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RESEARCH ARTICLE

Contextualized approach in teaching Chemistry: The perspectives and practices of teachers and students

Pema Tshojay[1] *, Nandu Giri[2]

[1]Sonamthang Central School, Ministry of Education, Bhutan
[2]Samtse College of Education, Royal University of Bhutan, Bhutan

* For correspondence: ptshojay1990@education.gov.bt

ABSTRACT

Implementing contextualized approach in teaching chemistry is mandatory in Bhutan as per the science curriculum framework, 2012. However, it serves its purpose, only if it is effectively implemented in the real classroom situation. Hence, this case study explored the current trend of contextualized approach in teaching class IX chemistry in one of the schools of Zhemgang Dzongkhag. Data were collected through semi-structured interview, classroom observations and document analysis. Three chemistry teachers and seven students were selected as participants through purposive sampling method. The study found that all the teachers and students preferred contextualized approach as it significantly impacts in enhancing the students' motivation and meaningful learning of chemistry. Further, the study revealed that the contextualized instructional strategies are featured by enriched real life examples and applications, hands-on-learning and experiential learning activities. Despite the positive attitude towards contextualized approach, the study confirmed that the contextualized approach is minimally implemented in teaching class IX chemistry, owing to the impeding factors such as decontextualized chemistry curriculum content, inadequate resources, time constraint, and lack of adequate pedagogical knowledge and skills in contextualizing the lesson. Therefore, the need of revisiting on the current chemistry curriculum in terms of contextualization for class IX chemistry is suggested. In addition, the study recommends class IX chemistry teachers to strive towards achieving competency in all aspects of contextualized approach.

Keywords: Chemistry curriculum, contextualized approach, hands-on-learning, real life applications,

1. INTRODUCTION

Contextualized approach is one aspect of constructivist approach that focuses on the relevancy of the curriculum and instructional strategies to learners' context. In Swaziland, it is described as connecting subject matter content to real word situations by using real-life examples and applications in teaching environments [1]. Contextualized approach also helps students to understand the role of

chemistry in everyday life situations. Specifically, contextualized approach in chemistry is described as a strategy to link chemical knowledge to students' daily lives in a way that is closely based on learner-centred teaching and learning [2]. Some of the prominent examples that indicate the implementation of context-based approach in chemistry include Chemistry in Context in USA, Salters Advanced Chemistry in UK, Industrial Chemistry in Israel and Chemistry in Practice in Holland [3].

The literature revealed that the contextualized approach can be ensured if the curriculum content is contextualized. It is reported in a review of criteria for content selection in Turkey that the relevancy and applicability of concepts is included in the criteria set by any experts [4]. Further, a study in Finland specified that contextualized content should consist of everyday phenomena [5] that enable students to make connections to important aspects of contemporary life rather than just delivering facts and information. Additionally, the use of contextualized instructions by teachers is also one aspect of contextualized approach. A study in United States found that teachers should be able to contextualize their lessons [6]. The study, further explained that the contextualized instructional strategies ensure active engagement of learners in their own construction of knowledge and understanding the concept with the ability to draw examples and apply theoretical concepts in real life contexts. Some of the contextualized instructional strategies include the incorporation of hands-on-learning activities, laboratory experiments [7], excursion activities [8], real life examples and applications [2] in the lessons.

Despite the significant importance given on contextualized approach, it is found that the teachers experience challenges in implementing contextualized instructions in teaching-learning process. For instance, a study in Netherlands concluded that the curricula in Netherlands have become overloaded with content because of which the curricula are too often aggregations of isolated facts, detached from everyday lives [9]. Further, Angiwan, *et al*. (2018) affirmed that the centralized, rigid and strict nature of syllabi is one of the causes of teacher's reluctance to contextually based mediation in their everyday science teaching [10]. Additionally, the lack of competent teachers to make authentic connections to relevant context also adds a hurdle to effectively contextualize the lesson [11]. Furthermore, a study in Ethiopia found that the inadequate resources for hands-on-activities and excursion activities, as well as the laboratory equipment obstructed the effective implementation of contextualized approach [12].

In Bhutan, contextualization of curriculum started since 1980s with the inception of Bhutanisation of education system, whereby there was the replacement of some of the imported textbooks from India such as Druk Readers, Bhutan Geography, Bhutan History and Bhutan civics [13]. Later, in 1985 New Approach to Primary Education (NAPE) was launched with the main aim to bring the primary science curriculum and delivery of the

subject into the Bhutanese context [14]. The major reform in science curriculum was initiated by Department of Curriculum Research and Development (DCRD), in 10th Five Year Plan with the development of the Science Curriculum Framework for Classes PP – XII [14]. It is clearly stated in science curriculum framework that science, at all levels must be contextualized [15]. Guided by this framework, the chemistry textbook with new curriculum for class IX was implemented in 2016.

Hence, the researcher is interested in exploring the current trend of contextualized approach in teaching class IX chemistry, whose study is the first of it's kind in Bhutan. The study also aimed at examining the impeding factors for contextualizing class IX chemistry concepts and the possible methods to contextualize chemistry lessons. The findings will serve as a database to various stakeholders in Ministry of Education (Royal Education Council [REC], Dzongkhag Education Officer [DEO], Principals and chemistry teachers) to understand the current situation and take necessary actions in order to have effective implementation of contextualized approach.

2. METHODS AND MATERIALS

2.1. Research Design

This study was guided by social constructivism paradigm. The study used a qualitative research approach and case study design in which the data were collected by employing various data collection tools: semi-structured interview with three class IX chemistry teachers (denoted as T) and seven class X students (denoted as S), classroom observation (3 sections of class IX) and document analysis (current class IX chemistry curriculum and science curriculum framework).

2.2. Data Collection

Abundant data were generated through close interactions with the participants that contributed to have in-depth understanding on a contextualized approach in teaching class IX chemistry.

2.3. Data analysis

The data collected were analysed using thematic analysis method, described in Creswell's (2014) [16]. In this process, researcher organized the data and familiarized with the data which are in the form of interview transcripts, observation filed notes and document analysis report. After researcher was familiarized with the data, the researcher coded the data. The descriptive codes were generated by identifying the text segments within the textual data and assigning a code word or phrase that accurately described the meaning of the identified text segments. The coded data were then reviewed and grouped the codes with similar features together to generate the themes. The findings from the three tools were triangulated, thereby, validating the accuracy of the findings.

3. RESULTS AND DISCUSSION

The study revealed some important aspects and it is found that most of the chemistry teachers and students are not satisfied with the current class IX chemistry curriculum. Firstly, the text

book is found to be content-laden, consisting of detailed information for all the concepts. T1 said, "*The current chemistry textbook is content loaded. Everything is given in detail for all the concepts. So, I feel that I am just explaining whatever is given in the textbook when I teach chemistry*". This view is further, supported by the findings of document analysis of current chemistry textbook. It is found that the experiments reflected in the textbook consist of detailed observations and conclusion, besides aims, procedures and theories. Similarly, curricula in Netherland are also found to be overloaded with content that impacted the effective and interactive teaching and learning process [17].

Further, teachers in this study are with the views that the curriculum content is marginally contextualized. T3 shared, "*I am not satisfied with the contextualization of the concepts in the current textbook. We could hardly see the real life examples and applications given in the textbook, except for green chemistry chapter*". Similarly, it is found that the students find most of the chemistry concepts irrelevant and way away from day-to-day lives. For instance, majority of the students failed to perceive the relevancy and practical applications of chemistry concepts such as mole concepts, periodic properties and various chemical reactions, therefore, impeding to have meaningful learning. Additionally, S2 said, "*Other than global warming, I don't find any topics that are relevant to our life*". At the same time, S3 failed to perceive the relevance of elements of periodic table and its periodic properties in everyday life. Further, S1 asserted, "*I wonder where I will use those knowledge of various chemical reactions in my life*". Such type of findings on the irrelevancy of the concepts was also revealed by Tenzin *et al.* (2012), whose study, therefore, recommended Bhutanese science curriculum content to have more local examples [14].

Based on the aforementioned views of teacher and student participants, the present study states that the teaching and learning of class IX chemistry is still perceived to be challenging to most of the teachers and students. Chemistry is considered as one of the difficult subjects, consisting of intangible and abstract concepts, mainly because students fail to perceive the relevance and practical applicability of the chemistry concepts to our everyday lives. This is found to be a main reason for students' demotivation to actively engage in learning chemistry. Further, teachers claimed that it is very challenging to have interactive and meaningful chemistry classes. The same thing was observed during classroom observations, whereby, chemistry classes were mostly found to be teacher-centred with students as passive listeners and there were hardly any interactions in the class. Hence, it indicates that chemistry teachers are still in preference of traditional lecture method of teaching with the minimal implementation of contextualized approach.

Contextualized Instructions

The findings of this study revealed that the use of effective contextualizing instructional strategies by the teachers is the main aspect of contextualized approach. This was consistent

with the findings of a study on contextual approach to chemistry instruction in North Tama High School in Traer, Iowa a small rural town in United States, stating that it is the role of the teachers to contextualize the lessons by using various contextualized instructions, even if the curriculum content is not contextualized [18].

The study found that one of the methods to enable students to see the practicality of the theoretical concepts is through laboratory experiments. T2 said, "*When we engage students actively in scientific practical work, it provides students with hands-on experiences through which they get to understand the practical applications of the theoretical concepts taught in the class*". Correspondingly, S2 stated, "*Chemistry is all about chemical reactions which are very difficult for us to understand and I feel that if those reactions are shown practically through experiments, we will be able to understand better*". Hence, the findings revealed that the students succeed in-depth understanding of chemistry concepts with real life applications when they explore themselves through practical activities in the laboratories. Several other studies have confirmed that the experiments help student link theory to practice, besides improved learning and performance [19].

However, the other findings of the present study confirmed that very minimal laboratory experiments are conducted for class IX chemistry. Hence, the presence of mismatch between teachers' and students' positive perception on the need of laboratory activities and their actual integration of laboratory activities in the chemistry lessons is deduced. The teachers believed that lack of adequate laboratory equipment and chemicals in their chemistry laboratory as the main hindrances to carry out the most of the practical activities reflected in the textbook. This finding was in agreement with the findings of Sesen and Tarhan (2011) where they found that the inadequate resources such as chemicals, apparatus and other laboratory facilities contributed to the minimal possibilities of laboratory activities [7]. Time constraint is found to be the other factor for the minimal conduct of practical activities. The instructional time per period is only 40 minutes, from which, it is observed that teachers get hardly 30 minutes to take actual class. Within half an hour, in fact, it would be very challenging to complete any kind of experiment. The similar finding on the time constraint, impeding to carry out laboratory experiment regularly is reported by class XI students in an exploratory case study in Bhutan [20].

The results also revealed that enriching lesson with the real life examples and applications is one way of teaching chemistry concepts at the learners' context. Incorporating real life examples and applications in the lesson help students to make the connections of theoretical concepts of chemistry to the day-to-day life. S5 said, "*From the concepts on reactivity series of metal, I learnt that the gold is the least reactive metal. I still remember that this is the reason why the things like ring, ear ring, chain and other things made up of gold do not get faded and damaged for longer duration. As we all*

know, iron rod easily gets rusted when we keep it in open area because it is reactive metal".

During classroom observation, it was observed that T1 explained the arrangement of elements in the periodic table (elements with similar properties in same group), making connection with the arrangement of books in library (figure 1).

The same teacher then gave acronyms to memorize the first twenty elements of the periodic table. The acronym for first 10 elements was in English version while for other 10 elements was in Hindi version (figure 2). It was observed that teacher failed to explain or translate what that Hindi version means. As a result, students were interested to learn the acronyms of first ten elements and reluctant for next ten elements.

Based on the above data, the present study confirmed that the infusion of real life examples and applications in the lesson enhance motivation of students to learn and better understanding of the chemistry concepts. It is also evident from the interview that the students are able to apply the knowledge gained in rate of reaction to their day-to-day

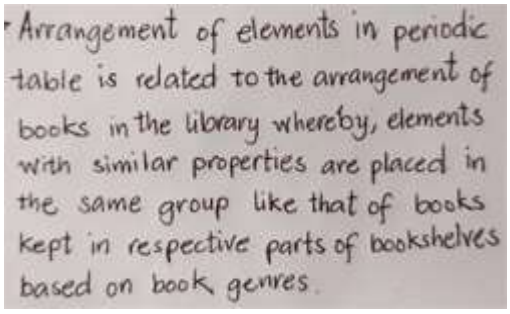

Figure 1: Example of contextualized approach

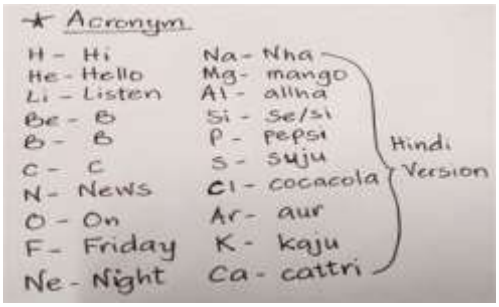

Figure 2: Acronym of first 20 elements

lives, which is said to be taught by using real life examples and applications. Hence, it is clear that enriching lesson with the real life examples and applications is one way to contextualize the chemistry concepts.

On the other hand, the findings of the study also affirmed that the focus is mostly given only on the examples and applications reflected in the textbook, which is very minimal. The reason could mainly attribute to the minimal instructional hours to cover vast syllabus that obstructs to carry out activities involving maximum real life examples and applications. This finding is consistent with the findings of Sherab and Dorji (2013) whose study on pedagogical practices in schools of Western Bhutan claimed that teachers need to teach by drawing wider examples from the real-life context, rather, than sticking only to the content given in the textbook [26]. Similar conclusion was drawn in other studies that in the name of bulky syllabus and time constraint, teachers usually focus only on the syllabus coverage and are reluctant to draw the information beyond prescribed content [11].

Therefore, the present study suggests the necessity to connect chemistry concepts and daily life to a larger degree. It means that learning scientific facts, concepts and natural

phenomena in school should not be separated from the context in which they appear. It is through the infusion of real life examples and applications in the lesson that the context of the learners can be taken care in the process of teaching and learning.

All the teacher participants shared that excursion activities such as field trips, out-of-class activities and visiting resource person can be one of the effective contextualized approaches that involve every student in visual and real world practical experiences. Similarly, a study in one of the universities in Canada reported the importance of outdoor educational activities in extending the opportunity for the experiential learning to the students [8]. Additionally, S3 stated, "*We wish our chemistry teacher take us out of class sometimes for some activities so that most of the students will learn with more interest. Most of us feel bored in chemistry class when our teachers teach the chemistry concepts, simply by explaining in the class and all we have to do is listen and imagine*".

Hence, the study found that the incorporation of relevant excursion activities enable students to have direct experience with the concrete phenomena and materials of the relevant concepts, thereby, enhancing the motivation and enthusiasm of students to learn chemistry. Although, teachers and students exhibited positive attitude towards excursion activities, the findings of this study indicated that hardly any kind of excursion activities are carried out in school. This is attributed to the lack of easily accessible relevant sites for field trips, experts or relevant resource person and time constraint. This finding is well supported by Forest and Rayne (2009), whose study reported the similar challenges of managing time from daily instructional hours and distant location of the relevant sites for field trips [8].

Furthermore, the present study regarded the importance of considering prior knowledge and experiences of the learners in the process of teaching and learning, as one of the strategies to contextualize the chemistry lesson. The study found that the students could feel and see the real life applications of the chemistry concepts when the concepts are taught in relation to their existing knowledge and everyday experiences. T2 shared, "*When we relate the concepts with their existing knowledge and everyday experiences, students can visualize the practical applications of the concepts and it enhances in-depth understanding of the concepts*". When asked how teachers consider the prior knowledge and experiences of the learners, T3 replied, "*I contextualize the lesson by taking child's experience as a fundamental starting point in the teaching-learning process. For example, when I teach temperature affecting the rate of reaction, I relate it with the students' experience of water boiling faster on larger flame than smaller flame*".

The teaching approach that builds on the prior knowledge and experiences held by students enhances relevance in the eyes of the students. The findings of this study also revealed that learning and understanding of new concepts becomes much easier when the learners are equipped with adequate prior knowledge and experiences based on which the new concepts are taught. This is because the existing prior knowledge and experiences elevate learners'

thinking. Further, their ability to link and relate the new knowledge to their prior knowledge help them to understand the new concepts systematically. Correspondingly, a study in Finland also reported that the quantity and quality of prior knowledge influence both acquisition of knowledge and the capacity to apply higher order cognitive problem-solving skills of the students [22].

However, during a review on curricular contextualization in European countries for a period of a decade from 2001 to 2010, it was found that most of the teachers give minimal importance to the learners' prior knowledge and experiences [23]. Similarly, the present study found that the learners' prior knowledge and experiences are predominantly used only for recapitulation of the concepts learnt in the lower classes in lesson introduction part.

Impeding Factors for Contextualized Approach

It is found that science curriculum framework, 2012 demands the curriculum content to be developed based on the learners' experiences from their everyday lives for the science subjects of all levels in Bhutanese education system [24]. However, the findings from this study revealed that the current class IX chemistry curriculum content is minimally contextualized. Majority of the participants pointed out that the current chemistry textbook is content-laden with minimal real life examples and applications, which was considered to be one of the impeding factors for effective implementation of contextualized approach. Further, it is because of the minimal use of Bhutanese context and contextual language in the current chemistry textbook. This finding is parallel to the findings of Tenzin *et al*. (2012), who reported that Bhutanese science curriculum of class IX – XII is mostly academic and content focused with limited examples and applications from everyday life [14].

On the other hand, the present study found that most of the students prefer to have curriculum content consisting of real life practical experiences, rather than focusing merely on theoretical parts. It is the general perception that students feel the concepts irrelevant and abstract if the real life examples and applications are not given. Stating examples of periodic table concepts and mole concepts, student participants shared that those concepts are not related to everyday life and they don't feel like studying those concepts. The findings of other study also recommended Bhutanese science curriculum content to have more local examples, including field trips and projects, rather than a decontextualized chapter like that of organic chemistry and periodic table [14].

The findings of the study revealed inadequate resources as other impeding factor. Although, all the teachers and students have a positive attitude towards the out-of-class educational activities as a part of contextualized approach, the other findings of the study reported the impossibilities to have out-of-class excursion activities, owing to the lack of adequate resource sites, resource personals and other necessary resources nearby the school. Additionally, inadequate laboratory facilities such as out-dated and insufficient chemicals, reagents and equipment are claimed to be other

aspects of inadequate resources. T1 stated, "*Due to the lack of proper laboratory facilities, enough necessary chemicals and equipment, it is very challenging to carry out the experiments and hands-on-activities in laboratory*". Similar finding on the limitation of necessary resources in the school hindering the contextualization of the chemistry curriculum was reported in Swaziland and Ethiopia [1, 25].

Further, it is evident from the classroom observation that a school lack the basic teaching aids for chemistry such as modern periodic table chart and molecular model kit. The minimal use of teaching aids in chemistry classes is also supported by the students. On the other hand, Schwartz (2006) in Philippines reported that one of the major points in chemistry curriculum contextualization is about using improvised teaching- learning materials made out of the locally available resources [26]. In line to this, teachers, in this study are found using improvised periodic table chart (figure 3). However, it is observed that the periodic table chart used was not very clear and most parts of the chart are invisible to the students at the back. On the other hand, T2 was drawing the rough sketch of periodic table on the board, which was found to be time consuming as well as not very clear (figure 4). Hence, it is recommendable for the teachers to ensure that their improvised teaching aids are clear, meaningful and purposeful.

All the teacher participants shared that they don't get enough instructional hours which is considered to be the major factor impeding to contextualize the lesson. T1 stated, "*For chemistry, we get only 40 minutes of 3 periods in a week. I would say that this is very less to cover the prescribed syllabus of chemistry, if we have to contextualize every lesson*". Similarly, T3 elaborated, "*I think, to connect the concepts to the real life, come up with so many real life examples and to see the practicality of the chemistry concepts, it really requires enough time which is very difficult for us to manage in reality*". As shared by teacher participants, it is found that the instructional hours of 40 minutes of three periods per week is based on the document on rationalization of school curriculum & instructional time allocation (REC, 2019) [27]. Further, as per this document, the current class IX chemistry syllabus should be covered within 66 periods of 40 minutes per period in a year (figure 5). On contrary, it is found that the syllabus of the same textbook is developed for 96 periods of 45 minutes per period in a year as shown in figure 6.

Figure 3: Improvised modern periodic table chart

Figure 4: Periodic table drawn on the board

The aforementioned discrepancy between the number of periods allocated and the actual number of periods required as per the prescribed syllabus clearly indicates that the current chemistry syllabus is vast, compared to the instructional time provided in real classroom situations.

The present studies have shown that the effectiveness of context-based approach depends on the efficacy and competency of the teachers who play a central role in curriculum delivery and implementation. However, it is found that class IX chemistry is allocated for fresh graduate teachers, who claimed that due to the lack of experiences in teaching, they are not equipped with enough instructional strategies to contextualize the lessons. Most of the teachers expressed that the experience contributes to the competency of the teachers.

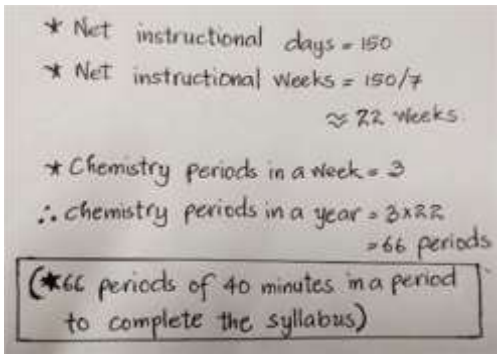

Figure 5: Revised Instructional time allocation for class IX chemistry

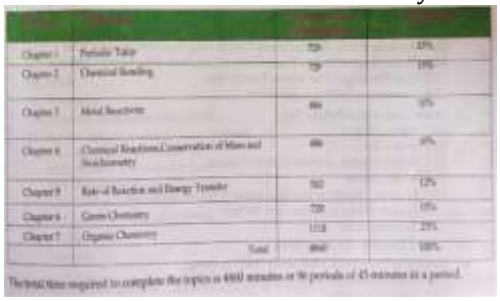

Figure 6: Number of periods as per prescribed syllabus

T1 asserted, "*Being a fresh gratitude in the field, I at times lack confidence and face difficulty in choosing the right teaching strategies due to the lack of experiences. Further, I am not aware of prior knowledge and experiences that students possess. I also think that, we are not adequately equipped with the ways to contextualize the lesson. This could be the one reason for me to be handicapped in the field, especially in terms of contextualizing the lesson and I think it would be better if we get some training or workshop on this topic*".

Additionally, it was found that experience matters to understand the existing prior knowledge and experiences of the students beforehand and accordingly, plan and implement the lesson effectively. This is in agreement with the findings of a study with Zambian teachers, who reported that first year teachers possessed insufficient conceptions of students' prior knowledge and its role in instruction, while experienced teachers hold complex conceptions of prior knowledge and make use of it in significant ways during instruction [28]. Hence, the need to have experienced and competent teachers who can invest much time and effort and carry out well-thought preparation to have successful contextualized lesson is reported in this study. Further, the present study suggests having more trainings and professional development programs on the pedagogies related to the contextualizing of the lesson.

4. CONCLUSION AND RECOMMENDATION

Teaching and learning of class IX chemistry is still perceived to be challenging to most of the

teachers and students. Chemistry is considered as one of the difficult subjects, consisting of intangible and abstract concepts, mainly because students fail to perceive the relevance and practical applicability of the chemistry concepts to our everyday lives. This is found to be a main reason for students' demotivation to actively engage in learning chemistry. However, the study revealed that the aforementioned negative attitude of students towards learning chemistry can be minimized by employing contextualized approach in teaching and learning chemistry. With the greater possibility to bring the chemistry concepts to the real life context, contextualized approach plays a significant role in enhancing the students' motivation and meaningful learning of chemistry concepts.

The study concluded that students should be actively engaged in learning to have effective implementation of contextualized approach. This can be possible, firstly, by employing the instructional strategies that involve students' participation in hands-on-learning activities. Secondly, the context of the learners can be taken care in the process of teaching and learning through infusion of real life examples and applications in the lesson. Thirdly, the excursion educational activities such as field trips and other inquiry-based learning activities, outside the class enable students to have experiential learning. Finally, students could feel and see the real life applications of the chemistry concepts when the concepts are taught in relation to their existing knowledge and everyday experiences.

Conversely, it is found that the class IX chemistry classes are mostly teacher-centred, confined within the four walls of classroom, with the minimal interactive activities. The teachers usually focus on the content given in the textbook. The fewer real life examples and applications are drawn from other sources. Further, there is no record of any kind of excursion activities carried out for class IX chemistry. It is also found that the chemistry laboratory is minimally used for relevant experiments.

The present study, therefore, found a gap still existing between what is reflected in science curriculum framework and the actual practice of contextualized approach in real classroom situations. As per the science curriculum framework, not only the curriculum content should be contextualized, teachers should also be responsible to contextualize the lessons. However, the study revealed the minimal implementation of contextualized approach in teaching class IX chemistry. This is attributed to the wide range of impeding factors. Analysis from this study revealed that the curriculum content of current class IX chemistry textbook is minimally contextualized except for the chapter on Green chemistry. The lack of adequate resources that include laboratory equipment and chemicals, relevant sites for field trips and other excursion activities, resource persons or experts and teaching aids, is reported to be another hindrance. Additionally, time constraint and lack of experienced and pedagogically competent chemistry teachers were found to be other

challenges to have effective implementation of contextualized approach.

Therefore, the study recommends the REC to revisit on the curriculum content in terms of contextualization as well as the instructional time allocation for chemistry as per the prescribed syllabus. Further, DEO and school management should ensure the relevant professional development programs on pedagogical knowledge and skills on contextualized approach. Above all, it is highly recommendable to the chemistry teachers to make a paradigm shift of teaching pedagogy towards the contextualized learner-centred pedagogy and make best use of available resources such as laboratory facilities and teaching aids to contextualize the lessons.

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6. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

7. SOURCE/S OF FUNDING

No source of funding

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