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Challenges and Prospects of Science Education: A Study of Middle Level Schools in Southern Ethiopia

Juneidi Hussen[1*], **Milkiyas Asso**[2], **and Abduljewad Kurkura**[3]

[1,2]Department of Curriculum and Instructional Supervision, Dilla University, Dilla, Ethiopia
[3]Department of Educational Planning and Management, Dilla University, Dilla, Ethiopia

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Abstract

This study looked at the challenges and prospects of science education in middle-level schools in Southern Ethiopia. A mixed-methods research was used, which included classroom observations, interviews made to supervisors, and surveys given to students, teachers, and principals. Results showed that teachers are not properly utilizing classroom instructions. Moreover, there are challenges in science teaching caused as a result of large class size, limited in-service teacher training, and lack of instructional materials, insufficient laboratory materials, and theory-loaded instructional methods. The study concludes that while some prospects exist due to policy emphasis on science education, systemic challenges hinder its effective implementation. Recommendations are made to improve resource allocation, teacher capacity building, and to strengthen science education in the region.

1 Introduction

Through the process of constant pursuit of knowledge, science education uses different educational theories (learning), which are based on philosophical, social and psychological aspects of the study. This helps in the development of intellectual and psychological motor faculties through certain techniques such as close observation, deductions and empirical studies (Igbaji *et al*. 2017). This theory helps to combine educational and scientific factors to make the scientific learning process easy for individuals not belonging to the scientific community. In the area of science and technology, advancement of any nation is highly dependent on science education (Sani *et al*., 2019). With proper development, it can act as a catalyst for educating people, creating public awareness, values and behaviors that are necessary for sustainable development of human beings. Science education consists of three major subjects, biology, chemistry and physics (Badmus and Omosewo, 2018).

Around the world, science education is seen as a cornerstone of innovation, technological advancement, and sustainable development (UNESCO, 2021). As a catalyst for national development, the Ethiopian government has made science education one of the top priorities (MoE, 2022). Notwithstanding the policy's priority, there are still difficulties in effectively teaching science education in middle-level schools, especially in Southern Ethiopia's resource-constrained areas. Science education in middle-level schools is critical for fostering inquiry skills, problem-solving ability, and favorable attitudes toward science at a young age (World Bank, 2021). However, in Ethiopia, middle-level schools frequently experience laboratory shortages, limited instructional materials, and inadequately prepared teachers (Semela, 2020; Tesfaye & Abate, 2022). Furthermore, language variety in the southern region hampers science education, since many children must learn science in Amharic or English rather than their native language (Ayalew, 2024).

*Corresponding Author; Email: hjuneidi18@gmail.com;
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These problems highlight the necessity for rigorous research into the challenges and opportunities of science education in primary schools.

In our current time period, there is a dominance of science and technology, and hence, it becomes necessary for every individual to be aware of and implement scientific knowledge in daily life. For the accomplishment of this goal, there should be a strategy to teach science in schools. Hence, the importance of science education lies in the fact that it helps create an overall understanding of science for people through their entire life span. According to Jablon (2020), science education refers to the dissemination of scientific knowledge and processes to people who are normally not regarded as a part of the scientific community. It also emphasizes that the target audience may be children, college students, and adults in general. Middle school teachers are responsible for teaching students different subjects, including science. Scientific teaching is a collective process that involves having knowledge of scientific knowledge and how students learn science. Upon considering this aspect, teachers realize their importance in science education of students (Garraway-Lashley, 2019).

The success of the implementation of the science programme can be influenced by a number of factors, including the compatibility of the curriculum and teaching approaches, as well as the resources that will support teachers (Michael *et al*., 2023). Teaching approaches employed in the area are among the important elements that determine how much of the curriculum is implemented. But there are a lot of teachers in secondary schools who view science teaching as a challenging activity (Garraway-Lashley, 2019).

Although Ethiopia has proposed ambitious educational reforms, such as increasing science and technology learning in the Education Sector Development Programme VI (2021/22-2025/26) (MoE, 2022), the realities in intermediate-level schools remain dismal. Previous studies have shown that classrooms are frequently overcrowded, laboratory facilities are scarce, and many teachers lack adequate professional training in science pedagogy (Semela, 2020; Yohannes & Alemu, 2023). According to Belay (2018), laboratories, textbooks, and qualified teachers are still in short supply, undermining effective science instruction. Most classes still use rote memorization instead of inquiry-based or hands-on learning. Overcrowded classes, a lack of in-service teacher training, and insufficient resource allocation, particularly in rural regions, exacerbate the issue. Furthermore, language difficulties, which occur when children learn science in Amharic or English rather than their mother tongue, contribute to the difficulty of comprehension.

Several studies in Ethiopia have highlighted numerous difficulties in the efficient implementation of science education. Sbhatu (2021) found several important concerns, including outmoded pedagogical approaches, insufficient teacher preparation, and a mismatch between educational policies and practical classroom reality. These obstacles contribute to a considerable disparity between what is expected and what is accomplished in middle school science teaching. Despite these stated issues, there is a significant lack of concentrated study on middle-level science teaching in Ethiopia. Only a few empirical studies focus on middle-level schools, while most research focuses on secondary and post-secondary education (Mekonnen & Fisseha, 2021). The research by Tadesse (2014) offers valuable information regarding the resourcefulness and active learning techniques, but lacks an examination of the entire process of the classroom teaching of science. This gap is critical in the sense that it hinders the development of a holistic view of the difficulties encountered and how to solve them. There are several other research papers that have been done on various aspects related to this problem such as the current status of science education, lab practical sessions, and matching of the proposed courses to the actual courses undertaken (Michael, 2023; Nsengimana, 2020; Bichi, 2017).

This study seeks to investigate the problems and possibilities of science teaching in secondary schools in southern Ethiopia, based on the research questions below:

1. How is the classroom teaching approach applied in secondary science teaching?
2. What are the problems that affect the effectiveness of science teaching in secondary schools?

3. Are there any differences between the teaching approaches of seventh grade and eighth grade teachers in primary schools?

2 Review of Related Literature

2.1 Challenges in teaching Science Education

Education can never be achieved without teachers in every nation of the world. Teaching strategies are the ways in which teachers deliver their lessons and make learning experiences realistic to learners. Teachers are very crucial for quality education, and teachers' teaching strategies define professionalism among teachers (Okoli *et al*., 2013).

Science education in Ethiopia has systemic challenges such as insufficient teacher preparation, limited professional development, and curriculum overload (Yohannes & Alemu, 2023; MoE, 2022). Language diversity affects learning since pupils are frequently instructed in languages they do not understand (Ayalew, 2024). These variables all contribute to inefficient scientific instruction and low student performance. Overcrowded classrooms, linguistic barriers, a lack of instructional materials, and insufficient teacher preparation are all major difficulties (World Bank, 2021). In other areas, multilingualism creates extra challenges because children may learn science in a second or third language.

Other difficulties in science education learning may arise from lack of infrastructure. Most schools in Africa do not have enough laboratories or they lack the laboratory facilities to offer quality education to the students who are legally entitled (Dike *et al*., 2015). The difference is that of traditional classroom lessons and laboratory classes. In the laboratory, the students are actively involved in intensive learning processes through various techniques used in the laboratory. The practical processes not only engage the students to learn more about science but also involve the students in the process of knowledge construction, questioning, hypotheses, or problems in small groups or individually. The hands-on approach makes use of scientific materials to assist students to construct their own theories on scientific phenomena (Pareek, 2019).

There is need for more funding in the field of scientific education. Many schools in Africa do not have well-equipped workshops, laboratories, and libraries because of lack of money in education (Nwangwu, 2014). The shortage of money negatively impacts the availability of needed facilities, infrastructure, and competent scientific teachers (Sani and Ikpe, 2019). Financial shortages in science education create a negative educational environment that leads directly to the low quality of science education (Okoli *et al*., 2013). Shortage of appropriate educational facilities such as laboratories, libraries, and science kits is one of the key problems in Ethiopian schools (Tesfaye and Abate, 2022; World Bank, 2021). According to UNESCO, scientific education needs practice, but many Ethiopian schools do not have even basic facilities.

2.2 Prospects of Science Education

Because of problems like bad governance, corruption, and unfavorable environmental factors, the likelihood of African countries being able to promote science education is almost nonexistent, and all these factors have an impact on the quality of science education services (Aeni, 2021). In spite of the problems that hinder the development of science education, some of the expectations are mentioned below. The Ethiopian Government has been prioritizing STEM programs, attracting donors and boosting enrollment in order to create opportunities. However, there is still no full implementation due to implementation gaps (MOE, 2020).

Notwithstanding the present day backwardness of Africa in matters relating to science and technology, the Government of Africa, in the future, may consider increasing efforts to promote scientific education, which is essential for the development of the digital age in the 21^{st} century. Information and Communications Technology (ICT) comprises inventions and innovations made in advanced sciences including information science, communications, space science and aeronautics, biotechnology, medical science, and so forth. Consequently, educational institutions have to be prepared for the task. For instance, whereas South Korea, the United States and China have been producing smartphones for more than ten years, Rwanda has now produced

its first smartphone domestically (Monks, 2019).

Many obstacles exist in the health care system of Africa. According to the World Health Organization (2019), not only does effective dissemination of scientific education help in creating good scientists who can make vaccines and drugs for the locals, but also helps the masses understand the prevention and treatment of diseases. In addition to this, Africa is the largest food deficit region of the world where almost 20 percent of people are affected (FAO, 2019).

Various natural disasters have hindered food production in Africa. Science education can help one understand how to get ready for dangerous weather events and how to operate mechanized equipment in cultivation, planting, and harvesting processes using agricultural science knowledge. Employers in Africa view a lack of adequately skilled workers as a major challenge for their firms. These include 41 per cent of Tanzania's businesses, 30 per cent of Kenya, 9 per cent of South Africa and 6 per cent of Nigeria. Nowadays, a majority of the necessary skills that will be required by 2020 for all kinds of jobs will be completely different owing to the unstable nature of these skills as many jobs on the continent depend on the use of digital technologies. Occupations in Africa are digitalizing in different sectors such as creative industries, designers, food technologists, data analysts, educators, and health workers. Consequently, the skills that will be necessary in Africa in the near future are greatly influenced by science education.

3 Methodology

3.1 Research Design

This research employs the mixed methods approach to research. According to Cohen *et al.* (2018), mixed methods research acknowledges and appreciates the fact that the world is inherently a mixture of the quantitative and qualitative parts of reality even though it may sometimes be discovered that there is a trend or necessity of numbers or qualitative data. The research used a convergent parallel triangulation design, which is important for integrating the findings from the data and interpreting the challenges and opportunities in secondary science education. Mixing of the quantitative and qualitative datasets is appropriate for study (Mertler, 2017).

3.2 Sample Size and Sampling Techniques

The research involved 453 respondents, which included both students and teachers as well as school supervisors and directors from the Regional Education Bureau. Out of the number, 444 respondents including 319 students, 83 science teachers and 42 teachers took part in the survey. Additionally, 9 key informant interviewers from the Education Office in the Gedeo, Gamo and Halaba regions took part in the key informant interviews. Random sampling methods were employed in order to choose the sample participants as well as stratified sampling methods using a single population percentage formula.

3.3 Methods of Data Collection

The data were gathered through different methods such as questionnaires, interviews, and observation lists. Similar content questionnaires were used for teachers and principals in science education and modified forms were used for the students. Interview was done for the experts in the Department of Educational Affairs. Questionnaire was designed by the researchers and its validity was proved through the comprehensive review by the experts in the field, which led to modification in some of the items. Pilot tests were conducted for the reliability of the questionnaire through small samples using Cronbach's alpha. Altogether, 53 students, 13 science teachers, and 10 non-test teachers participated in the pilot test randomly based on their readiness to take part in the test. Finally, Cronbach's alpha was computed to test the reliability of the instrument with 0.807 accuracy.

Prior to administering the questionnaires to gather quantitative data, all respondents were briefed on ethical considerations and the study's objectives. To collect qualitative data, unstructured interview guides were employed with 9 supervisors from the three zones education offices with each interview lasting approximately 30 minutes. Moreover, observation was employed twice to observe teachers' utilization of classroom instruction.

3.4 Methods of Data Analysis

There were 453 respondents involved in the research consisting of students, science teachers, school principals and supervisors from zonal education offices. Among these, 444 people (including 319 students, 83 science teachers and 42 principals) completed the questionnaire survey. Apart from these, 9 supervisors from the education offices of the Gedeo, Gamo and Halaba zones were interviewed as key informants.

The data were analyzed by employing quantitative and qualitative methods of analysis according to the characteristics of the collected information. For analyzing data collected from the closed questionnaires, the answers were counted and analyzed descriptively by using measures such as frequency, percentages and means. In addition to the above, an independent sample t-test was used as an inferential statistic in order to establish whether there are statistically significant differences between Grade 7 teachers and Grade 8 teachers' use of classroom instructions in middle-level schools in Southern Ethiopia. The statistical tests conducted on the quantitative data were done using the Statistical Package for Social Sciences (SPSS) Version 27. Qualitative data obtained from the interviews, open-ended questionnaire and observations were analyzed narratively. Participants of the study were recruited randomly and through stratified sampling technique based on a single population percentage formula while Key informant interview participants were chosen through purposive sampling to ensure they possessed relevant expertise.

3.5 Ethical Consideration

The research obtained approval from relevant institutional bodies to safeguard participants' rights, well-being, and dignity. At first, the study secured research ethical clearance of the Dilla University. Then, the study sought the permission of Zone Education offices and District education offices before proceeding with data collection in the field. Before participation in the study, the intended participant teachers received comprehensive explanations about the study's objectives and measures to assure their confidentiality. Then, the participants were requested to participate freely by signing a consent form. As per the opinions of Cohen *et al*. (2018), these measures fostered trust and honesty of the data collected.

4 Results and Discussions

4.1 Demographic characteristics of the Teachers and Principals

The study had 125 participants, including 83 science teachers and 42 school principals. Table 1 shows that 98 respondents (78.4%) were male, with 63 science teachers and 35 principals, while 27 respondents (21.6%) were female, with 20 science teachers and 7 principals. In terms of age, 69 respondents (55.2%) were between the ages of 31 and 35, 40 (32.0%) between the ages of 26 and 30, and 10 (8.0%) between the ages of 36 and 40, with only 6 (4.8%) being under the age of 25. In terms of educational qualifications, 102 of the participants (81.6%) possessed degrees, while 23 (18.4%) earned diplomas. Based on work experience, 83 respondents (66.4%) reported having 11 to 15 years of teaching or leadership experience. On the other hand, only five individuals (4.0%) had less than six years of experience. This shows that many science teachers and administrators possess the educational skills necessary for teaching and administration of the secondary schools according to the Ethiopian Education and Training Policy (2023). The maturity and competency of these individuals can be used to deal with the educational problems of the area and make the scientific education program appropriate for the learners.

Table 1: General profile of the teachers and principals

S. No.	Items		Teachers		Principals		Total	
			F	%	F	%	F	%
1	Sex	Male	63	75.9	35	83.3	98	78.4
		Female	20	24.1	7	16.7	27	21.6
		Total	83	100	42	100	125	100
2	Age	Below 26	6	7.2	-	-	6	13.0
		26-30 years	40	18.9	-	15.4	16	17.4
		31-35 years	37	56.6	32	48.7	49	53.3
		36- 40 years	-	1.9	10	35.9	15	16.3
		Total	83	100	42	100	125	100
3	Educational Background	Diploma	23	27.7	0	-	23	18.4
		Degree	60	72.3	42	100	102	81.6
		Total	83	100	42	100	125	100
4	Work experience	Below 6 years	5	6.0	0	-	5	4.0
		6-10 years	18	21.8	0	-	18	14.4
		11-15 years	53	63.8	30	71.4	83	66.4
		16-20 years	7	8.4	12	28.6	19	15.2
		Total	83	100	42	100	125	100

f=frequency; % = percentage

4.2 Utilization of Classroom Instruction

4.2.1 Teachers' and principals' responses

The first research question was addressed by calculating the mean ($\bar{x}$) of respondents' agreement on classroom instruction utilization across different items (refer to Table 2). In general, the mean is an effective statistic (Cohen *et al*., 2018).

From Table 2, one can see that in intermediate schools in Gedeo, Gamo and Halaba, the practice of instructional planning is sometimes employed ($\bar{x}$ = 3.08). In terms of the preparation of learning plan, it is important for the provision of good learning experience. Moreover, from the interviews with the experts of curriculum in education bureau, it is found that "some teachers in schools have practiced explaining the objectives of lesson to their students; planning and following teaching plan during lesson". The purpose of teaching ($\bar{x}$ = 3.11) was occasionally used in those middle schools.

Findings from observations made in science lessons indicate that most lessons sometimes begin with an introduction of its objectives. Findings from the interviews revealed that many teachers do not share with the students the objectives of education, while a few reveal the objective of the lesson. As the objective indicated in the teaching materials is supposed to be for the benefit of learners, learners should know about them so as to know the path of their learning. Moreover, learners will be more interested in learning when they know what they will be doing at the beginning of the class. In Gedeo, Gamo and Halaba, a prepared teaching plan was sometimes used in lesson instruction ($\bar{x}$ = 2.93). From the findings of the interview, it is evident that whereas there are some teachers who have made an effort to make and implement teaching plans, there are many teachers who have prepared their teaching plans but have failed to implement them effectively in class. This observation is also true in light of the fact that despite teachers preparing their teaching plans in the right format, the implementation of these plans effectively in the process of teaching has failed. Lack of proper preparation and implementation of the curriculum impacts negatively on the teaching and learning process as a whole due to

the importance of effective curriculum preparation and communication of objectives.

In addition to this, the intermediate schools in the Gedeo, Gamo and Halaba zones have been found to apply the new content as a continuation of the previous one ($\bar{x}$ = 3.01) taking into consideration the students' learning style while teaching lessons. However, taking into consideration the students' learning style has many advantages for both teachers and students. In this respect, Sitotaw and Tadele (2016) stressed that there could be many benefits in changing the teaching style according to the learning styles of students. In addition, classroom observations revealed that teachers usually ignore the students' learning styles.

Furthermore, the data gathered from classroom observations showed that teachers failed to take the students' learning preferences into account. The supervisors who participated in the interviews indicated that different instructional methods must be used to teach science education in a way that every student can have the opportunity to learn. Other students may be excluded if teachers just use one approach. This showed that, despite the fact that it influences how the science instruction is practiced, middle school science teachers did not consider the learning preferences of their students or how to incorporate new material with existing knowledge. This result supports that of Tadesse (2014), who found that many teachers find it difficult to modify their instruction to suit a variety of learning preferences.

When it came to teaching, middle-level schools in the Gedeo, Gamo, and Halaba zones occasionally used appropriate instructional materials ($\bar{x}$ = 3.06). In a similar vein, the supervisors who were interviewed stated that most teachers did not use instructional materials when delivering science lessons, despite the fact that instructional materials were important and necessary tools for teaching and learning science to increase teacher effectiveness and enhance students' performance in science. All things considered, the results highlight a significant discrepancy between the acknowledgement of the value of instructional tools and their actual use in the classroom. According to Tadesse (2014), instructional materials are acknowledged as crucial resources to enhance teaching effectiveness and students' achievement in science education, but their actual use in classrooms is limited. On the other hand, with respect to giving homework, assignments, and classwork to students and giving feedback on students' learning, the mean values were ($\bar{x}$ = 3.17) and ($\bar{x}$ = 2.87) respectively, indicating that giving homework, assignments, classwork to students and giving feedback on students' learning were sometimes employed in middle-level schools of the three zones. This suggests that these practices were occasionally used in middle-level schools in the Gedeo, Gamo, and Halaba zones. Additionally, the findings of the observations made in the classroom showed that teachers do not engage students in performing activities or tasks. Furthermore, the use of suitable instructional materials was uncommon, according to discussions with supervisors.

Moreover, science teachers do not provide timely feedback for students' work. The failure in providing feedback to the students is one of the greatest problems in the learning-teaching process. It corroborates with the research conducted by Afework and Asfaw (2014), which pointed out that there was a lack of feedback in the education process. In middle schools in the zones of Gedeo, Gamo and Halaba, the habit of linking theory with practice ($\bar{x}$ = 2.94) has been sometimes used. Likewise, in those schools, the guidance of students to conduct experiments ($\bar{x}$ = 3.03) has also been sometimes observed. Despite the need for practical activities for developing knowledge and understanding of scientific concepts, the findings indicate that the practical activities have not been conducted systematically. Abdulbasit found in 2017 that teachers lacked the necessary skills and motivation to engage students in practical experiments.

Similarly, middle-level schools in the Gedeo, Gamo, and Halaba zones occasionally used student-centered teaching techniques ($\bar{x}$ = 2.96). Additionally, it was discovered through the interviews with supervisors that science teachers occasionally employ student-centered teaching strategies. Furthermore, the data gathered from classroom observations demonstrates that science teachers employ conventional teacher-centered teaching techniques despite the fact that several instructional strategies are recommended for use in syllabuses and teacher manuals.

Table 2: Teachers' and Principals Responses Regarding the Utilization of Classroom Instruction

Items	Teachers		Principals		Total	
	No.	Mean	No.	Mean	No.	Mean
Prepare instructional plans	83	3.4	42	2.75	125	3.08
Explain objectives of the lesson to their students	83	3.32	42	2.89	125	3.11
Implement the instructional plans in delivering the lesson	83	3.41	42	2.48	125	2.95
Consider students' learning styles in lesson delivery	83	3.51	42	2.54	125	3.03
Connect the new content with the previously learnt content	83	3.2	42	2.82	125	3.01
Use appropriate instructional materials whenever necessary	83	3.43	42	2.7	125	3.06
Give homework, assignments and class work to students	83	3.58	42	2.76	125	3.17
Give feedback on students learning	83	3.5	42	2.24	125	2.87
Teach by relating theoretical concepts with real life situations	83	3.52	42	2.36	125	2.94
Instruct and guide students to do experiments	83	3.12	42	2.94	125	3.03
Apply student centered teaching methods	83	3.32	42	2.6	125	2.96

*Level of Utilization: [(1.00 - 1.80= not employed); (1.81 - 2.60 = rarely employed); (2.61 - 3.40 = sometimes employed), (3.41-4.20 = often (usually employed) and (4.20 -5.00 = regularly employed)]

In general, even though the use of classroom teaching has been quite successful, there are still some important inadequacies that need to be addressed in terms of the consistency of the methods used for teaching, the process of giving feedback and inclusion of practical lessons.

4.2.2 Students' Responses

As seen from Table 3, the students' answers show that there are some learning strategies that are hardly applied in secondary schools of the Gedeo, Gamo, and Halaba zones. In particular, the objective of the lesson was explained ($\bar{x}$ = 2.57), the learning style of the student during the lesson was considered ($\bar{x}$ = 2.27), and new material was related to previous experience ($\bar{x}$ = 2.28), and this was hardly done. Thus, it can be said that teachers in elementary schools rarely explain the lesson objectives properly, do not pay proper attention to the learning style of the student and integrate the new material into the previous experience of the student. These findings confirm the idea that insufficient presentation of the teaching objectives could prevent the understanding of the learning objectives on the part of students and negatively affect the participation of students in classes (Reta, 2017). Moreover, according to Arega *et al*. (2024), many teachers do not consider the learning style of the student while teaching. Such practice hinders the creation of an inclusive and effective learning environment that is necessary for enhancing the participation and understanding of the students. In addition, the use of proper teaching materials ($\bar{x}$ = 2.25) was rare. This shows that even though instructional materials are viewed as vital instructional tools that will help teachers become more effective in the delivery of lessons to improve the performance of the students, most teachers did not make use of teaching aids while teaching.

In general, from the results above, there is a great disconnection between recognizing the value of teaching aids and the practical application of those teaching aids in the classroom. One major limitation that needs to be addressed in the various literature is the fact that there has been very limited usage of teaching aids which has been pointed out by several scholars. For instance, a study of instructional materials showed that most teachers do not have sufficient material that can enhance the learning process.

Moreover, it is worth noting that according to the answers of students, instructions for carrying out experiments ($\bar{x}$ =2.15) were never provided. At the same time, it can be said that the practice of linking theoretical concepts to real life ($\bar{x}$ =2.23) is perceived as a very seldom practice. It should be noted that teaching students-centered techniques ($\bar{x}$ =3.09) has been practiced from time to time.

Thus, it can be concluded that teachers do not provide enough guidance for carrying out experiments necessary for the successful implementation of the program of science education. According to Arega *et al*. (2024), many teachers did not engage students into practical actions or experiments, which led to the fact that students did not get any practical knowledge about scientific concepts. Also, it can be mentioned that because of insufficient skills and resources many teachers are unable to connect theory with practical application of concepts. This creates difficulties in realizing the importance of their studies and thus makes the necessity of improvement of educational methods clear, including practical examples. Moreover, Bizuneh (2022) notes that despite attempts to reform the system and introduce the methods of active learning and involvement of students in process, many teachers still use traditional methods. It is apparent from this contradiction that while there is the intention of adopting students-centered practices, the classroom environment ends up reverting to traditional ways due to several constraints such as lack of training and resources.

In addition, the mean score assigned to homework, classwork, assignments ($\bar{X}$ = 2.50) and feedback grading of students' learning ($\bar{x}$ = 2.49) show that such practices are hardly ever done in the schools under study. This means that most teachers fail to adopt effective assessment strategies, which involve frequent feedback and activities that would enhance learning outcomes. The inability to participate in the formative assessment technique study will greatly affect students' learning experiences and also confirms that lack of adequate feedback and participation through homework and classes will negatively influence students' academic achievement. Findings of Akayuure (2021) and Chaffi (2021) revealed that classroom assessment practices in sub-Saharan Africa, including Ethiopia, involved the use of conventional approach focusing on summary assessments as opposed to transformational approach that incorporates both formative and summary assessment strategies.

Table 3: Students' Responses Regarding the Utilization of Classroom Instruction

Items	Responses in %					Mean
	Very often	Often	Sometimes	Rarely	Never	
1. Explains objectives of the lesson to you	-	16.3	33.4	41.2	9.1	2.57
2. Considers your learning styles in lesson delivery	-	8.8	21.9	53.3	19.1	2.27
3. Connects the new content with the previously learnt content	-	5.0	22.0	66.4	6.6	2.28
4. Teaches using appropriate instructional materials whenever necessary	-	5.6	24.5	59.2	10.7	2.25
5. Instructs and guides you to do experiments	-	-	32.3	43.9	30.1	2.15
6. Teaches by relating theoretical concepts with real life situations	-	-	40.4	42.9	16.7	2.23
7. Applies student-centered teaching methods	6.9	33.5	29.8	21.0	8.8	3.09
8. Gives you homework, assignments and class work to students	-	9.4	35.4	51.4	3.8	2.50
9. Gives feedback on students learning	5.0	13.8	27.6	33.2	20.4	2.49

*Level of Utilization: [(1.00 - 1.80= not employed); (1.81 - 2.60 = rarely employed); (2.61 - 3.40 = sometimes employed), (3.41-4.20 = often (usually employed)) and (4.20 -5.00 = regularly employed)]

It can be clearly seen that there is a tendency to move towards efficient teaching techniques. The frequency of many actions was found to be low or even non-existent; thus, there is quite a serious lack in classroom involvement and efficiency of teaching. Such a discrepancy may negatively affect the process of learning of students and the result of scientific education altogether. It is necessary to solve these shortcomings for increasing the efficiency of scientific education in these schools.

4.3 Challenges in Teaching Science Education at Middle Level Schools

As shown in Table 4 below, the responses from teachers and principals indicate that large class size ($\bar{x}$ = 4.21) is a very serious challenge of science education in the middle-level schools of Gedeo Zone, Gamo Zone, and Halaba Zone. This has a negative effect on the teaching and learning process in many ways. In support of this, Benard and Milton (2025) stated that as the number of students in the class increases, teachers face substantial challenges

in delivering quality instruction, managing classrooms effectively, and providing individualized attention to students. Teachers need to always attend in-service training to enhance their capacity to effectively deliver the lesson. Teachers' in-service training helps in improving the teaching methods, teacher-student relationships and ultimately school performance (Merfat, 2016). However, the findings indicate that there is limited in-service teacher training ($\bar{x}$ = 3.91) in the middle-level schools of the three zones, it is one of the serious challenges of science education.

The availability of educational materials enables teachers to implement a variety of teaching methods, create the climate for exploratory learning of students and facilitate their independent learning (Quansah *et al*., 2019). Also, the availability of appropriate laboratories and the way teachers make use of the existing opportunities is one of the key factors in the quality of education and the learning process (Pareek, 2019). But according to teachers' and principals' responses, the three zones in middle school encounter serious problems in science teaching due to the absence of curriculum (3.596 average score) and lab resources (4.02 average score). This opinion was shared by Quansah *et al*. (2019), who pointed out that the absence of adequate educational materials adversely affected science teaching. Moreover, Dari and Slai (2015) noted that many African schools lacked laboratories or laboratory facilities, failing to meet educational standards of students. According to Quansah *et al*. (2019), the absence of laboratory materials prevented practical work implementation and increased the complexity of the learning process.

Teaching methodology is a way in which teachers conduct their lessons in order to make the learning process more practical for students (Ayeni, 2021). Teachers should encourage students' active participation in the learning process. Nonetheless, teachers' and administrators' data indicate that the implementation of highly theoretical teaching methodologies (scores average = 3.89) faces numerous difficulties in the delivery of scientific education in the three selected middle school domains. In order to confirm this viewpoint, Ayeni (2021) states that teachers can reach the goals of scientific education only through the implementation of diverse ways of conducting instruction. Such diversification will help students implement successful ways of learning and thus obtain basic knowledge, values, and skills while maintaining freedom in solving problems in practice and with creativity.

Table 4: Teachers' and Principals Responses Regarding the Challenges of Science Education

Items	Teachers		Principals		Total	
	No.	Mean	No.	Mean	No.	Mean
Large class size	83	4.45	42	3.96	125	4.21
limited in-service teacher training,	83	4.06	42	3.75	125	3.91
Shortage of instructional materials	83	4.34	42	3.58	125	3.96
Insufficient laboratory materials	83	4.49	42	3.54	125	4.02
Students' attitude towards science education	83	3.00	42	2.12	125	2.56
Theory loaded instructional methods	83	3.57	42	4.20	125	3.89

*Challenge: [(1.00 - 1.80= not challenge); (1.81 - 2.60 = minor); (2.61 - 3.40 = moderate, (3.41-4.20 = serious) and (4.20 -5.00 = very serious)]

4.4 Independent sample t-test

In this study, the third research question aimed to determine whether there are significant differences in the utilization of classroom instruction of Grade 7 teachers compared to Grade 8 teachers in middle level primary schools. To address this question, an independent sample t-test was conducted, and the results are presented in Table 5.

Table 5: Independent t-test for Teachers' utilization of Classroom Instruction by Grade Level

Utilization of Classroom instruction	Grade level	N	Mean	SD	df	t	p
	Grade 7	33	29.3333	0.47871	81	-4.851	0.000
	Grade 8	50	32.0400	3.17490			

As evidenced in Table 5, there is a significant difference in the utilization of classroom instruction between grade seven and eighth teacher participants ($t = -4.851$; $p < 0.01$). This indicates that the mean utilization of classroom science instruction among Grade 7 teachers (Mean = 29.3333) is lower in comparison to Grade 8 teachers (Mean = 32.0400).

5 Conclusion and Implications

On the basis of the findings of this study, the following conclusions were drawn: the overall grand mean for utilization of classroom instruction reported by science teachers and principals was 3.02, whereas students reported a lower grand mean of 2.43. This indicates that the utilization of classroom instruction was not regular, which ultimately contributed to the ineffective teaching of science education in the schools studied. Teaching science education in the middle-level schools poses serious challenges due to large class size, limited in-service teacher training, lack of instructional materials, insufficient laboratory materials, and theory-loaded instructional methods where the overall grand mean reported by science teachers and principals was 3.76.

Moreover, the results of an independent sample t-test showed a statistically significant difference in the use of classroom science instruction between teachers in grades seventh and eighth. This significant difference in classroom science instruction between seventh and eighth grade teachers may be due to several factors, for example, eighth grade curriculum often emphasizes students for high school preparation, which may require teachers to implement more structured teaching approaches, and eighth grade students are generally more mature and able to cope with complex concepts, which may lead to teachers adopting various teaching strategies.

The implications of these findings are significant for educational policy and practice. The significant difference in classroom instruction between seventh and eighth-grade teachers suggests a need for targeted professional development. Workshops and training sessions should focus on effective instructional strategies that engage students at different developmental levels.

It is also crucial for teachers, educators, and administrators to enhance the practices of utilizing classroom instruction effectively. This can be achieved through establishing effective support and follow up mechanisms, strengthening in-service training for teachers to equip them with the necessary skills and strategies for effective classroom instruction, and a focus on broader systemic improvements, such as resource allocation, and ongoing professional development, may yield more productive outcomes in science education effectiveness. Moreover, further research is needed to explore other factors influencing these practices and their implications for science education outcomes.

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Conflict of Interest

The researchers declare that there is no conflict of interest regarding the publication of this study.

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