

Enhancing Chemistry Learning Using Language Supportive Pedagogy in Multilingual Classroom

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Abstract

While there is a rich literature on science teaching and learning, little is hardly documented about how Chemistry learning is enhanced in lower secondary schools in Tanzania. This qualitative study assessed Chemistry learning using the Language Supportive Pedagogy (LSP) approach in multilingual classrooms. The study was conducted in community secondary schools in Kagera Region and it involved 30 Form II students who were randomly selected. It also involved 5 in-service Chemistry teachers in the host schools and 5 student teachers from the University of Dodoma with Chemistry specialties and Language Supportive Pedagogy (LSP) skills. Both in-service and student teachers were purposively selected for the current study. LSP employed a bilingual teaching approach whereby Kiswahili was strategically used alongside English to enhance Chemistry learning. Data were collected through interviews, Focus Group Discussions and classroom observation. The study findings revealed that most students were able to use subject specialism vocabulary when interacting with fellow students, teachers and subject matter, participate in English discussion and respond to questions in English despite minor grammatical errors in their speeches. Similarly, in-service teachers, student-teachers and students recommended the LSP approach to facilitate more engagement of students in Chemistry learning through intentional scaffolding. The study concludes that more students engage in learning activities through familiar language and instructional scaffolding assured students' confidence and interest in learning Chemistry. It recommends the scaling up of the LSP approach in other regions in Tanzania in an attempt to enhance smooth Chemistry learning.

Keywords: *Language Supportive Pedagogy (LSP), multilingual classroom, "English only" approach, bilingual teaching approach*

INTRODUCTION

Language Supportive Pedagogy (LSP) is an approach that integrates language learning into the teaching and learning of different subjects among students whose language ability is not sufficient for learning

subjects effectively without support. The LSP approach is increasingly drawing attention in Sub-Saharan Africa and Tanzania is no exception. The education and training policy of Tanzania recommends Kiswahili¹ as the language of learning and teaching (LoLT) for public primary school² education and English as LoLT for secondary and higher education (United Republic of Tanzania [URT], 2014). As Brock-Utne (2006) insists, the secondary schools which receive students from public primary schools do not aim at giving the learners any specific language proficiency qualifications as a preparatory step before being taught in English. If the learners are not furnished with any specific language proficiency, how will they master science content tailored to the language which they lack proficiency?

Sumra and Katabaro (2014) enlighten that the current practice of using Kiswahili in primary schools for the vast majority of children and English at secondary and higher levels is creating quality problems at the secondary school level. The findings by Cantoni (2007) corroborate those by Sumra and Katabaro in that the sudden transition from mother tongue to English instruction creates some descent in the participation of the pupils and possibly in the learning in the new language and content subjects. The fact that the issues related to language of instruction, as Adamson (2016) also explicates, should be fundamental to any definition of quality education or learning as it is the medium through which learning is communicated and most often demonstrated. Contrary to Adamson's argument with regard to the significance of language of instruction in relation to quality of education, the case is appalling in Tanzania. Despite teaching English as the subject from the first year of primary school, many children, do not acquire adequate proficiency to cope with an English medium instruction upon joining secondary education (Joyce-Gibbons et al., 2017). According to Joyce-Gibbons et al., some students lose hope, especially when they meet English language at secondary schools, and to some, it acts as a barrier towards students' understanding with regard to what the teacher is teaching and it suppresses their capacity to learn.

¹ Kiswahili is a Bantu language originating from the coastal areas of East Africa, which serves as an accessible lingua franca for most Tanzanians. It is also the Tanzania's national language which also serves as a native language to most Tanzanians notably those born and raised in urban Tanzania.

² They are primary schools in the country are accessed by the children from low-income families and those who do not have access to sponsorship.

To address the challenge of English proficiency among secondary school entrants, the first eight weeks are currently spent for English orientation course which aims to equip the referred entrants with necessary language skills before the commencement of secondary education. However, the experience shows that English teachers do less than required for a typical orientation, not to mention the ability of other subject teachers to teach English (Sane, Ndabakurane, & Biseko, n.d.). As such, the science curriculum, as conceptualized and delivered, does not necessarily consider the learners' level of proficiency in the language of instruction, in this case, English. The fact that most of the learners in lower secondary schools lack considerable English proficiency to cope up with academic needs in subjects content has consistently been emphasized in Tanzania (Ndabakurane, 2020). Ndabakurane further reports that whenever English is used as the sole medium of instruction through "English only" approach, the class becomes less interactive by most of the learners being silent. The relationship between language mastery and meaningful learning has largely been documented by Wang and Qi (2018) and Cantoni (2007). The aspect of learner's language proficiency has not been given due attention and it is normally detached from science learning as long as science does not have language component. This motivated the author to address the question of language in science learning in a multilingual classroom³ as a question of learners' concern through LSP in selected community secondary schools in Tanzania.

Principles of Language Supportive Pedagogy (LSP) Approach

The LSP is considered to be a pragmatic response which builds on enduring challenges to learning science content by enhancing language skills to enable the learners with limited language proficiency cope with subject content offered in the language that they require proficiency. It also brings together language educators and other experts (science educators in this context) to develop an approach that supports students' subject and language learning all together. According to Rubagumya, Sane, and Ndabakurane (2021), the principles of LSP require the subject teachers to:

- i) Guide the learners to accomplish activities by giving them clear

³ This is a classroom which comprises students who are capable of using (mostly in spoken context) three languages. However, most students would adeptly speak two languages namely Kiswahili and Ethnic Community Language (ECL). English comes in as a third language through classroom learning.

- instructions. The teacher can still use the learners' first language when necessary;
- ii) Encourage learners to discuss using the language that they are familiar with to clearly conceptualize the content and connect it with what they learnt before;
 - iii) Make sure that everyone fully participates in class activities;
 - iv) Help them prepare their English presentations for the class;
 - v) Make sure that everybody gets an equal opportunity to prepare and present responses to the class;
 - vi) Encourage more girls to participate actively because in many rural schools, boys get more opportunities to participate compared to girls and
 - vii) Clarify all unclear points to encourage learners to read further.

The suggested principles of LSP are accomplished through the strategic use of Kiswahili. In this context, strategic use of Kiswahili implies that Kiswahili should be used when the needs arise. Therefore, implementation of LSP approach recognizes parallel use of English and Kiswahili. This fact is supported by Cummins (1980a) as quoted in Baker (2006) in that information processing skills and educational attainment may be developed through two languages as well as through one language. The two languages should, however, be equally successfully developed. In some circumstances, Kiswahili is not necessarily used in LSP classroom. The teacher may use a variety of teaching approaches which requires the teacher to simplify his/her English, thus making his/her students connect well with the content being covered.

The author of this paper would like to emphasize that LSP embraces bilingual approach without affecting the current language policy. It does, however, not suggest the replacement of English by Kiswahili but working in harmony. It is, therefore, worth mentioning that LSP approach is in tandem with the current parameters of the current education and training policy of Tanzania. The policy provides that Kiswahili as the national language will be used for teaching and learning at all levels of education and training, and the government will introduce a mechanism to facilitate the sustainable and effective use of this language in providing the targeted people with productive education and training both nationally and internationally (URT, 2014). URT further provides that the government will maintain the mechanism of strengthening the use of English language in teaching and learning at all levels of education and

training. Although the two clauses contradict each other by recommending both Kiswahili and English to be used in teaching and learning at all levels of education, the strategic use of Kiswahili medium in teaching Chemistry content stands to be a viable option in multilingual classroom. According to Mulwa (2014), the language used for thinking is most likely to be the learner's first language. Simultaneous use of two languages has been recommended by Creese and Blackledge (2015) in Chinese classroom context. For instance, both Chinese and Gujarati were needed for the story to be understood that is, the teacher used and allowed the student's bilingualism for the story to be made complete. It should, therefore, be noted that there is no harm behind simultaneous usage of both English and Kiswahili in the classroom context as Kiswahili can facilitate English learning.

Studies on Science Teaching Strategies

Teaching and learning Physics, Geography and Chemistry has not been effective in Tanzania, the context whereby Kiswahili is predominant (Maganga, 2016) due to learners' poor capability in English, which limits their ability to understand concepts. Bikongoro (2012) opines that most students from Swahili-medium primary schools fail secondary school examinations due to their insufficient English proficiency and fail to grasp large parts of the content presented in English in most lessons at secondary school level. Elsewhere, South Africa included, poor learner achievement has been closely linked to several factors including limited English language proficiency and literacy (Prinsloo, Rogers, & Harvey, 2018). In Kenya, Mathematics communicated in one language might need to be translated into another language to allow thinking and then translated back in order to converse with the teacher (Mulwa, 2014). For effective science learning, the learner must play an active role in 'taking on' the new knowledge through the range of learning activities (Millar, 2004). Millar further reveals that a learner has to 'make sense' of the experiences and discourse of science class, and use it to 'construct meaning'.

Bruun and Christiansen (2016) insist that fundamental insight should be utilized in teaching by devising experiments and teaching that explores the analogy between the students' basic bodily experiences and physical concepts and language. The use of local material adds value in terms of their content and pedagogical skills, creativity and confidence in teaching practical lessons (Kira & Nchungu, 2015). Millar (2004) reports that

learning science should involve seeing, handling and manipulating real objects and materials, and that teaching science will involve acts of 'showing' as well as of 'telling'. According to Yitbarek (2012), low-cost apparatus from locally available materials is believed to enrich the capacity to observe, explain and do real science. To meet the aim of utilizing locally available resources at low costs, Kira and Nchunga (2015) conducted practical lessons using local materials such as pins and plastic bottle to demonstrate the concept of floatation in connection to students' life situations.

Bonces (2012) and Harrop, E. (2012) propose Content and Language Integrated Learning (CLIL) as an effective approach in learning subject content as entails teaching the foreign language while students learn the subject – matter. In its broader sense, CLIL refers to any dual focused type of provision in which a second language, foreign or other, is used for the teaching and learning of a non-language subject matter, with language and content having a joint and mutually beneficial role (Marsh, 2002 as cited in Harrop, 2012). Given the fact that CLIL accommodates the learners with diverse language backgrounds, it can, therefore, translate well an aspect of placing learning in a truly multilingual context. According to Bonces (2012), CLIL has been able to guarantee students communicate academically and socially and it opens new borders and encourages students to explore and travel around the world.

The reviewed literature presents the rich strategies used to enhance science teaching and learning at various levels of education. It is evident that science learning enhancement may be accomplished through translation of difficult or unfamiliar vocabulary to students, a range of activities, drawing on learner's past knowledge and experiences, experiments, practical works, local material, manipulation of real objects and scaffolding by the knowledgeable other. However, to enhance effective science teaching, the strategies in question need to be integrated with LSP approach if the desired outcomes were sought. This study argues that employing Chemistry learning strategies in Tanzanian context (where students' English proficiency is relatively low) in isolation from language component is as good as disconnecting the learning process. The fact that the language should be developed in order to enhance Chemistry content learning and fully functioning of the child's cognitive system is contrary to what transpires in both Tanzanian educational system and classroom context. The current study, therefore, is an attempt to enhance

Chemistry content learning using Language Supportive Pedagogy (LSP) approach in multilingual classroom. It uniquely employs strategic use of learners' familiar language, in this context Kiswahili, in learning Chemistry content. It also inculcates a sense of collaboration between the Chemistry teacher and language teacher or expert in the preparation of the lesson plan. The role of the language expert is to integrate language aspects in attempt to enhance smooth science learning among students whose English proficiency is undoubtedly low.

METHODOLOGY

The current study was conducted in Kagera Region in Tanzania in 5 community secondary schools which were purposely sampled. It employed qualitative research approach in collecting the data. According to Haradhan (2018), qualitative research is a form of social action that stresses on the way of people interpret, and make sense of their experiences to understand the social reality of individuals. The approach in question was ideal since the current study accommodate the data obtained from interviews, classroom observations and focus group discussion. Most of such data, as Haradhan (2018) insists, seek to explain 'how' and 'why' a particular social phenomenon, or program, operates as it does in a particular context.

It adopted classroom ethnographic research design around which the research activities were based. Classroom ethnographic research seeks to understand what is taking place in the classroom as the teacher interacts with the students and how the interaction of the students and their teacher in the classroom reflect the multiple social and historical contexts in which they are embedded (Bloome, 2012). In essence, the researcher sought to observe the interaction between the teacher and students, students and Chemistry content and students and students during Chemistry learning through LSP.

The study involved Form II students who were obtained through random sampling. The selection of Form II class was based on the fact that this is among the transition classes whose learners' poor capability in English limits their ability to understand concepts in Chemistry (Maganga, 2016). A total of five (5) student teachers from the University of Dodoma with Chemistry specialties and LSP skills and 5 in-service Chemistry teachers (in host schools) were purposively selected for the current study. On the

other hand, the total of 30 Form II students were randomly selected for the current study.

The data were collected using interviews which were administered to both student teachers and in-service teachers in the host schools and focus group discussions which were administered to Form II students having been oriented towards LSP. Moreover, classroom observation was conducted while the student teachers taught Chemistry using LSP approach in the classroom context. The in-service Chemistry teachers from the school's understudy were invited as the co-observers. The in-service Chemistry teachers' role was to observe the implementation of LSP approach in the classroom context and eventually give their opinion on its effectiveness in enhancing science content learning among Form II students.

Taylor, Sinha and Ghoshal (2006) revealed that the nature of the data determines which methods of data analysis are applicable. The data which were obtained through interviews and focus group discussion were first listened to in order to ascertain the quality of the data in relation research objectives requirements. The qualitative data on the form of written and verbal texts were further subjected to coding and later reduction of wordy details and selection of pertinent information regarding its richness in data. The analysis stage was followed by establishment of themes and sub-themes to reflect the occurrence of the details on the research tools.

FINDINGS AND DISCUSSION

Lesson Preparation and Associated Challenges

Among other things, LSP considers collaboration in lesson preparation whereby teachers with distinguished expertise in relevant science subject collaborate with language specialists in the preparation of the lesson plan. The preparation of some Chemistry lessons involved the student teachers (prospective Chemistry teachers) and researcher who is a language expert. The main role of the language expert was to facilitate stating of language objective in Chemistry lesson plan and determine the nature of activities that would engage learners in the learning process and foster subject specialism language. Therefore, the language aspect was highly considered in order to enhance the students' English proficiency, which would in turn, enhance the mastery of Chemistry content. Some of the language supportive aspects included loud reading, pronunciation, writing, forming simple English sentences using different scientific terms,

translation (from English to Kiswahili) alternatives, strategic use of Kiswahili, pictorial representations, probing statements etc.

According to student teachers, LSP implementation was associated with several challenges. Firstly, lesson preparation is challenging since planning and integrating language-related issues that would enhance Chemistry learning among students are apparently cumbersome due to their limited scope in language issues. Moreover, implementation of LSP approach, particularly reading and writing, is difficult for most students due to limited English proficiency, thus making it difficult to enhance Chemistry learning among some students. Limited English proficiency among most students is worsened by the influence of the mother tongue which limits them in mastering some English aspects such as pronunciation. For instance, the vowel phonemes /ei/ and /ai/ as used in words such as “lake” and “like” were clumsily articulated due to students’ mother tongue. The words “lake” and “like” would be pronounced as /laik/ and /leik/ respectively instead of /leik/ and /laik/ respectively. The issue of language problem among the students transiting to secondary school has acutely been reported by several scholars such as (Brock-Utne, 2006: Qorro, 2006).

Secondly, LSP approach was reported as being time-consuming in its implementation, thus making it too challenging to locate learning activities which engage students directly in the prescribed time. Thirdly, encouraging some students, in some cases, becomes difficult especially having demonstrated low confidence in making presentations and responding to questions in English. In some instances, some students felt shy when laughed at having made language mistakes amid responding to questions. Fourthly, the number of students is recorded at 75 instead of the recognized or recommended number which amounts to 45. The issue of overcrowded classes was also noted by Jidamva (2012) to be the major hindrance towards quality teaching and learning in schools. Therefore, attending 75 students in an attempt to realize the goals of LSP was difficult since the teachers could not effectively render scaffold to needy students.

Instructional Strategies and Language Supportive Activities in LSP Class Execution of LSP encompasses a wide range of teaching and learning strategies. During some Chemistry lesson, teachers encouraged the students to express themselves using Kiswahili especially at times when

they failed to do so in English. The fact that Kiswahili was strategically employed in clarifying some of the Chemistry concepts which seemed cumbersome was evident in several learning activities. For instance, the students were allowed to use Kiswahili to explain some Chemistry concepts such as melting point, freezing point and molten material notably having failed to explain the same in English. It was also strategically used by teachers through translation (from Kiswahili to English) of some Chemistry terms such as manufacturing, carbon, non-polar and polar solvent which seemed difficult. The finding in question is in consonant with the finding by Mpapalika (2013) in that teachers in Tanzania opted to use 'Swahili' language in order to support the learners to elaborate scientific concepts.

LSP approach operates in the parameters of interactionist theory (Vygotsky, 1978), which stress that learning occurs through interaction. This was evident in LSP classes through grouping students into group discussions in which they interacted over Chemistry material. Group discussions on various concepts or activities give students good opportunity to express their own ideas and enhance their language proficiency (Juan, 2014). The role of discussion is of paramount importance in that it engages the students and encourages their active participation in teaching and learning process (Garrett, 2008). For effective learning, LSP class encourages interaction among students, with the teaching and learning materials and with their teachers. Linking the lesson of the day with what was previously taught was observed through a myriad of tasks. For instance, in some instances, there was a brainstorming session before the coverage of the planned lesson items. Brainstorming focused on concepts such as autotrophs, polar and non-polar solvents, poisonous compounds, just to mention a few. The teachers also executed LSP by drawing from the students' prior knowledge during Chemistry lessons. By doing so, LSP was observed through encouraging learners to respond to various questions or tasks before teaching the planned concepts.

Other tasks which were assigned to students in attempt to engage them in classroom interactions included giving explanations on various concepts, question-answer quizzes or challenging tasks, deriving formulae on scientific concepts such as electrovalent and electrolysis. Furthermore, demonstration of various experiments and discussions over various Chemistry matters followed by presentation of findings were also meant

to engage students in learning Chemistry through LSP. LSP qualities were overtly evident especially in the instances when some of the students failed to pronounce some of the scientific vocabulary such as crystalline, ionic bond, cathode, anode and aqueous and use the same in spoken text. In some circumstances, the subject teacher would encourage students to speak out as they demonstrated their findings on the chalk board by writing in order to enhance Chemistry vocabulary use in both spoken and written texts. Initially, the calculations on the chalk board were done quietly due to lack of proper Chemistry vocabulary to use and how to use them during the presentation.

Despite being able to employ a variety of instructional skills, some of the teachers still face language problem especially in grammar and pronunciation. The teachers' limited pronunciation and grammar were reflected through the following sentences as captured during Chemistry lesson:

T 1: Write five different between cathode/kæsd/ and anode/ænød/.

Ideal grammar and pronunciation: Write five differences between cathode/kæθød/ and anode/ænød/.

T 2: It is something/sæmsɪŋ/ which look like a mirror/mɪrə/.

Ideal grammar and pronunciation: It is something/sæməɪŋ/ which looks like a mirror/mɪrə/.

T3: If someone is running, it is movement/mʊvmənt/ or locomotion/ləʊkəməʊʃən/?

Ideal grammar and pronunciation: If someone is running, is he/she making a movement /mu:vmənt/ or locomotion/ləʊkəməʊʃən/?

T 1: Ion is a feature of the radio/redɪə/ battery/betɪrɪ/?

Ideal grammar and pronunciation: Is ion a feature of the radio/reɪdiə/ battery/bætəri/?

T 2: What you mean by crystalline/kraɪstælɪn/?

Ideal grammar and pronunciation: What do you mean by crystalline/kristələm/?

T2: Ok. Radio battery is ionic/ɪjənɪk/ or non-ionic/næn-ɪjənɪk/?

Ideal grammar and pronunciation: Ok. Is radio battery ionic/əɪənɪk/ or non-ionic/nɒn-əɪənɪk/?

Source: Classroom observation

With reference to above teachers' sentences, it is evident that some of the teachers still face grammar and pronunciation challenges as the sentences

in question clearly indicate. The analysis indicates that the first sentence bears an adjective “different” which was wrongly used. The word “differences” which is a noun appears to be an appropriate word to make the sentence grammatical. The grammatical aspect appears to still be a problem among some of the teachers who seem to face a lot of challenges in “question forming” as revealed in the sentences as captured from the teachers during Chemistry lessons. The pronunciation aspect has inherently been a big challenge among some of the teachers as some of the key words in the subject matter were wrongly pronounced as revealed in all sentences. As Gilakjani (2016) affirms, limited pronunciation skills among the students may limit subject’s content understanding. Gilakjani further affirms that if learners cannot utter the correct version of a word, they may consequently not be able to communicate it correctly.

Limited English proficiency among science teachers is also evident in other countries where English is used as language of instruction. This may, among other factors, be attributed to limited exposure to English use especially outside the school premises. As Hormarsdottir (2006) insists, most science teachers in South Africa do not use English outside the classroom setting and, as a result, their own exposure to the language is also limited. Such limited language proficiency among teachers is what Brock-Utne (2006) refers to as humiliating experience which may not happen when the teaching is in Kiswahili. This implies that strategic use of Kiswahili may save the teacher from English humiliating experience.

Through LSP approach, the learners were encouraged and oriented to participate in classroom activities that develop language skills, namely listening, reading, speaking and writing. Cummins (1980a), as quoted in Baker (2006), argued that speaking, listening, reading and writing in the first or the second language helps the whole cognitive system to develop. Several learning activities such as presentation of responses orally before the class and orienting students to correctly pronounce scientific terms such as crystalline, ionic bond, cathode, anode, compound, aqueous, electrolysis etc. were geared to enhance both presentation confidence and speaking skills among students.

Despite the big number of students in the class, group activities constituted part of the learning activities and were frequently given amid the teaching and learning process. During group activities, the learners taking part in the discussion were given greater autonomy to choose the

language to be used in discussing Chemistry subject concepts as assigned by their subject teachers. In the environment where English was used for discussing assigned tasks, the discussion was conducted in whispers. On the contrary, the discussion was actively done whenever Kiswahili was used as the medium for discussion. An appropriate thinking would rather be done in a familiar language than in a foreign one (Baker, 2006). After the discussion, the students were willingly asked to present their responses in English before the class under the guidance of subject teacher. In case of English challenges, some of the teachers could intervene in the process and guide the students through the appropriate approach. However, this approach works, at its best, when the teacher encourages his/her students to try to speak regardless of the likely language mistakes to be committed by a student as he/she speaks. However, some of the teachers could care less when language mistakes were committed by the students. Improving students' oral communication skills is a primary outcome of presentation/speech classes (Dollisso & Koundinya, 2011). Assigning students to copy notes in their copy books, listening while taking notes and inviting students to write responses on the board was evident in two classes and was geared to enhance writing skills among the students. Reading and listening skills among the students were largely enhanced through loud reading of the texts from the books and words or phrases on the board.

Language Guidance and Students' Lesson Participation

Through classroom observation, language guidance and students' participation were highly observed during LSP implementation. The two aspects were handled in several ways. The students were guided, from time to time, on how to pronounce Chemistry vocabularies which seemed completely alien and difficult to pronounce. This finding is in consonant with the finding by William and Ndobakurane (2017) in that the students faced more difficulties in pronouncing Mathematics terms in English because they had few English vocabulary. Words such as crystalline, ionic bond, aqueous, electrolysis, radius, periodicity, configuration, immiscible, electrolysis etc. seemed difficult to pronounce among most Form II students. It is worth mentioning that most students in lower secondary schools demonstrate limited English proficiency as Sumra and Katabaro (2014) and Rubagumya et al. (2021) report. For instance, Rubagumya et al. (2021) insist that adequate preparations for students to learn through English and enough resources dedicated to supporting students to learn the language are lacking.

Given their low level of English proficiency, most students were frequently scaffolded in sentence forming and uttering most Chemistry specialism vocabulary. The scaffolding was also widely used in guiding the students on how to appropriately use Chemistry terminologies in different contexts. For instance, most of the students failed to grasp the meaning of the word heterogeneous and phrase molten stage until when helped by their teacher. The students' failure to grasp the meaning of Chemistry terminologies is an inherent feature of monolingual class where English is a sole medium of instruction. To enable the students grasp the meaning of the word heterogeneous and phrase molten stage, the teacher translated them as “-enye mchanganyiko” and “hatua ya uyeyukaji” respectively. He also gave examples on how each of the two concepts can be used in a sentence. The following students' sentences indicate the extent to which the meanings of the word heterogeneous and phrase molten stage were grasped.

ST 1: Solvent is *heterogenous* as its colour indicate.

Ideal sentence: Solvent is *heterogenous* as its colour indicates.

ST 2: Our class is *heterogenous* because it has boys and girls.

Ideal sentence: Our class is *heterogenous* because it comprises the boys and girls.

ST 3: Water level was increased when ice reached *molten stage*.

Ideal sentence: Water level increased as an ice reached *molten stage*.

ST 4: Sun can *melt* ice.

Ideal sentence: The sun can *melt* an ice.

Source: Classroom observation

With reference to above sentences, it indicates that some of the students could appropriately use the vocabularies in different contexts having grasped their meanings and exposed to teacher's scaffolds. The analysis of the sentences constructed by the students had obvious grammatical errors. Semantic errors also characterize some of the formed sentences as reflected in the third sentence. Although the students were capable of constructing sentences in attempt to show how the vocabularies can be used in various contexts, just a few of them especially boys would do it. Despite being encouraged, the girls' participation in presenting group responses and responding to teachers' questions was evidently low. Girls' limited participation in science subjects is also documented elsewhere in African countries. For instance, Ekine and Abay (2013) acknowledge the

issue of girls' limited participation in science subjects in Nigeria. Since LSP approach is gender sensitive, encouragement of students' participation in the learning process would cut across both female and male students.

While students in LSP classes are given scaffolding when facing learning challenges, the case is different in ordinary science classes where students are punished in case they give incorrect answers (Brock-Utne, 2006). In an attempt to guide students, improve their English skills, group discussions coupled with reporting back what was discussed in their groups were used from time to time in LSP classes. Some of the sentences generated by the students during reporting of the group responses include but not limited to the following:

ST 1: Boiling point is a temperature at which liquid boils to form gas.

ST 2: Melting point decrease down the group.

ST 3: Period is a horizontal column of elements.

ST 4: Group is a vertical column of elements.

Source: Classroom observation

With reference to above sentences, the sentence analysis indicates that most students were able to construct correct, meaningful and fully-fledged sentences especially having been exposed to LSP approach. However, some of the students still need scaffolding to improve the language proficiency especially in spoken English. The teaching experience indicates that short responses characterize most students' written and spoken texts. For instance, Brock-Utne (2006) insists that the "yes response" was probably the only talk from the students in Tanzanian classes. Such short responses limit the students' possibility of developing language ability that would help them use English in different contexts and access both Chemistry content and learning materials. The learner who understands the learning language will be in a better position to understand during the learning process and acquisition of knowledge from different sources (Bikongoro, 2012).

Teachers' and Students' Views on Effectiveness of LSP Approach in Enhancing Chemistry Content Learning

Through interviews with both student teachers and Chemistry teachers in host schools, the views on the effectiveness of LSP in enhancing Chemistry learning were sought. During the interview, Chemistry

teachers in host schools reported that LSP approach is vitally important not only in Chemistry teaching but also in teaching other subjects. According to teachers, it gives flexibility to them to uniquely use learners' familiar language, Kiswahili in this context, to elaborate or translate Chemistry concepts especially those ones which seem unfamiliar to most students. This is mainly done in order to enable the students connect well with the concepts that they learn in science. In support of the argument in question, one of the teachers had the following assertion to comment during the interview:

... When we use English as the medium of instruction to students from Swahili medium schools from the beginning to the end, they don't understand the subject matter. So, as you change and, at least, use Kiswahili at some point, it makes their life easier when studying Chemistry (Interview with Chemistry teacher in one of the school's understudy).

Secondly, it enables students participate fully during the teaching and learning process because they can easily grasp concepts as they are given necessary scaffolding in case of any challenges during the participation. Thirdly, LSP approach was recommended to be an ideal approach as it efficiently addresses the question of difficult or unfamiliar scientific terms through translation (mainly from English to Kiswahili). When the meaning of vocabulary is well known to a learner, learning becomes meaningful since the learner can easily comprehend the larger text which would otherwise be difficult to comprehend in the presence of a single unfamiliar or difficult vocabulary. Fourthly, being able to perfectly explain what was taught or covered in the class is the concrete evidence that LSP approach is effective. Understanding the subject matter is demonstrated by what a learner can do after instruction to signify the change in behaviour.

According to most students, LSP was recommended to be an ideal approach as it engages students in a myriad of activities around which concepts are made clear through the language that they best understand. Secondly, it is a good approach since it relies much on discussions over concepts which would have been difficult if dealt with individually. Thirdly, it encourages the use of teaching aids which not only expose the students to real object but also help them to acquire new subject specialism vocabulary. Some of the subject specialism vocabulary as attested by students include but not limited to high concentration, low concentration, crystalline, non-polar solvent, polar solvent and aqueous.

The classroom observation further indicated that the majority of students were able to freely involve themselves in discussion especially when Kiswahili was used. Interestingly, the majority of students whose discussion was in English did it in whispers or remained silent in the entire period of discussion. This finding was in consonant with that by Bikongoro (2012) in that the students' ability to express themselves in classroom is partly limited by the use of English as the medium of instruction, thus constituting a serious cause of poor quality of teaching, low level of acquisition of knowledge from different sources where English dominates. The findings in question also correspond with those by William and Ndabakurane (2017) and Brock-Utne (2006) in that most students remained silent during the discussions, notably when the discussions were done in English. The observation findings further indicated that 78.7% of the students who volunteered to ask questions and responded to questions posed by the teacher were able to do so in English. The research evidence indicated that most students especially in two schools out of those school's understudy demonstrated the highest ability in responding to questions posed during the lesson. The students' increased ability in responding to questions and participation in the teaching and learning process signals an increased students' mastery and interest in learning science subjects after the exposure to LSP approach.

Pedagogical Implications of LSP

LSP entails innovation in teaching methods and language approaches by considering language aspect as a potential lubricant of the teaching and learning process. Based on the principles of LSP as advanced by Rubagumya, Sane, and Ndabakurane (2021), the following constitute pedagogical implications: Firstly, the Tanzanian language policy should be recognize the role of the learners' familiar language in learning both foreign or second language and content. This implies that the foreign language in this context English may co-exist with learners' familiar language and work harmoniously in the classroom interaction. Secondly, since LSP requires the subject teacher to render the scaffold to needy learners to make them learn both language and subject content with ease, the teachers are required to get hold of linguistic aspects to be able to scaffold the learners faced with critical learning difficulties. Thirdly, LSP inculcates inclusive learning by making the teaching and learning process fun by accommodating all learners with diverse socio-economic backgrounds. Lastly, LSP needs to be conceived as a multifaceted

potential aspect which delineates linguistic diversity as a spice to meaningful learning.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the current study, it can be concluded that more students' engagement in learning activities through familiar language and other instructional scaffolds assured students' confidence, interaction with the subject matter, mastery and increased interest in Chemistry content learning and usage of subject specialism vocabulary in meaningful context. There should be a deliberate effort to integrate language objectives in Chemistry lessons through collaboration between Chemistry teachers and language specialists to enhance the learners' full learning potential. This paper appeals to all teachers, notably those other than language specialists, to have language objectives in mind when planning for the lesson of the day. Coupled with other language-supportive gears, the learners' familiar language, Kiswahili in this context, should constitute an integral part of teaching and learning Chemistry in multilingual classrooms. Using the "English only" approach limits students' participation and exploration of knowledge and it, indeed, undermines the teaching and learning process. Despite being potential in enhancing both content and English learning, most of the in-service teachers would initially cast doubt on the usage of the learners' familiar language, Kiswahili in this context, in scaffolding the learners when the need arises. To such teachers, the usage of Kiswahili in teaching in the classroom context contradicts the language policy as far as teaching is concerned. Since LSP proved greater effective in Chemistry learning, the study recommends the scaling up of the LSP approach in other regions in Tanzania in an attempt to enhance Chemistry and other subjects' content learning. Based on the great potential of LSP in science teaching as the study findings demonstrated, scaling up LSP to other schools is deemed necessary. The study also recommends the introduction of LSP in all classes at lower secondary schools in an attempt to safeguarding and nurture the students' talented abilities in science along with their language enhancement. Moreover, the extension of LSP in other non-science subjects except Kiswahili is highly recommended to address the issue of language difficulties among students whose English background still poses a subject learning quagmire. The integration in teaching science and non-science subject content learning is guaranteed through recognizable classroom context which may not be disentangled from the learners' familiar language coupled with other learning supportive gears.

Embracing a bilingual approach through the parallel use of Kiswahili as a co-medium of instruction in teaching Chemistry does not necessarily suggest the replacement of English by Kiswahili but working in harmony.

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