Language Supportive Pedagogy as a Tool for Improving Science Teaching and Learning in Tanzania: Case of Dodoma Secondary Schools

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Abstract: Worldwide, learning of science subjects is a challenge to many students. In many African countries which were colonized by Europeans, it is even more challenging to learn science subjects because most of them the language for learning science subjects is different from their native languages. Tanzania is one of the colonized countries that use English as a medium of instruction, and for many students, it is either a second or third language. The introduction of Language supportive pedagogy (LSP) in some secondary schools in Dodoma showed improved performance in students' learning of science subjects. The present trial study for tryout of language supportive pedagogy skills and knowledge conducted in five secondary schools showed improvement in science learning among students. The study employed both qualitative and quantitative data collection methods. In this study, form one and two secondary school students from five schools were exposed to classroom observations and in each school five students were randomly selected for the interviews after classroom observations. A total of 26 science teachers were trained on LSP during the first two workshops. Data collection methods included the workshop conducted for 26 science teachers, classroom observation as well as students' interviews. The findings of the study revealed that both students and teachers positively responded to the use of language supportive skills and knowledge during teaching and learning activities. The study concluded by recommending the scaling up of LSP knowledge and skills to all secondary school teachers and students in Tanzania.

Keywords: Language Supportive Pedagogy, Language Supportive Teaching and Textbook, Science Subjects, Secondary School, Language of Instruction.

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1. Introduction

The use of English as language of instruction to academic subjects has become a global phenomenon, especially in the former British colonies. In most of these countries, English is not their first language; therefore, majority of learners face challenges in their learning (Mwinsheikke, 2003). There are various logical explanations for the use of English language as a medium of teaching academic subjects in these countries (Telli, 2014). Tanzania is not exceptional from these colonial countries, which face challenges of language in instruction. Tanzania education system inherited the use

of English as language of instruction from British colony. In this regard, the challenge of learning for understanding, especially science subjects in secondary schools through English becomes critical (Juma, 2015).

Gibbon, (1998) argued that students whose language of instruction is not their first language face dual challenges in learning science. This implies that students facing a dual task do not only need to learn the language of instruction but also a subject-specific content through the language. Since most of the students had language limitations in English, their known language enabled them to learn science in a way that might not have been possible if the lessons had been conducted exclusively in English (Ünsal, Jakobson, Molander, & Wickman, 2017). In this kind of a situation, initiatives need to be done to improve students' learning for understanding scientific concepts.

In Tanzania, the language of instruction is a key challenge in students learning secondary schools (Juma, 2015). This is due to the fact that many students studied using Kiswahili as medium of instruction in primary schools then they moved to English as medium of instruction in secondary schools. This transition poses challenges to students learning, especially in science subjects. Mwinsheikke (2003) argued that this situation encourages teachers to use code switching between Kiswahili and English.

Further, Mwinsheikke (2003) insisted that although students understand when teachers switch languages, teachers set tests and exams in English. Therefore, while students may well be able to answer the questions in Kiswahili, they may struggle to provide the same answers in English and if they answer questions in Kiswahili, they will fail the examination (Mwinsheikke, 2003). This creates many tensions around the language of instruction in educational settings.

Consequently, Language Supportive Teaching and Textbook (LSTT) project in Tanzania came up with pedagogical way to improve the situation of science and mathematics learning using English as language of instruction. LSTT project introduced Language Supportive Pedagogy (LSP) to science and mathematics secondary school pre-service and in-services teachers whereby St John's University of Tanzania had opportunity to be a partner institution in LSTT project.

Overall, this study specifically intended to answer the research question: How has LSP facilitated in improving science teaching and learning in Dodoma secondary schools.

2. Literature Review

2.1 Context of Study

English as the language of instruction in secondary schools is perceived as an obstacle to students' science and mathematics learning because they are generally more fluent in Kiswahili than English (Juma, 2015). Many students struggle with switching from Kiswahili as the medium of instruction in primary schools to speaking English when they reach secondary school. However, this would pose problems because in the end students must answer examination questions in English. Controversy surrounding the language of instruction in Tanzanian schools is ongoing and to date no sustainable solution from policy-practice has been found. Currently in Tanzania, parents, teachers, academics, policy-makers, and students have different views about the language of instruction. Telli (2014) found that policy-makers in Tanzania prefer English because it is an international language and argue that students need to become fluent in it through their schooling. Qorro (2006) argues that there are good reasons for "teaching English" but not "teaching in English" (p. 4), suggesting that students can become proficient speakers by learning English as a school subject. Qorro (2006) believes that Kiswahili needs to be the main language of instruction for all levels of education, arguing that it is widely used in trade, offices and throughout the country. While stakeholders continue debating of language of instruction issues in Tanzania, students are still facing challenges in learning for understanding science matters.

2.2 Language and Science Education

The quality of science education cannot be separated from the language of instruction used in teaching and learning of science. The education Sustainable Development Goal insists that all learners acquire the knowledge and skills needed to promote sustainable development. Scientific knowledge and skills among citizens is vital for sustainable development of the country (Karaarslan, & Teksöz, 2016). Therefore, it is imperative for any country's education system to ensure that citizens are well equipped with scientific knowledge and skills for sustainable development of the country (Karaarslan, & Teksöz, 2016). In this regard, it is important for the country to address challenges such as

language of instruction in order to reduce issues that threaten the development of scientific skills and knowledge.

In essence, language is viewed as a tool to mediate the existing knowledge and new situations learners are introduced to (David & Venuste, 2021). Besides, since each subject discipline possess its technical words (Daniels, 2001) communicating these words in writings and speaking becomes unique. It therefore assumed that LSP strategies could enable both teachers and students improve in communicating science for meaningful learning to occur. The theoretical question that provokes the LSP strategies used was how and when the language and content can or should be integrated for a meaningful learning of science? The question can be followed up by the process of language acquisition with regard to various genres specific to science subject, for example, biology, physics, and chemistry (Barrett, & Bainton, 2016).

David and Venuste (2021) points that effective teaching and learning science through English as a medium language of instruction requires appropriate pedagogy. The same authors extends that some set pedagogical language strategies (PLS) would potentially be useful to be put in place to address the concern. Similarly, LSP advocates that these fundamental strategies, which make up the fabric of classroom teaching involving proper use of subject specific vocabulary, are vital for teaching and learning science. Furthermore, Brock-Utne (2014) points an important role of language as mediating the knowledge between teacher and learner shared with precision. In essence, science and language cannot be separated when it comes to teaching and learning process.

Traditionally, science teachers have considered science learning and language learning to be very different subjects. However, language cannot be separated from science learning. Both students and teachers need language of communication for effective teaching and learning of science subjects. The use of language to communicate about ideas is essential to the development of scientific understanding (Ünsal, et al., 2017). Many recent researches showed the importance of taking into account language issues in science learning (Juma, 2015; Barrett & Bainton, 2016; Ünsal, et al., 2017).

2.3 Initiatives to Transform Science Education in Tanzania

In Tanzania, poverty reduction initiatives are embedded in the *Tanzania Development Vision 2025* (United Republic of Tanzania, [RT], 2013). This policy outlines a long-term nation-wide vision of economic and social priorities that the government hopes to realize by the year 2025. *Vision 2025* aims at eliminating poverty by 2025, through developing the national education sector as a means of bringing about social and economic transformation. According to *Vision 2025,* Tanzania proposes to create a knowledge based society with well-educated citizens. In line with this policy, the Ministry of Education and Vocational Training (MoEVT, 2000) of Tanzania developed the Education Sector Development Programme (ESDP). The ESDP was initiated in 1997 considerably amended in 2001. It provides a framework that regulates and monitors early childhood, primary, secondary, and adult education, teacher training and school-based programmes. ESDP is therefore interpreted in the context of improving teaching and learning practices.

Further, a related educational reform, known as the Secondary Education Development Plan (SEDEP), aims to improve the quality of secondary schooling in Tanzania. Since its inception in 2004, most major policy developments in Tanzania have been closely linked to the *Vision 2025* document and SEDEP officials have responsibility for the oversight of the implementation of policy development plans, including teacher education, Community-based Adult Education and Vocational education. These initiatives are expected to improve people's lives through raising the quality of education.

In this regard, the Tanzanian government has acknowledged the importance of education in national development. Tanzania's science and technology policy emphasizes the effective utilization of the country's resources based on a scientific understanding of the nature and the dynamics of these resources, as well as consideration of the socio-economic needs of the local people. None of these plans can be achieved, however, without public education on scientific matters. This is because it is not only people who enter the science professions who require this kind of education but in a real sense, all people need good quality science education to address socio-scientific issues that affect them (Hodson, 2014; Holbrook & Rannikmae, 2009). In this respect, poverty alleviation programmes in Tanzania are

closely connected to what is taught in schools and they aim at influencing the kinds of choices available to people who have received some form of education. Given that Tanzanian communities face challenges related to the education and wellbeing of individuals and communities, many living in poverty, the importance of a grounding in science during the years of school, cannot be ignored.

Despite the mentioned initiatives, many of which are aimed at education, Tanzania still faces many challenges related to national development. The majority of Tanzanians live in disadvantage environment where parents cannot afford to take their children to English medium primary schools. These children afford to attend in Kiswahili medium primary schools, so they face challenges when they go to secondary schools where English is a medium of instruction.

2.4 Theoretical Framework

LSP as one of the pedagogical innovations in science teaching is built on the social constructivism assumptions, particular that proposed by Vygotsky (1978). The LSP practical classroom application lies at the heart of learner centeredness (Barrett, & Bainton, 2016; David & Venuste, 2021). In this regard, the recognition of prior knowledge of learners becomes the priority for science educators. According to David and Venuste (2021), social constructivism theory can enable the understanding of the role of active learning with regard to learners' context such as culture and language. In addition, Moate (2010) states that in the context of social constructivism "knowledge is understood as a historically constructed, culturally and socially contextualised entity instantiated in language"

Practically, in the classroom context, learning outcomes were viewed as the product of effective language use and science content understanding. Science educators are therefore of the view that learners had something to contribute to the new knowledge while language educators were of the view that communicating scientific findings depended on learners' proper use of English language. This is added to a view that the understanding of the content depends on social interactions which depends on the learners' culture (Barrett, & Bainton, 2016). Wells (1994) adds that Language is the 'tool of tools' that 'functions as a mediator of social activity by enabling participants to plan, coordinate, and review their actions through external speech'. In this case, LSP

practitioners treated the science content and language as two inseparable things.

3. Methodology

3.1 Research Design

The study mainly used qualitative methods in collecting data. The use of qualitative approach is appropriate because it accommodates multiple meanings constructed when people who experience similar condition about issues science education interact together to create meaningful knowledge (Krauss, 2005). Yin (2011) argues that using qualitative research methodology helps in exploring the meanings people give to their lives and helps them how to understand their world. This research design allows the researcher to interact with participants through conversation to obtain detailed information about meanings people hold about their world (Yin, 2011). Krauss (2005) insists that face to face interactions help the researcher to understand meanings of the words participants use and how they make sense of their life. The interactions occurring during qualitative research help the researcher to understand the meaning participants hold in social settings (Krauss, 2005). In this regard, this study used the following qualitative data collection tools.

The main intention of the study was to improve students' science and mathematics learning in Tanzania secondary schools. In this project, LSTT team had opportunity to work together with five secondary schools around Dodoma on using Language supportive pedagogy skills and knowledge in schools. Secondary school teachers were exposed to workshops and then applying the skills and knowledge of LSP in classroom setting. Further, the interviews were conducted from teachers to get their feedback. Therefore, this paper elaborates the findings obtained from working with teachers and students from those five secondary schools in Dodoma region.

3.2 Workshops as Qualitative Data Collection Tool

Ahmed and Asraf (2018) argued that a workshop is a promising tool for collecting data. This implies workshops encourage engagement through collaborative discussions and constructive feedback participants and facilitators (Ahmed & Asraf, 2018). In addition, in cases where a researcher is in need of information-rich data

(Creswell & Poth, 2017), workshops serve well as an avenue for the meeting of participants who have volunteered to be a part of the study. In other words, through workshops, researchers may be able to elicit rich information from the participants who are selected through the purposive sampling technique.

In this study, two workshops were conducted at St John's University of Tanzania (SJUT). In these two workshops, the twenty six (26) science and mathematics teachers at least five teachers from each school were trained on pedagogical issues of LSP.

3.3 Classroom Observations

In school settings, classroom observation is an effective research method that helps the researcher to understand how teachers teach (Estacion, McMahon, Quint, Melamud, & Stephens, 2004). The process included collecting data in a cooperative manner, which involved both researcher and participants (Mulhall, 2002). In the present study, the researchers were non-participating observer during the classroom observations. This enabled them to observe and record the activities that took place and provided them with a clear picture of the whole learning process (Creswell, 2012). In this study, a specific tool was prepared and used by each observer to collected information.

3.4 Semi-Structured Interview

Bisman and Highfield (2012) argue that the semi-structured interview is useful in exploring multiple views and allows the researcher to probe for further information. Interviews are usually based on a set of open-ended questions that prompt participants to talk about their experiences (Creswell, 2012). This approach resonates with constructivist perspectives, which acknowledge multiple realities (Bisman & Highfield, 2012). The use of semi-structured interviews therefore allows the researcher to gather in-depth information by encouraging participants to tell their stories about how students acquired useful knowledge and skills (Bisman & Highfield, 2012; Creswell, 2012).

During interviews, about 60 students were interviewed after classroom observations. Each observer interviewed two students, the first one in day one of the observations, and second one in day two. Based on scheduled interviews, each observer got an opportunity to discuss with one student to get feedback on what teachers taught in classroom.

4. Results and Discussion

4.1 Teachers' Training and Implementation of LSP

In the first two workshops, a total of twenty-six (26) science and mathematics teachers at least five teachers from each school received trainings on LSP. The science teachers trained were biology, chemistry, and physics teachers. In addition, mathematics and English teachers were trained. In each workshop the first day, science, mathematics, and English teachers were introduced to the project history of Language issues in Tanzania as well as language Supportive Teaching and Textbooks (LSTT) Project. The participants also learned about LSP as one of the tools in LSTT project. Participants were then trained on features of LSP. The presentation was accompanied by discussion from all participants.

One of the activities conducted in the first day of the workshop was to prepare lesson plan and activities in order to be able to implement it in the second day of the workshop. Teachers from the same subject such as physics, chemistry, biology, and mathematics formed a group. In each subject group, at least one English teacher was there to facilitate language issues. Each group selected a lesson and prepared lesson plan, and resources for teaching the next day. Each lesson plan was presented to participants; all participants participated in improving the lesson plan. The lesson plans were scrutinized to see if they had included LSP features. One of the features was inclusion of language objectives (David & Venuste, 2021).

In each workshop in the second day, teachers had the opportunity to practice the LSP skills in the classroom environment in their respective schools. Teacher participants under each subject selected one teacher to teach in the classroom and other teachers and LSTT team from SJUT were observers. A prepared observation schedule was used by each observer to collect data from classroom. A total of 60 lessons were observed. This means that one teacher had at least an opportunity to be observed twice.

4.2 Classroom Observations

4.2.1 Lesson Objectives Achievement in Class

The lesson objectives were set into three areas for observation namely: competencies, language objectives, as well as activities used to reinforce competencies. The observation checklist guided the observer to indicate whether the objectives were evident or not. The findings from the 60 lessons were as indicated in Table 1.

Table 1: Objectives achieved

Statement	Evident (Frequency)	Not Evident (Frequency)
Set of competencies to be achieved in class	60	0
Set of language objectives to be achieved in class	57	3
Set of activities to reinforce competencies	56	4

All teachers' (60 lessons) were successful in setting subject competences, however only three observers failed to see teachers set language objectives, and four(4) observers did not observe teachers set activities to reinforce competences. During observation one observer observed a language objective for basic mathematics were "by the end of 80 minutes, each student should be able to; define the term congruence, polygon, and triangle; identify and write properties of congruent triangles". This objective was mainly achieved by the teacher because students were able to attempt different questions raised by the teacher and activities given in the classroom. This finding is consistent with that from David & Venuste (2021) that a substantial number of teachers were able to set competencies to be achieved in class. It can be argued that LSP features such as the inclusion of language objectives appeared to influence the instructional strategy used by teachers in class.
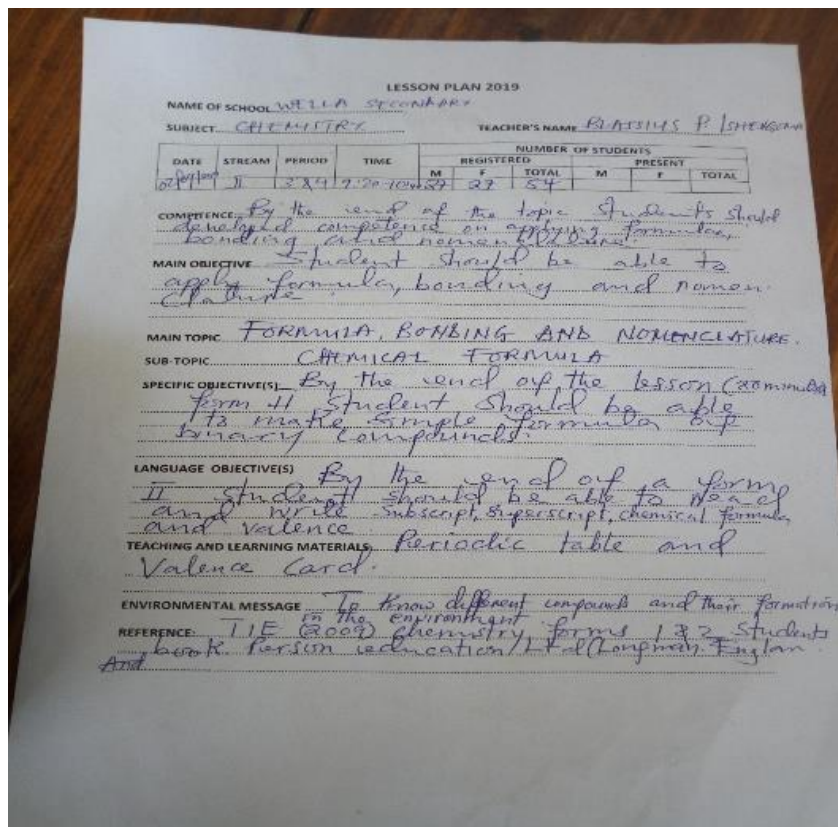
Figure 1: Example of Lesson Plan

4.2.2 Strategies used to enhance Teaching and Learning

In classroom observations, observers had the opportunity to observe different strategies used to foster students' understanding. The observation checklist assisted them to indicate whether the strategies were evident or not. Results of this analysis are as shown in Table 2.

Table 2: Teaching Strategies

Statements (60)	Evident (Frequency)	Not Evident (Frequency)
Use of Kiswahili strategically	40	20
Demonstrate ability to link subject with previous learning	43	17
Exploration of students' prior knowledge	42	18
Engage all students in classroom interactions	52	8
Use different activities learning of the subject knowledge	53	7

56

Observers observed that majority (40) of the lessons allow students to use Kiswahili strategically. This implies use Kiswahili when is necessary for students' understanding. Teachers also indicated to the students that the use of Kiswahili was allowed at times strategically during the lesson to reinforce leaning. For instance during group discussion students were given time to discuss, to write and in the end were required to present in front of the class whereby a teacher had an opportunity to correct pronunciation, spelling and ungrammatical sentences. During discussion, the teacher allowed students to discuss in their thinking language (Kiswahili) and instructed students to present their ideas in English as the language of instruction. The method of teaching was student centered and many activities were given. In most cases, this aspect was successfully implemented by the teachers.

Again, majority of teachers (52) allowed students to share their knowledge by mentioning and writing what they knew about the issue posed to them. This was done by setting activities that students had to form group/pair to discuss using the language they knew; however, they were asked to present in a targeted language (English). Moreover, many of the teachers (53) set different activities such as practical activities to enforce learning of subject knowledge. The stressing of students to present their findings in English is consistent with findings from Brock-Utne, B. (2007). The author points that "if the aim is the stupidification of the Tanzanian labor force, then the use of English, which is a foreign language to the students and a language poorly mastered by the teachers, seems to be an excellent strategy. If the aim is to create a labor force with critical abilities and creative qualifications, the language of instruction policy is unlikely to have such an outcome". In essence, this need to be evaluated through set of different activities such as practical activities to enforce learning of subject knowledge with which majority of teachers (53) managed.
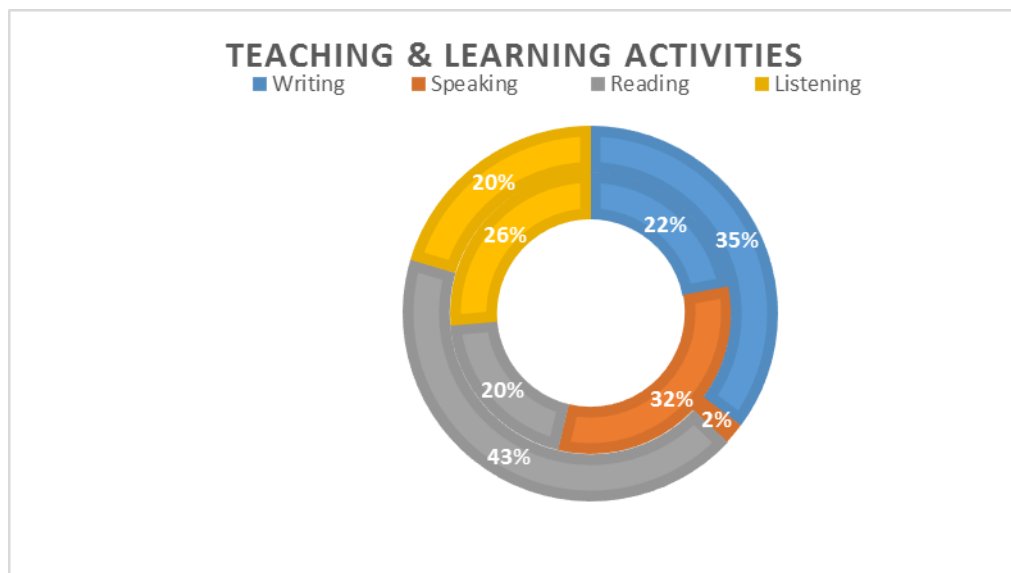
4.2.3 Teaching and Learning Activities

Figure 2: Activities

Majority of the observers (32%) observed that teachers set activities which fostered speaking skills followed by activities which enhanced listening skills about 26%. The reasons to this finding could be due to the opportunity provided to students to answer questions, to write on the board and read words/vocabularies posted on the board loudly. This gave a chance to the teacher to correct pronunciation, subject-verb agreement, and correction of repetition of subject like "Students They" and make emphasis on appropriate vocabularies to be used in a given topic/sub-topic.

4.2.4 Language Guidance and Students' Participation in the Lesson

In the classroom, teachers were observed the way they supported students to correct their mistakes in various English aspects such as pronunciations, sentence writing, and so on. Table 3 explains the frequency of teachers supported students.

Table 3: Students guidance and participation

Statements	Evident (Frequency)	Not Evident (Frequency)
Correct students' pronunciation	48	12
Help students' to finish their sentences	44	16
Guiding students to use appropriate language terminologies where students fail	49	11
Teacher asks to make group discussions and report back to class	51	9
Teacher allows students to discuss in Kiswahili and their answers in English	52	8

Majority (48%) of the observers observed teachers corrected students' pronunciation. About 44 observers observed teachers helping students to finish their sentences. Forty nine respondents (49) observed that there was misuse of inappropriate terminology during student's feedback and helped students to correct their mistakes. Therefore, teachers helped them to finish their sentences by producing an appropriate vocabulary in students' sentences. One among the teachers reported, "Most students often fail to pronounce the word 'Archimedes'….and I normally correct them".

4.2.5 Students' Perceptions on the use of LSP

During interview question students (95%) revealed that they liked the way the lesson was taught. For example, one student narrated that "*I didn't know the meaning of the term superscript and subscript and valence, but due to how the teacher taught us, now I know, I recommend this method of teaching to be used every day*".

In addition, 90% of the students pointed out that the method/technique (LSP) used in teaching and learning activities helped them to understand the topic. One student observed that in Kiswahili language that "*Nimefurahishwa na jinsi mwalimu alivyofundisha hasa pale alipotoa kifupi cha Iron (symbol of Iron) ambacho mwanzo nilikuasiijui*". This statement means that the student was happy in way the teacher taught specifically when pointing out the symbol for Iron because he did not know it before. This implies that students like the different methodology of teaching, especially the learner centered approach, as opposed to the teacher centered approach.

Similarly, 85% of the interviewees asserted that the use of both Kiswahili and English during the lesson helps them in learning. Further; students appreciated illustrations/demonstration using real objects such as water in the container, sponge and plate to show transformation of some smallest particles in the body. In addition, most students stressed that pronunciation correction should be done in each class session to enrich in-depth understanding of concepts being taught. One student pointed out that "*the method of teaching used by the teacher allowed us to discuss freely and even elaborated the concepts in Kiswahili which improved my*

understanding". This shows that student really appreciate the use of Kiswahili strategically.

All subjects were well taught regardless of some few challenges such as time management and students arrangement in the class. Results from the interview revealed that the strategic use of bilingual instructions, one of LSP features, can potentially transform the practice from rote learning to meaningful learning. David and Venuste (2021) advocate that "consideration of students' familiar language has the potential to convert interrelationships between teachers and students, and students themselves". In summary, students find it more helpful if the familiar language is used to scaffold their subject content learning.

5. Conclusion and Recommendations

There is one African proverb, which states that '*Smooth seas do not make skillful sailors, rather it is the rough seas that make skillful sailors.* This implies that challenges stand a chance of making people to be more innovative for improvement. The challenge related to language of instruction has made scholars to be more innovative to improve science and mathematics learning not only in language issues but even in the pedagogy as a whole. The introduction of LSP improved science and mathematics learning in Tanzanian secondary schools as it was evidenced through the findings of this study. Overall, this study revealed that the use of LSP in science and mathematics classrooms, supports students' learning for understanding. Hence, this study recommends the use of LSP to enhance the teaching and learning of science and mathematics subjects at secondary school level in Tanzania.

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