the students suggested that more qualified and dedicated science teachers should be employed and that they need to engage in hands-on activities (47.5%).

DISCUSSION

The primary purpose of this study was to explore the quality of secondary science teaching and learning in North Gondar Region. Specifically, the study emphasized on the teaching learning methods in science, the assessment strategies in science, the factors that hinder the quality of teaching and learning of science, and strategies to improve the quality of teaching and learning of science.

The entire population of 132 science teachers was surveyed, and all completed and returned questionnaires. The distribution of teachers was according to name of school and major subject area of teaching. Of the total 132 science teachers, 18.2 percent and 12.1 percent were from Chilga Secondary School and Dabat Secondary in Chilga and Dabat Woreda respectively, 14.4 percent and 12.1 percent were from Fasiledes Secondary School and Debark Secondary School in Gondar Town and in Debark Woreda, 12.9 percent and 11.4 percent were from Azezo Secondary School in Gondar Town and Maksegnit Secondary School in Maksegnit Woreda, 10.6 percent were from Meqdela Secondary in Meqdela Woreda, and 8.3 percent were from Metema Secondary School in Metema Woreda, respectively. Concerning, the major subject area of teaching, 42.4 percent science teachers majored in biology, 28.8 percent in chemistry and 28.8 percent in physics.

The data depicted that 24.8 percent of science teachers were between the service years range of 1-5 years, 28.6 percent were between the experience range of 6-10 and 18.4 percent were between the experience ranges of 11-15 years. Of the remaining respondents, 14.7 percent and 13.5 percent of science teachers were between the range of 16-20 and above 21 years of experience, respectively. Because qualified, experienced and knowledgeable teachers are significant for enhancing quality of teaching and

learning of science, it creates the chance to share experience among them.

Moreover, regarding the service year of interviewees, 12.5 percent, twenty-five percent, 37.5 percent and twenty-five percent of the school principals have served 6-10, 11-15, 16-20 and above 20 years of work experience, respectively. This indicated that the school principals were assigned from well-experienced teachers. Therefore, they are in a good position to critically identify the challenges encountered to promote quality of teaching and learning of science.

The data revealed that of the total 650 lower secondary school students, sixteen percent and 11.7 percent were from Chilga Secondary School in Chilga Woreda and Dabat Secondary School in Dabat Woreda, 13.8 percent and thirteen percent were from Azezo Secondary School in Gondar Town and Maksegnit Secondary School in Maksegnit Woreda, 13.7 percent and 11.1 percent were from Fasiledes Secondary School in Gondar Town and Debark Secondary School in Debark Woreda, 10.5 percent were from Meqdela Secondary School in Meqdela Woreda, and 10.2 percent were from Metema Secondary School in Metema Woreda.

With regards to grade level, of the total 650 lower secondary school students, 58.3 percent were grade 9 students, whereas 41.7 percent were grade 10 students.

Teaching and Learning Strategies

The science teachers were asked for an estimate of time used for science teaching/learning activities in weekly science lessons revealed that in weekly science lessons, on average, 76.7 percent of weekly science lesson time is devoted to teacher-centered methods (explanation, demonstration, whole-class discussion and giving notes) while only 23.3 percent of weekly science lesson time is devoted to student-centered methods (individual work, and small-group practical work).

Students were asked to estimate the amount of time they spent on each of five categories of teaching-learning methods in a typical weekly lesson. Students also indicated how often they engaged in various teaching-learning methods in a typical weekly lesson reveals that above half of the total time devoted to teaching and learning in weekly science lessons were allocated to teacher explanations and demonstrations

and note copying by the students twenty-one percent of the time is used to engage students in whole class discussion with the teacher while only thirteen percent of the weekly lesson time is used for students taking part in group practical activities.

From the data, students listen to the teacher explaining ideas all or most of the time (86.1%), copy notes all or most of the time (89.3%), and watch the teacher do an experiment all or most of the time (72.2%), and all or most of the time they follow the teacher's instructions in practical work (78%). However, fewer students indicated that they read the textbook and made their own notes (45.3%), carry out practical experiment on their own all or most of the time (49.9%) and only 40.1 percent indicated they planned their own experiment all or most of the time.

The frequencies of group work (44.2%) and discussion with other students (42.1%) were also quite low. In addition, about two-thirds of students believe that science deals with what they are concerned with (66.9%) but does not relate much to their life (38%). It could be inferred from this data that instruction is highly teacher-centered, students are passive listeners to teachers' instruction and there are limited opportunities for students to do hands-on activities.

Data showed that strong agreement between teachers' and students' estimates of the amount of time spent on teaching-learning activities. Teachers indicated that about 33.7 percent of the weekly science lesson time was spent on explanation and demonstration to the whole class and the students gave estimate of about 29.1 percent of the lesson time. Teachers also indicated that they spent about 26.6 percent of the lesson time giving notes to students and this correlates with 22.9 percent of the lesson time estimated by students. In addition, teachers' estimates of about 12.7 percent of the lesson time spent on students working individually including working from text agrees with students' estimates of fourteen percent of the lesson time. Teachers' estimate that about 10.6 percent of the lesson time was spent on students doing practical and activity in small groups further agrees with students' estimates of thirteen percent of the lesson time spent on practical and activity work. However, there is a variation in the teachers' estimates, which indicated that about 16.4 percent of the lesson time was spent on whole-class discussion as against students'

estimates of twenty-one percent of the lesson time.

Assessment Strategies

The questionnaire asked teachers to rate the relative importance/weighting for assessment strategies used in science with emphasis on the learning outcomes, strategies and purpose for assessments in teaching and learning activities depicted that on average, science teachers gave a higher assessment weighting for understanding of science content (49.2% weighting) than for skills and processes (29.1%) and for attitudes (21.7%).

Data revealed that science teachers gave a higher assessment weighting to written tests and quizzes (56.1%) than for assignments/projects (20.3%) and for practical work (11%) or practical tests (12.6%). Data revealed that science teachers gave a higher weighting to assessment for marking and reporting (52%) than for student feedback (27.4%) and for identifying students' misunderstanding (20.6%).

Factors Limiting the Quality of Teaching and Learning of Science

Teachers were asked what factors limited the quality of science teaching in their schools depicted that the six most important factors limiting the quality of teaching and learning of science mentioned by the respondents include insufficient teaching and learning resources, lack of well-equipped laboratories, poor students' attitude to science, non-conducive classroom environment, insufficient time for teaching science and large class sizes. Teachers' lack of subject matter knowledge and inadequate motivation were also mentioned as factors that limit the quality of teaching and learning of science.

Suggestions for Improving the Quality of Teaching and Learning of Science

Finally, the questionnaire asked science teachers to suggest various strategies for improving the teaching and learning of science depicted that the most common suggestions for improving science teaching and learning by the respondents include providing more or better equipment and facilities (81.3%), better curriculum resources (76.5%), need for students to de-

velop interest and better attitudes in science (58.9%), improved maintenance of classrooms (50.6%), need for better quality science textbooks for students and in school library (46.3%), additional funding for new laboratories and classrooms (40.6%), more and better timing for science in the school timetable (37.9%), employing more qualified and dedicated science teachers (30.5%), more professional development programs for teachers (28.5%), and need for regular assessments and feedback for students (26.6%).

Students were also asked to respond to the item about what do they suggest improving the quality of teaching and learning of science many students made more than one suggestions for improving the quality of teaching and learning of science. The 650 students made a total of 1489 suggestions for improvement. The four most common suggestions for improving science were sufficient science facilities and equipment (57.2%), more student group work (47.5%), having qualified, competent and interested teachers (38.3%), and students being actively engaged in learning (31.6%).

CONCLUSION

Based on the findings, the following conclusions were drawn.

- ♦ In teaching science lessons, teacher-centered activity predominates and there is less frequent independent student practical works.
- ♦ Written tests and quizzes are the most commonly used assessment strategy and assessment is mainly used for summative purposes of marking and reporting.
- ♦ Important factors the respondents mentioned that limit the quality of science teaching and learning include insufficient funding in science, lack of teaching resources and qualified, dedicated and knowledgeable teachers.
- ♦ Furthermore, low status of teaching profession in the community, inadequate teachers' salaries and allowances, lack of motivation and opportunities for ongoing professional learning for teachers, lack of collaboration of teachers with colleagues and experts on curriculum materials and policy, low morale and attitude to work and lack of teachers' commitment

to the profession also limit the quality of science teaching and learning

RECOMMENDATIONS

Based on the findings and conclusions drawn the following recommendations were forwarded.

- ♦ For science teacher to remain professionally competent, pre-service training alone cannot be enough. A continuous professional development needs to be put in place to help science teachers become perpetual learners and effectively perform their day-to-day professional tasks.
- ♦ Science teachers should be equipped with the various strategies for conducting inquiry-based teaching and formative assessment practices through ongoing training
- ♦ The management of secondary schools is advised to try and equip their schools with necessary science facilities through mobilizing local communities.
- ♦ To alleviate the class-size related problems, it is recommended that Woreda Education Office and school officials in collaboration with NGOs and other voluntary partners build extra classroom.
- ♦ Finally, to better address the problems, and obtain representative finding North Gondar Regional State, further studies need to be conducted by incorporating secondary schools found in rural areas.

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