CHALLENGES FOR EFFECTIVE TEACHING OF CHEMISTRY IN SECONDARY SCHOOLS OF DEVELOPING COUNTRIES: A REVIEW

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ABSTRACT

Effective teaching is the ability to improve student achievement and expressed by content knowledge, quality of instruction, teaching climate, classroom management, teacher beliefs and professional behaviors. Teaching chemistry has been identified to be one of the major bases for the transformation of our national economy, and hence must be accorded adequate attention. However, it has been shown that implementing of effective teaching chemistry almost ignored in secondary schools in many countries of the world because of different factors. The main purpose of this review was to identify challenges facing implementing effective teaching chemistry at secondary schools in different areas of the world based on different published works. The most recent and majorly the last 10 years that published in reputable journals have been reviewed and used as a direct source. Hence, the dominant factors that frequently indicated in most findings specially in developing countries to implement effective teaching chemistry in secondary schools are problems related to student attitude toward chemistry, laboratory inadequacy, poor method of instruction, large class size, curriculum constraints, and educational administrations. The other factors are teacher's salary, parental support, teachers' feelings and attitude, professionalism, time constraints, self-assurance and school setting are identified as causes for the dominant factors. However, each of them affects the implementation of effective teaching chemistry with varies degree from school to school and also among different countries. The implementation process of effective teaching chemistry in developing countries is still limited in high schools and students perform poorly in chemistry subject. It is recommended that teachers, educational leadership, parents, educators and policymakers address the factors. *[African Journal of Chemical Education—AJCE 14(2), May 2024]*

INTRODUCTION

Education is a process of acquiring knowledge, skills, values, and attitudes through various formal and informal methods. It is a lifelong journey, starting in childhood and continuing throughout life. Education plays a vital role in shaping individuals, societies, and civilizations by providing them with the tools to understand the world, think critically, solve problems, and contribute to improvement of society. At its core, education aims to facilitate intellectual, social, emotional and physical development. It gives individuals the ability to acquire and apply knowledge effectively, allowing them to adapt to changing circumstances and make informed decisions [1].

Among the goals of education are the acquisition of useful skills and the development of mental and physical competences as tools for people to live their lives and contribute to the advancement of society. According to [2], teaching people how to acquire systematic skills, knowledge, and attitudes as well as how to use them in society is the primary and inevitable focus of science and technology education. It goes without saying that science and technology are crucial to the development of a country. Education, especially science and technology education are the "factory" for producing the technologists, technicians, craftsmen, and skilled artisans needed to revive the country's economy and bring about the desired technological advancement, which is crucial for the future of humanity [3].

Science education is an integral part of the curriculum from primary school to higher education. The science curriculum distinguishes the roles of science and technology in people's daily activities [4]. “Reference [5], argue that science education is an important key to success in today's global knowledge environment, deeply shaped by science and technology”. Additionally, science education is essential to navigate the Volatile, Uncertain, Complex, Ambiguous, Disruptive, and Diverse ($VUCAD^2$) world, which is considered a new normal in education. “Reference [6], reiterates that education in the modern world faces increasing uncertainties due to globalization and the widespread and modern use of technologies”.

Education in science is crucial for both industrialized and underdeveloped countries. It supports industrial development, expansion, and international economic competition [7]. Science has been important and will continue to be important due to its ability to explain many natural phenomena and the crucial role it plays in the current development of the globe. Our century has seen a nation's depth of success, particularly in terms of economic and technological advancement and the improvement of the worth of human life and society. Over time, science has become a respected academic topic [8].

“Reference [9], asserts that scientific education has contributed significantly to the advancement of science and technology in many industrialized countries”. Every country should

take science education very seriously in all educational institutions, since it involves the sharing of scientific content and methodologies, which is important to any nation's success.

Science today has a wide range of influences, making it a highly broad subject to address. Our knowledge and understanding of science are impacted by the niche we have chosen for ourselves in this setting. Teachers and students alike should be aware that the places where all scientific developments and hypotheses are discussed are not just found in the classroom. Due to its breadth, science also faces a variety of difficulties [10].

When people think about one of the branches of science about chemistry, they typically image the various synthetic materials we encounter every day. We might consider how chemicals are used to make dyes, plastics, fibers, and medications. Most people think that studying chemistry is really fascinating, vastly mathematical, and experimental. From physical to biological sciences, nearly every area of life science both living and non-living, has some connection to chemistry. One of the prerequisites for engineering, technology, medical, and other applied science courses at the institution is chemistry [11].

Chemistry is the study of natural laws that control how the universe behaves in ranges ranging from the tiniest subatomic particles to the greatest cosmological objects. Chemistry is becoming more interdisciplinary as it collaborates with engineers, physicists, and biologists to

investigate and address a variety of societal issues. Nearly every aspect of modern life is based on chemistry. Training in chemistry is available for a wide variety of professions. As a result, there are many employment alternatives accessible, some of which may not directly include chemistry. Chemistry is self-assured and understands where to find the knowledge they require to do a task [11].

Chemistry teaching is expected to be goal-oriented and student-centered, and this can only be accomplished when students are willing and teachers are in good spirits, employing the right teaching strategies and tools [12]. Since students are naturally curious, they must actively participate in the learning process, constantly preparing, testing, speculating, and constructing their own particular construct and knowledge. Such knowledge can only be made valid, significant, and beneficial to people by personalizing it. Students must actively create their own personal awareness and significance in chemistry [13]. “Reference [14], made the statement that the brain is not a passive consumer of knowledge and that in order to learn with understanding, a learner must actively participate in the learning process”.

When teachers use effective chemistry instruction that involves students' active participation, it promotes socioeconomic development and encourages developing nations to launch initiatives that support the advancement of science education at the secondary and higher educational levels [15].

Flexible teachers must use cutting-edge teaching techniques in a supportive learning environment and adapt the curriculum to suit the needs of students with various backgrounds and abilities [16]. No single teaching strategy works for all students [17], and instruction that primarily consists of lectures does not motivate students to learn. In contrast, effective teaching strategies have an impact on students' interest in the subject because effective teachers take into account their viewpoints by addressing and assisting with any misconceptions they may have about the material. As a result, teaching methods are appealing and help students develop good attitudes toward the subject. It is the facilitator's (teacher) responsibility to control these aspects [18-19].

A single teaching strategy is also insufficient because students have diverse learning preferences and are more likely to pay attention when their desire to learn is stimulated [20]. In this regard, chemistry teachers could use a variety of strategies to maximize their students' learning outcomes by involving them in learning activities and organizing the concepts to be taught from simple to complex in order to make it easier for them to comprehend the abstract or complex concepts; otherwise, students have a tendency to memorize what they are taught without understanding it [21].

However, there are significant issues with chemistry education in many nations around the world. Students still do poorly in chemistry in our educational system and researchers' best attempts

to raise achievement levels. This failure has been attributed to a number of factors, including an inadequate laboratory, teachers' attitudes, examination malpractice, a lack of time for practice sessions, a lack of syllabus coverage, class size, a lack of professionalism, lack of adequate teacher of pay, low motivation and low self-confidence of students to study, the rigorous curriculum, shortage appropriate textbooks, the unavailability of classroom resources, religious and political opposition to cutting-edge science instruction, and the setting [22-24]. Therefore, reviewing the challenges of effective teaching chemistry is very necessary in order to ensure several important issues, like to gain a deeper understanding of the obstacles faced by educators in this field, to ensure the accuracy and reliability of information, and identifying potential solutions.

Therefore, the objective of this review is to identify the challenges of effective teaching chemistry in secondary schools. The researcher is extremely interested to reviewing and identifying various dominant factors hindering the effective teaching of chemistry in secondary schools at various secondary schools. Additionally, its practice in a wider way of different finding will be collected, organized and presented from different research findings worldwide. Basically, this article attempt to provide answers to the following questions: what are the basic determinant challenges for effective teaching chemistry in secondary schools: to how much extent schools have enough resources to do practical activities in teaching chemistry; do teachers use different methods to teach

chemistry in secondary school; do the curriculum integrated with the realities of the learner; do secondary school students have good attitude to learn chemistry; do the class size appropriate for effective teaching; what are the roles of school leadership in implementing effective teaching chemistry at secondary schools.

METHODOLOGY

To answer the research question related to the challenges of effective teaching and learning chemistry in secondary school, we conducted a literature search to collect the related literature. The search also included challenges for effective teaching science to obtain more studies that could increase the data as a search term. Sixty-nine (69) studies were obtained; some of them were not related to our investigation; and those which did not answer the research question were excluded; we remained with 12 studies. In order to attain this, the Web of Science, Google Scholar, ERIC database and related Websites indexed database were used to source articles describing challenges for effective teaching chemistry and science in secondary schools. The selection of studies was based on the year of publication, location of the study, type of publication and participants. Cited and citing references from these articles were consulted to identify additional relevant material.

CHALLENGES ON EFFECTIVE TEACHING OF CHEMISTRY

The dominant challenges for effective teaching chemistry at secondary schools have been identified in this review. The summery of factors are presented in the following Table 1. Moreover, the detail description of each factor is presented in the next sections.

Table 1. Dominant Challenges for Effective Teaching Chemistry in Secondary Schools

No_	**Dominant challenges for effective teaching chemistry**
1	Students' attitudes toward chemistry
2	Laboratory in-adequacy
3	Poor method of instruction
4	Large class size
5	Curriculum constraints
6	Educational administrations related Issues

Students' Attitudes Toward Chemistry

One of the intentions of the chemistry curriculum for secondary school students is to deliver students with knowledge and skills in science and technology. Chemistry is also powerful in raising awareness of the need to respect and care for the environment and to take an active part in its

preservation and conservation for future communities. The globe is currently experiencing environmental problems, and as a result, future generations are becoming less interested in fields of science like chemistry. This suggests that many students from the result of almost all studies frequently form unfavorable views towards chemistry, which may have an impact on their academic performance and future employment.

According to [25], the attitude of secondary school students in scientific classes is declining. The latter has led to a relatively low number of students selecting jobs in science. Additionally, attitudes toward biology are the most positive among students, while attitudes toward chemistry and physics are the least positive [25-26]. From my experience from selection of students, I have observed that the same means that attitudes towards biology are more positive than chemistry and physics.

The studies identify different factors for the decreasing of attitude of students towards learning chemistry. The main factors for dwindling the attitude of students to wards learning chemistry teachers' feelings and attitudes [27-28], their illiteracy [29], effectiveness in teaching and presentation on experiments [27], broad syllabus and content [30], gender disparities, lack of equipment's and facilities, home or family setting, social standing of the parents, the student's culture and ideology [3, 27, 31-34], peers and other students [35].

Further studies and reports carried out in the U.S. and in Europe attributed these factors to the lack of relevant content and pedagogical approaches at school levels [36]. The other findings of this study showed that the majority of students in secondary schools feel that chemistry is hard and difficult for them. Hence, they have no positive feeling toward the content of the chemistry curriculum, confirming other studies [27, 33-34, 37].

In addition, a number of studies have examined high school students' attitudes towards chemistry in relation to the difficulty, interest, usefulness, and importance of chemistry to high school students' views on learning chemistry. “Reference [38], in Chile and [37] in Greece, students' attitudes towards chemistry were neutral”. There was no gender difference in this study. Their results also revealed that the attitudes of boys and girls regarding the interest, usefulness and importance of chemistry were identical. In addition, the authors found a significant relationship between chemistry and achievement.

However, it is observed that boys have developed more positive attitudes than girls toward chemistry learning. According the research conducted by “Reference [34], in Tanzania and [39], in Ethiopia who found a difference in the attitudes of boys and girls towards chemistry in terms of fear, pleasure and confidence”. In chemistry, male students were found to have higher self-confidence, better results and happiness than their female counterparts. Girls’ attitudes are probably caused by

some socio-cultural context, which favors boys to study the hardiest subjects such as chemistry. Therefore, boys have a more positive attitude and interest in chemistry than girls and they are more likely to participate in chemistry activities [31, 40-41].

Laboratory In-adequacy

Students are fundamentally prepared for science education in secondary school. At this level, students are exposed to observation, participate in laboratory activities, interact with laboratory equipment and learn safety rule or precautions [42]. The laboratory has been given a central and unique place in science education, and science educators have indicated that using laboratory activities can have a wealth of educational benefits. Students can work cooperatively in small groups to study scientific events in the science laboratory [43].

Participating in laboratory sessions is crucial in learning physical science, since actual work, in a sense, brings to life what is described in textbooks. Learning is improved when students observe educators performing demonstrations or experiments that complement what is in textbooks. Utilizing laboratories has the benefit of enhancing students' higher level learning abilities, such as analysis, problem-solving, and evaluation [44].

"Reference [45], states one of the activities in chemistry is experimentation. An experiment is a test done in a controlled setting to show a known fact, check the accuracy of a theory, or see how well a novel idea works". A laboratory project can provide students with rich learning opportunities and serve as a link between conceptual and practical knowledge as well as between molecular and macroscales [46]. It gives teachers and students a place to exercise their theoretical knowledge and show off their psychomotor abilities. It is believed that giving pupils the chance to apply what they have learned in the classroom will help them accomplish more. Utilizing laboratories in the teaching and learning process of science in general and chemistry in particular helps to promote long-term memory in students, enhances pupils' development of the ethical dimension of science, inspires the spirit of collaboration and active participation among learners, exposes learners to scientific experiences that could ultimately help them in developing scientific attitudes and skills and inculcate in the students the spirit of inquiry and scientific mode of thinking [44-45].

The practical experience is also a crucial component of chemistry science; the course covers a wide range of topics that can be tested experimentally with the aim of stimulating student learning about chemistry, which is typically thought of as abstract, quantitative, and dull [47]. Effective teaching of chemistry could be accomplished if the availability of laboratory equipment, chemicals, and materials, laboratory personnel, working conditions in the lab, safety precautions, substantial

recommended textbooks, and accurate periods allocated for the teaching of the subjects are studied and carefully controlled. This will create a scholastically rich, rewarding environment (atmosphere) for the students to learn [48].

According to [44], utilizing equipment creatively when teaching science enhances the likelihood that students would learn and advance their performance. Proper use of instructional or laboratory materials can promote learning, increase instructor competency, and provide students a greater sense of purpose in their education.

From the result of different studies, it is disheartening to see that the majority of our schools do not have separate laboratories, which is a must for the ultimate goal of effective teaching of chemistry in secondary schools [19, 45]. The practice in many developing continents, like African countries, has been observed there are problems regarding the availabilities of lab equipment and its usage. For instance, most secondary schools in Nigeria [11], South Africa [49-50], Kenya [51], Egypt [52], Ethiopia [44, 46, 53-54], have lack resources that are required for implementing practical work. In some schools, a considerable number of equipment and chemicals are present. However, these have been reserved for years out of practice.

In the majority of public secondary schools, both in urban and rural regions, laboratory activities do not allow learners to carry out investigations that involve designing, experiments,

making observations, gathering and evaluating data, and thinking through and evolving solutions to problems [19, 44-45].

Generally, laboratory inadequacy refers to the lack of proper resources, equipment, infrastructure, and support in educational laboratories. It encompasses various aspects such as outdated or insufficient equipment, inadequate space, limited access to materials and supplies, lack of safety measures, and insufficient technical support. These inadequacies can have a significant impact on teaching and learning in chemistry education. It hampers effective demonstration of scientific concepts, reduces student engagement and motivation, limits the development of essential skills, compromises safety, and affects future academic and career prospects [19, 24, 44-46, 50, 53-55].

Poor Method of Instruction

Teachers are expected to be highly qualified and familiar with this issue prior to teaching chemistry in the classroom [56]. A teacher's role may be considered as a catalyst, which can lead to change in the behaviour of pupils or learners. He or she is essential to the achievement of educational objectives and the continued existence of the educational system [57]. The teacher needs to develop the student's interest and attitudes in this subject through his or her method of teaching. The teachers,

as experts who have good exposure and experience in chemistry, are expected to foster the adjustment of students, match curricular offerings to levels of mental development, understand students' basic cognitive and social problems, make curricular specifications relevant, and motivate the students to learn the subject [31, 37, 56].

Chemistry is viewed as being esoteric by many students. It matters how it is taught to pupils in order to make it relevant and approachable. They consist of discussion, playing games, demonstrating projects, discovery, brainstorming, problem-solving techniques, and process-based approaches. These help students become more creative, open-minded, honest intellectually, and other traits [45].

The major goals of teaching chemistry in secondary schools are to give the students the opportunity to advance their knowledge and expertise in chemical science and to project their educational efforts in a way that will benefit both them and society at large. Students must therefore be interested in the subject, pay close attention to how it is taught, acquire and accomplish a variety of scientific goals, and not merely be able to recite scientific information [56, 58]. By using various teaching techniques based on the teacher's expertise, the student will be encouraged to make the learning process effective and rewarding. These techniques will enable them to function effectively in society within the limits of their capacity [45, 56, 59-60].

"Reference [55], states effective learning helps students change their intuitive, everyday explanations of the world around them in order to incorporate scientific concepts and ways of thinking into their personal frameworks". It also helps students learn how to learn and develop conceptual understanding and thinking skills. As a result, learners' problem-solving skills may improve, which could lead to better learning. Quality teaching, according to [19, 45, 55, 61-62] depends on the teacher's ability to turn textual knowledge into pedagogically effective forms that are nevertheless adaptable to the students' abilities and backgrounds.

According to [56], the way a teacher presents his or her materials to the class and involves them in the current task is referred to as the methodology". "Reference [63], notes that a teacher must be several things in order to be effective, including a source of knowledge and a mentor, an organizer of learning opportunities, someone who can create an environment that is conducive to learning, a superior, and a consultant". To choose the best approach in a given circumstance, the teacher must be aware of the most recent developments in education. The teaching approach either facilitates or impedes learning. Teachers of chemistry must employ effective methods in order to pique students' interest and foster the development of positive attitudes for successful learning outcomes, because chemistry is a subject that most students find intimidating.

Numerous studies have demonstrated that using inquiry-based teaching strategies helps students learn science more effectively [64]. The right physical environment and tools are essential for this inquiry-based learning, which gives students the chance to conduct independent research and investigation. The role of the teacher is to assist and guide the students in the learning environment. Beneficial interactions occur among students themselves, between students and the learning materials, and between students and teachers when inquiry-based instruction is used correctly.

However, a significant element impeding students' knowledge and academic success in science is the employment of improper, ineffective teaching methodologies. From the result of the study, many teachers place more emphasis on theory than on the practical aspects of science subjects, then there is a problem in transforming the subject knowledge into appropriate activities, analogies, demonstrations, or simulations, and adapting them to the different student learning styles. As a result, science lessons become boring and students struggle to understand some scientific concepts, skills, and principles [55, 59, 65-66].

One of the main causes of these difficulties is a lack of background in the subject, which will affect how successfully teachers build their pedagogical content knowledge as well as their attitudes and self-confidence when instructing chemical topics. The knowledge base of teachers has a significant impact on all areas of teaching, including planning, preparation, and decision-making

about the selection of subject to be learned [67]. Therefore, it can be said that having a solid foundation in the subject is one of the most crucial qualities of a good science teacher. However, studies that have looked for a link between subject-matter expertise and effective teaching haven't always been successful. According to [68-71], while having a solid foundation in the subject is a prerequisite for effective teaching, it is not the only one. Exemplary science teachers, according to [65], also need to develop pedagogical content knowledge. This knowledge will enable science teachers to combine content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners and presented for instruction.

According to [72], pedagogical content, knowledge for teaching chemistry consists of an orientation toward teaching chemistry, knowledge and beliefs about the chemistry curriculum and assessment of chemistry, knowledge about students' understanding and misconceptions of particular chemistry topics, and knowledge about teaching strategies for teaching chemistry or topic specific pedagogy. This suggests that the majority of chemistry teachers lack pedagogical content expertise, which continues to be a factor in their use of ineffective teaching strategies. To help students understand difficult scientific concepts, teachers might offer alternative explanations or employ

different strategies if they have a thorough understanding of the subject and pedagogical material [45, 60].

The use of nonprofessional certified teachers, or instructors who teach chemistry but lack teaching credentials, is another issue that contributes to poor instructional methods. Such teachers might not be familiar with teaching strategies that help students learn chemistry in efficiently manner, let alone be up-to-date on the usage of teaching aids and laboratory experimentation [45]. A teacher who is academically qualified has a better understanding of chemistry than a teacher who is less educated; in other words, a teacher who is not qualified to teach chemistry would result in pupils who perform poorly in chemistry. In a similar spirit, a teacher who has the fundamental competencies required for the teaching profession through the appropriate body is considered professionally qualified. According to the findings of many studies, a significant issue with teaching chemistry in underdeveloped nations is that the majority of chemistry teachers lack professional training. The other factors for implementing a poor method of teaching lack of equipment's and facilities that are necessary for chemistry teaching [45, 73].

Generally, poor method of instruction is expressed by lack of clarity and organization, overemphasis on memorization, lack of differentiation in the diverse needs and learning styles of individual students, insufficient active learning opportunities, lack of feedback and assessment and

limited use of technology. The impact of poor instructional methods on teaching and learning is significant. Students may experience decreased motivation, disengagement from the subject, lower academic achievement, and reduced confidence in their abilities. They may develop negative attitudes towards learning and school in general. Additionally, teachers may feel frustrated by the lack of student progress or engagement, leading to burnout or a decline in job satisfaction [19, 45, 56, 62, 64].

Large Class Size

Since the future of man depends heavily on scientific advancements and the growth of productive activity, science is regarded as an important subject in the school curriculum. We have learned things thanks to science that enable what we have now. In a world without science, life would still be extremely challenging compared to how it is now. Students are taught how to think, study, solve issues, and make decisions by being taught scientific procedures. Every part of a student's education and life, from school to employment, depends on these skills [74].

In order for students to build higher order mental processes like concepts, procedures, forecasting, and rationalizing with one another, teachers may foster an environment where students are actively learning. By giving kids the chance to demonstrate, planning field trips, science clubs,

and fairs, teachers may foster healthy competition among their students while their role responsibility is to support their learning [74].

However, different finding of research indicate that several circumstances could undermine this effective teaching. Class size is one of the elements that has the biggest impact on effective chemistry instruction. According to [60-61, 74-76], a large class size occurs when there are more pupils in a classroom than, what is necessary for efficient teaching and learning. Depending on the educational setting, the exact definition of a big class size may vary, but generally speaking, it is understood to be a class with more students than a teacher can effectively engage and give individualized attention to.

Large class sizes are common in secondary schools in most of developing nations, like Ethiopia [39, 46], Nigeria [77], Ghana [60], South Africa [19], Uganda, Kenya [51], Egypt [52] and the Philippines [78]. There are a number of difficulties that might arise when teaching chemistry to big classes, which can reduce the efficiency of education. While teaching chemistry in a big class environment is feasible, there are some issues that must be resolved to guarantee the best learning outcomes for pupils. Large class sizes can have a considerable and complex effect on both teaching and learning. It has an impact on both teachers and students, affecting many facets of the educational process. Some of the main impacts include limited individual attention, reduced student engagement,

increased classroom management challenges, inadequate feedback and assessment, limited opportunities for individualized instruction, increased teacher workload, limited communication and collaboration, and disparities in educational outcomes [19, 44, 46, 54, 60]. Generally, effective teaching of chemistry in developing countries like our country Ethiopia is highly influenced by large class size.

Curriculum Constraints

The field of chemistry, which is vital to the academic world, links the physical sciences with the applied and life sciences fields [79]. Chemistry is a subject in the scientific curriculum that promotes intellectual growth through real-world applications to the comprehension of natural transformations and processes. Effective chemistry teaching is still difficult, though, as is chemistry education. One of the dominant factors that influence the implementation of effective teaching chemistry is curriculum constraints. Curriculum constraints refer to the limitations or restrictions that are imposed on the design, development, implementation, and evaluation of a curriculum [62].

Researchers advocate those students perceive the curriculum in teaching chemistry to be overburdened and irrelevant to their practical everyday lives [62, 80]. This is because the problem of the correlational transfer of chemistry concepts with real-life situations [62], interlinking

theoretical knowledge and experimental approaches [11, 50], problem stability school curriculum [11], overloaded syllabus, the scheme chemistry subject does not inspire the students, problem involvement of ICT in studying of chemistry, contain limited time schedule for studying chemistry [11, 31, 37, 45, 55, 61], there huge gap between what is intended in curriculum in terms of students' learning in chemistry and what actually happens in classroom [74], and standardized assessments that prioritize rote memorization over conceptual understanding. As a result, teachers only focus on completing the curriculum without guiding the students to acquire relevant skills and many educators and learners feel that enhancing pupils' ideas and understanding of chemistry is a difficult task [62].

The inadequacy of the curriculum's offerings to students' levels of mental development presents another significant obstacle to effective chemistry instruction. If a teacher wants to have an impact on student learning, choosing who to teach and what to teach is crucial. According to [81], knowledge has different levels of obstruction that a child whose mental development is in line with the levels of knowledge given to them can grasp. Additionally, teachers should be concerned about the students' entrance behavior because it serves as the foundation upon which new knowledge can be built [56]. However, the curriculum in most of developing countries a copy from a developed country, does not consider the background of the students in your country, and it is difficult to link them with society's values, beliefs, and cultural norms.

Educational Administrations Related Issues

Educational administration plays a vital role in creating an environment conducive to effective teaching and learning. However, inadequate support from educational leaders can pose significant challenges for chemistry teachers. Some research findings have suggested that educational administration's lack of care and support was a contributing factor in the implementation of science being ineffective [82].

Raising curriculum standards, assisting the school in meeting learning attainment goals, and successfully implementing significant policy directives or targets can all be accomplished with adequate preparation by the school head, with the proper involvement of teachers, students, parents, and the community. The head of the school must be able to make adjustments to the internal operations of the school to supervise and direct the implementation of practical work as well as the terms of service for teachers and the school's funding system. Encourage effective teaching and learning strategies that help all students succeed in their chemistry coursework. This happens when school leadership sets clear, attainable goals for both teachers and students in the classroom and lab and offers a variety of options for them to pursue learning through student engagement and reflective teacher support. Curriculum levels can be raised with proper preparation by the school principal and participation from teachers, students, parents, and the community. It appears that in a setting where

creativity is often encouraged, science instructors who employ a range of instructional techniques can increase their students' interest in chemistry and their level of attentiveness [45, 54, 66, 82-83].

According to [54], school principals play a significant role in ensuring that the school's curriculum is implemented properly, which can result in improved academic achievement of students. They consider school administrators to be people who are informed about and dedicated to the curriculum, and they also see their jobs as offering support at one end of a continuum and acting as curriculum leaders on the other.

On the other hand, research has shown that school principals' support is not consistent with the obligations set forth in policy in developing nations, including Nigeria, Ghana, Cameroon, Gambia, Ethiopia, Philippines, North Macedonia, and Malaysia [11, 19, 51, 54, 60, 78, 84]. In relation to the schools in their municipality, local school authorities have duties and responsibilities. They have a responsibility to support teachers and administrators financially, to provide high-quality learning materials for real-world applications, and to keep an eye on school planning and development. The effectiveness of particular schools is monitored by both local and national education authorities. The local educational authorities are in charge of supervising teachers and school administrators as well as allocating learning places, resources, and tools for the implementation of efficient instruction.

The government now controls all financial aspects of schools after assuming control over them from the principals when free education was implemented [19, 85]. As a result, the number of students rises, which has a significant negative impact on the teaching and learning processes, particularly in the science and practical domains [19, 86]. According to [87], there are becoming more overcrowded classrooms and woefully inadequate infrastructure in the school systems of developing countries. Additionally, due to a lack of finance, schools lack the resources and facilities like textbooks and laboratory equipment's necessary to successfully execute the curriculum [19, 88]. Lack of support may manifest in various ways, such as insufficient resources (e.g., textbooks, laboratory equipment).

In addition, government funding cuts and broken promises are problems where the government promises extra pay to science teachers and surprisingly boosts their morale, promises are not kept [19, 89]. Thus, ineffective teaching of chemistry is also facilitated by the fact that the government does not motivate teachers or a lack of recognition for teachers' efforts and limited professional development opportunities occurs. "Reference [48, 54], argued that "the most commendable educational programs of nations (especially developing countries) are usually excellently designed, but they usually break down at the implementation stage due to insufficient funding". A group of educators argued that education, which is a basic human right, should be

financed by the state because there are enough resources to finance at least basic education for all children. According to this group, the obstacles to education for all children are corruption, wrong priorities, inequality and bad political choices [54, 90]. “Reference [19, 54, 91], blamed the government for the massive failure of chemistry and other subjects for the following reasons: without effective government policy and educational service, few resources are provided; insufficient trained personnel for school monitoring and evaluation; dilapidated infrastructure, lack of teaching materials; environmental hostility, inadequate staff with laboratory training and experience, inadequate development of professional teachers, and inadequate school funding”. In addition, the stated factors from my observation that most educational leaders who not graduated in science, if not graduated in science have not have full knowledge about what we require for effective teaching science, in general, chemistry in particular. Due to this reason, effective teaching chemistry is highly affected by educational leadership.

CONCLUSIONS

In this review, the authors mainly focused on examining the challenges of effective teaching chemistry for high-school students and what strategies help attaining the students’ learning

outcomes. To attain this purpose, selection criteria of articles and the methods of analysis for this review were established.

Effective chemistry teaching that involves learners' active engagement when properly used by teachers leads to socio-economic development, as well as developing countries embarking on programs that support the development of chemistry education at secondary levels. Flexible teachers need to employ innovative teaching methods directly to a conducive classroom environment, and which adjust the content to learners with different backgrounds and talents.

However, the results of this study revealed that implementation of effective teaching chemistry in many countries of the world specially developing countries, faced with different challenges. The dominant challenges for effective teaching in the field of chemistry at high school include low student attitudes toward chemistry, inadequacy of laboratory, poor method of instruction, large class size, curriculum constraints, and educational administrations related issues. The other factors, that cause for the dominant factors like teacher salary, parental support, teacher feelings and attitudes, lack of professionalism, time constraints, the inadequate school setting and low self-assurance in learning chemistry.

RECOMMENDATIONS

Considering the findings and the conclusions drawn from this study, some recommendations were made for effective teaching of chemistry. These are:

- Chemistry is an energetic to create awareness of the need to love and care for the environment and plays an active role in its preservation and conservation for future communities. However, in this current era, the world is facing environmental challenges where future communities are losing interest in science subjects such as chemistry. This indicates many students often develop negative attitudes towards chemistry, which can affect their learning outcomes and future careers. Therefore, teachers, parents and school leadership instigate the attitude of students by using active method of teaching, by giving continuous supporting, by fulfilling school resources like textbooks, laboratory equipment, arranging a good school setting, and by using technology in the teaching learning processes.
- Chemistry is an experimental subject; greater emphasis should be placed on the practical aspects or balanced emphasis on the theoretical and practical aspects and also implemented effectively in small class sizes. Therefore, government, non-government donors and parents should work hand in hand to build classes and appropriate laboratories with adequately equipped things like water system, electricity, fire extinguishers and chemicals, for effective

learning and to achieve standard class size, so that practically related concepts are better taught and better understood by the students.

- In the teaching of chemistry, teachers are expected to have a good level of competence and mastery of the subject before introducing it in the classroom. Teachers with inadequate background in the subject knowledge and pedagogical content knowledge for chemistry teaching should not be employed to teach chemistry as this will affect the effectiveness of the teaching, such teachers as he/she can easily run away from difficult topics and do not implement appropriate method of teaching.
- Another important factor or suggestion is the issues of the curriculum. The curriculum for chemistry must be properly addressed the real-life situation like background of students and problems of interlinking theoretical knowledge and experimental approaches, problem stability school curriculum, overloaded syllabus, problem involvement of ICT, limited time schedule, there huge gap between what is intended in curriculum in terms of students' learning in chemistry and what actually happens in classroom. Therefore, the curriculum design, development, implementation, and evaluation can be takes place cooperatively by educational administration, teachers, students, parents and policy makers on the ground in order to avoided the curriculum and time constraints.

- Lastly, educational administration is pivotal for the school to provide important facilities and laboratory room for the implementation and successful achievement of chemistry educational quality. Contrarily, studies indicated that supports of educational administration, in developing countries is not in line with their duties and responsibilities stated in the policy. Therefore, educational administration should have to give more attention on the adequate funding to fulfil the laboratory materials, school resources, teacher payment, as well as timely provide necessary support for teachers and students to initiate their motivation. In addition to this, they should have to make necessary follow-up from time to time to easily identify the gap and take remedial action for its improvement.

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