

Improvisation of Teaching Learning Materials (TLM) and its Contribution in Teaching and Learning of Primary Science



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ABSTRACT: The study was basically carried to find out about the contributions of improvisation on learning science education. The mixed mode of data collection method was used for the purpose whereby data were collected through semi structured interview questions and survey questionnaire. Analysis and interpretation of quantitative data was carried using Statistical Package for Social Sciences (SPSS) whereas analysis of qualitative data involved looking for similarities and dissimilarities and generating themes. Finally the collected data and information from both qualitative and quantitative method will be compared and analyzed.

It was inferred that TLM hold significant importance in providing valuable support and enhancing the learning experience for both educators and students. However, it was found that most schools lack the required TLM and teachers improvise the required TLM with locally available materials. However, improvisation of TLM requires lots of resources and support from many relevant stakeholders. Moreover, it was also found that improvisation is very time consuming and comes with the challenges of precision and accuracy. The study also founded that with the advancement of technology, digital tools like YouTube videos and simulations were used when readymade TLM are not available in the schools. However, this research study was carried during short period of time with minimum participants and findings from the study cannot be generalized for all the schools across the country. Furthermore, further research can be carried to find out about different module offered in two colleges of Education which teaches about preparation and improvisation of TLM.

INTRODUCTION

1.1 INTRODUCTION

Science is the study of human interaction with the environment to ensure survival and well being. It emphasizes on gaining knowledge of the environment through scientific methods of observation, experimentation, and investigation. Through the scientific methods of learning science, learners learn to appreciate the contribution of science towards human well being and value existence of living and other non living things. Johnson (1962, as cited in Bibon, 2022) defines “the primary goal of science education is to assist learners in achieving a functional understanding of scientific concepts and link to real life situations, attitudes, and values necessary for their daily life encounters” (p.5). Tairab (2001) also stated that science learning should prepare individuals to contribute in a rapidly changing world and create scientifically oriented society. Science education is considered indispensable for every citizen as the wellbeing and lifestyle of the people are influenced by scientific knowledge, skills, and value they possess (Department of curriculum Research and Development, 2012).

Bhutanese science education started with a curriculum borrowed from the neighboring country, India. However, Royal Education Council, 2018 (REC) states that in 1986, the ‘New Approach to Primary Education’ (NAPE) was launched, which mainly seek to orient and educate the primary science curriculum for classes IV to VI through Bhutanese context and to promote the teaching of science based on Bhutanese natural and social environment. After more than a decade of implementation, the localized primary science curriculum was found shallow in content and learning activities are outdated to meet the current requirement. Therefore, the localized primary science curriculum was revised in 2001 mainly to add content, learning activities, required skills and strategies which will help to enhance quality learning (DCPD, 2022). The erstwhile REC states that

The Primary Science Curriculum for Classes IV – VI aims to provide learners with opportunities to develop a scientific temperament through investigations of a wide range of living things, materials and phenomena, and the forces that impact the universe in their immediate environment and everyday life experiences. (p.1)

Science education offers opportunity for learners to draw inferences and develop connection between ideas, investigate and experiment the concept using evidenced explanation and, therefore, helping to enhance learners' creativity and critical thinking. “Science curriculum should stressed the development of investigative skills as opposed to more traditional learning and the memorization of scientific facts and figures” (Childs et al., 2012, p.378). Accordingly learning of science activities fosters

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investigation and experimentation while testing and connecting with their learning environment. Moreover, the learners are educated to understand the importance of testing and verifying ideas and concept using evidences from observations and exploration. Science learning focuses more on providing hands on experience learning through inquiry and discovery learning which helps learners explore vigorously to be independent learners.

1.2 Background Of The Study

According to National Research Center (2007), it was reported that science education aspires to help students interpret scientific explanations of the natural world and stimulate sensitivity, innovation, creativity in the field of science, technology, engineering and mathematic (STEM), and apply knowledge in diverse situations. Learners must be able to apply their scientific knowledge and skills for planning and achieving favorable outcomes for the welfare and well being of their communities. To further foster learners' understanding, they must do more organized investigation, in-depth exploration and systematic experimentation. Connecting scientific ideas to the real world through rigorous learners' participation in the scientific processes is crucial for making science education engaging and exciting. Therefore, teaching of science should incorporate the use of variety of teaching learning materials (TLM) which provides an avenue for learners to get in touch with real objects for inquiry and investigating to confirm their classroom learning.

“Education is very crucial in the development of every nation, and TLMs play critical roles in the teaching and learning processes globally. The effectiveness of teaching and learning largely depends on proficiency of teachers to use appropriate TLMs effectively” (Kyemereh et al., 2021, p.19). TLM plays a vital role in imparting skills, values, competencies and helps in knowledge construction. TLM are the tools used by teacher in delivering the lesson to clarify concepts and motivating learners. Obodo et al. (2020) defines TLM as “any collection of materials including animate and inanimate objects and human and non-human resources that a teacher may use in teaching and learning situations to help achieve desired learning objectives” (p.24). TLM are used in creating effective learning environment providing a real, practical and engaging experience to the learners. TLM promotes the application and linking of theoretical knowledge into practical applications. The application of theoretical knowledge into practical applications enables the students to enhance academic outcomes in an effective manner. Therefore, teachers are found using varieties of TLM. However, teachers are also found carrying out experiments and activities theoretically due to unavailability of required materials. Despite the teacher training and awareness about the use of TLM and improvisation of TLM, teachers seem to lack the understanding of the significance improvisation of TLMs and do not use it in their daily practice.

It is evident that TLM enable the teacher to transfer learning effectively. However, due to the inadequate and unavailability of instructional materials in the schools, teachers and learners need to adopt innovative ways to create TLM from locally available materials to fulfill the set objectives. Therefore, teachers and educators go for improvisation of TLM. Ibrahim et al. (2019) defines improvisation as “an act of making TLM from locally available resources” (p.34). Educators can make use of different locally available resources innovatively to make TLM which can help to make lesson interactive, aid in delivering the content knowledge effectively and substitute the unavailable first hand TLM. Moreover it helps both teachers and learners to develop their creativity and innovative skills. Ibrahim et al. (2019) reported that the process of improvisation “enhances teachers' knowledge of creativity, interactive skills, and critical thinking” (p.35).

1.3 Statement of Problem

“We must prioritize self-discovery and exploration, and involve learners in the creation of knowledge rather than making them mere consumers of it” (His Majesty, 2021, as cited in kuensel, 2021). In accordance with the Royal Edict, educators and teachers must build learners who are creative, innovative, critical thinkers and independent learners. Educators should not only teach the content knowledge but also teach how to apply the learned knowledge into real life situation. Imparting of content knowledge effectively and making learners discover their potential ability depends on the ways the teachers and educators use appropriate teaching strategies and learning materials while teaching. TLM are found aiding learners in giving real hands-on practice to convert classroom theoretical learning to concrete and meaningful learning.

Grover (2009, as cited Kyemereh et al, 2020) reported that the “selection and use of appropriate TLMs have great or greater impact on quality of students' performance” (p.21). Accordingly, the National Science Curriculum of Bhutan demands the use of a variety teaching strategies using relevant TLMs. However, the required materials are just reflected in the text and are not available in the classroom and moreover the teachers were found reluctant to improvise the unavailable TLM.

Kyemereh et al. (2020) studied about the effective use of TLM in the class and found out that teachers in the schools lack requisite knowledge and skills in TLMs design and utilization and further illustrated that skills development in TLM selection, design and utilization should be integrated into National Teacher Education Curriculum. However, there is no research being carried out to find out about contribution of improvisation on teaching and learning of science. Therefore, a proper study is needed to find out whether our teachers lack the skills of improvisation of TLM or they are reluctant to improvise TLM. According to Frimpong

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(2021), he reported that reported that TLM provide learners with opportunity to learn with hands on experience. The study further revealed that the unavailable nature of the TLM hindered children's accessibility and active interaction with them. The researcher comes from a remote school and has experienced teaching science experiments through lecture method due to unavailability of readymade TLM. Researcher observed that with non availability of TLM to carry out experiment, most of the topics were left out without teaching. It has resulted in hindrance of learning science effectively. Therefore if teachers pay much importance on the significance of improvisation, there will be effective learning outcome.

“The ability of the teacher to make use of local materials in place of standard ready-made materials makes lesson more effective and improved students’ achievement” (Olabiya, 2015,

p.23). Teaching using the improvised TLM has found effective in content delivery as it is locally made and learners feel more attached in learning. Olabiya (2015) also found out that learner get motivated to learn through improvised TLM and helps in retention of knowledge. As learners improvise their TLM through their creativity and innovative skills, they feel more attached and motivated towards learning more and helps in longer retention. Obodo et al. (2020) also found that “students taught using improvised TLM performed better than students taught without improvised TLM” (p.29). The students’ improvised instructional materials were more effective because these materials are locally made and captured students’ interest during teaching processes which lead to maximizing comprehension of the subject matter.

Improvised teaching and learning materials help in teaching the concept effectively, however, in the real classroom situation the researcher found out that most of the teachers lack confidence in improvisation of TLM and are reluctant to input their skills in improvisation and therefore, this study is intended to find out importance of improvisation of TLM. Obodo et al. (2020) also reported that the “teacher education program must integrate material development whereby teachers learn how to design and construct various materials and equipment which could be used for teaching-and learning process” (p.29). It was found that relevant trainings were needed to enhance and develop appropriate TLM. A researcher is interested in finding out about the trainings and seminar that they have received about improvisation of TLM.

Although the improvised TLM were found effective in substituting the readymade TLM, few studies reported that improvised TLM faces some problems for effective implementation in the classroom. Ibrahim et al. (2019) reported that teachers lack the skills and there are some technical factors with the improvised TLM. He illustrated that improvised TLM comes with the challenge of accuracy and precision which hampers the effective delivery of knowledge (p.35). Therefore, the researcher also intends to identify factors which hinder for improvisation, importance of improvised TLM and contributions of improvised TLM in teaching and learning of primary science.

1.4 Purpose of the study

The main purpose of this study is to find out the contributions of improvised TLM in teaching primary science.

Specifically, the study will be carried out to;

- i. examine the exposure of teachers and learners perspectives to the concept of improvisation
- ii. find out about the trainings received on preparation and improvisation of TLM
- iii. investigate why teachers and learners improvise teaching learning materials
- iv. find out the contributions of improvised teaching learning materials in teaching and learning of primary science
- v. find out the challenges face with the use improvised TLMs in teaching science
- vi. determine the challenges face by teachers and learners while improvising teaching leaning materials

1.5 Research questions

The following research questions will support the study;

1.5.1 Central Questions

1. What are the contributions of improvising teaching learning materials on students’ learning?

1.5.2 Sub questions

1. What are the teachers’ and learners’ perspectives about improvisation of TLM?
2. How does improvisation helps in teaching and learning?
3. Why do teachers and learners improvise teaching learning materials?
4. What are the challenges faced by teachers and students on improvising TLM?
5. What are challenges face with the use of improvised TLM?

1.6 Significance of the study

- i. The findings of this research are intended to add to the existing information on the improvisation of teaching aids and its contribution in teaching and learning of primary science.
- ii. It will be significant to teachers and learners to use improvised TLM during the unavailability of readymade resources.

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- iii. It will help and guide teachers in understanding better the diversity of teaching aids and as such, develop more effective methodologies in teaching their subject matter for better understanding.
- iv. The findings will also help school administration to assist teachers in improvising teaching learning materials while talking about challenges.
- v. Also, the study will help the curriculum developer and government to provide the needed teaching aids and facilities to motivate students in learning.

1.7 Scope of the research

This study is intended to have immense significance for all the teachers and students. The study and its finding mainly aim to explore about the materials resources available and which can be substituted or improvised. Moreover it will specifically explore the attitudes and confidence of teachers on improvisation and contribution of improvised TLM on learning effectively.

Additionally this study is also intended to study the challenges face by teachers while improvising the TLM and using it in the classroom. This study on improvisation and its contribution in teaching primary and learning primary science is therefore intended to show through the use of survey questionnaires and the use of one on one interview with teachers who are currently teaching science in three primary schools under Paro Dzongkhag.

1.8 Summary

The use of TLM has greater impact on learning effectively. TLM provides instant hands on experiences making the learning more interactive, engaging and effective. Past research studies revealed that due to unavailability of TLM, most of the concepts left are without experimenting. However, some of the teachers with the knowledge of improvisation often improve the unavailable TLM and implement in the class. Though improvised TLM help in teaching the concept, it has also found some drawbacks. Therefore this study seeks to highlight the current status of implementation of concept of improvisation in the school and its contribution in learning science education.

LITERATURE REVIEW

2.1 INTRODUCTION

“A literature review involves a critical evaluation identifying similarities and differences between existing literatures and the work being undertaken. It reviews what have already been done in the context of a topic” (Arshed and Danson, 2015, p.31). A literature study helps to comprehend how knowledge has developed and expanded. Reviewing prior studies on a subject makes it simpler to identify areas that still require investigation. The review of relevant literature to the present study was carried out in turn as indicated below:

1. The concept of teaching and learning
2. The use of TLM in teaching and learning
3. TLM and Academic Achievement
4. The concept of Improvisation
5. Importance of improvisation
6. Inhibiting factors for effective implementation of improvised TLMs
7. Summary of Literature Reviewed

2.2 The concept of teaching and learning

Teaching is one of the noblest and revered professions which contribute significantly to social development. Teaching requires highly specific skills and information that must be applied when interacting with other people. To achieve effective learning outcomes, the teaching and learning process involves the participation of teachers and learners in a range of exploration and investigation. Teaching can be understood as the act of imparting information to another person with the intention of bringing about a certain changes to someone. Teaching and learning aid in the acquisition of knowledge, which enhances ones capacity for taking meaningful action. Bruner (1994, as cited in Kyeremeh et al., 2020) defines teaching as

The ability to transfer knowledge to a group of people, or showing them the process or the way, something is done.

Teaching is not a mere pouring of a body of knowledge to students, rather stimulating learners to use their mental faculties to solve problems on their own. (p.20)

The ultimate goal of teaching and learning is not merely about transferring of knowledge rather it is the transfer of knowledge and applying it in real life situations. Teaching needs willingness desire to create a positive learning environment and mind of motivation to better the lives of learners. A teaching method needs to provide an educational strategy that goes beyond just having students memorize facts that are learned in the classroom. Sequeira (2012) said that “as teachers we tend to think that teaching is all about teachers and our role; in fact the most important aspects of the educational process are the students and what they learn”

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(p.1). Teaching is therefore, all about bringing differences in learners. It is crucial that teaching should have effective learning process and situations for effective learning with the help of different instrumental tools and strategies.

“Teaching is a process but not an event: it is not limited to only classroom activities rather it involves planning and organizing learning experiences” (Kyeremeh et al, 2020, p.20). Teaching and learning are ongoing processes that significantly alter behavior, advance knowledge, and sharpen thinking abilities. However, the significant change should not be limited within the classroom but should go beyond the walls of the classroom. Therefore, teaching required extensive researching and planning to give positive learning experiences.

2.3 The use of TLM in Teaching and Learning

“TLM are those equipment and materials that a teacher uses to illustrate, emphasize, and explain a lesson in order to make it clearer to the students” (Ibrahim et al, 2019, p.33). Learning may be easily and effectively supported by TLM; giving students the opportunity to engage in interactive learning. Learning with the involvement of TLM motivates and directs the learners to actively take part in the learning processes. “Students learn effectively when learning experiences and activities are illustrated with teaching learning materials” (Obodo et al, 2020, p.24). TLM aids in the successful understanding of the concept by offering a variety of learning experiences through involvement of multiple senses. When TLM are used in an adequate manner, they foster motivation towards acquisition of knowledge.

“TLM are any collection of materials that teacher uses to achieve desired learning objectives” (Obodo et al, 2020, p.24). TLM can be in any shape and form which can be used in teaching the concepts in an interactive way. TLM can undoubtedly enhance teachers' efforts to present material in a way that influences and promotes learning. TLM is regarded as one of the major aspects that would promote learners' learning and help in the achievement of academic goals and objectives. When TLM are appropriately chosen, correctly organized, and suitably structured into the lesson activities, learning is enhanced and efficiently have greater impact.

The inclusion of TLM in teaching process not only helps in understanding concept but also helps in developing innovative skills. Busljeta (2013) reported that “the purpose of TLM doesn't only consist of making the educational process more attractive and interesting, but also of encouraging active learning, the development of different skills and the adoption of desirable values and attitudes in students” (p.49). TLM promotes students to learn new things, develop new talents, and have optimistic attitudes in learning. Utilizing TLM can increase motivation for TLM development, help learners recognize its worth, and help learners comprehend its importance.

Teaching and learning materials creates possible direct interaction between learners and their environment. TLM makes it possible to contextualize the classroom learning and relate it with their learning environment as TLM fosters to make learning more realistic and hands on.

Teachers can more clearly define, establish, and correlate the concepts with the use of TLM. “Better knowledge and skill acquisition can be developed through hands on activity or learning by doing. TLMs afford children the opportunity to have hands on experiences, which increases and develops their knowledge” (Frimpong, 2021, p.169). Instructional materials boost teaching and learning as they stimulate thinking and concretize learning as learning is more of hands on experiences.

TLM plays a significant role in guiding teachers to teach effectively. “TLM give teachers the air of guidance, coordination, supervision and more time for correction in the class” (Stephen, 2015, p.28). Since young learners typically lack the ability to assimilate concepts abstractly, the use of TLM makes it easy for learners to understand communicated information as there is more interactive learning.

2.4 TLM and academic achievement

The major significance of TLM is recognized within the classroom environment as it provides support and assistance to the educators for the transmission of content and the achievement of learning objectives. “Availability of TLM enhances the effectiveness of schools as these are basic things that can bring about good academic performance in the students” (Yara & Omondi, 2010, p.126). Obodo et al. (2020) also found out the relation between the use of TLM and academic achievement of learners and reported that “the availability of TLM has long been recognized as an important factor in bringing positive educational attainment and learning performance is determined by the teachers' knowledge of the subject matter, pedagogical skills, and the availability of learning materials” (p. 25). The major role that has been rendered by the TLM is to make learning real, practical and pleasurable for the students. The teachers make use of TLM to illustrate or reinforce a skill, viewpoint, perspective or an idea. The use of TLM at lower classes is found to have directly proportional relation in learning at higher levels. It has been found to develop critical, creative and logical thinking skills. Obodo et al. (2020) reported that

The success of any system of education depends to a large extent on the availability and quality of teaching-learning materials properly utilized by the teacher. The availability and utilization of teaching materials at lower levels will help to enhance the quality of inputs into the higher level and consequently impact positively on the outputs of the higher levels. (p.25)

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The use of TLM promotes interaction and participation of the students which ultimately helps to bring positive learning outcomes. “Teaching resources help to provide materials and opportunity for experiment. This ensures students participation in the lesson, which promotes effective learning” (Ibrahim et al., 2019, p.33). It was also reported that in real situation, the learners are born with different abilities and capabilities to learn the concept differently. TLM provides opportunity for learners to learn the way they feel effective for them. Muelas and Navarro (2014) also supported that “TLM is important and work with different cognitive styles, abilities and skills as well” (p.217). TLM takes care of individual differences and gives opportunity to learn with wide variety of learning strategies. It is therefore, imperative on the part of the teachers to use as many relevant instructional materials as possible, for learners to have maximum interaction and participation in the process of learning.

“TLM encourages the process of understanding the educational content, logical thinking, communication, interaction, and helps in contributing to the development of different skills and the acquisition of values as well as the retention of desirable knowledge, skills and attitudes”. (Busljeta, 2013, p.5). It is believed that learners can achieve more if given the opportunity to learn and interact with TLM. Additionally, it has been reported that it promotes the growth of analytical and critical thinking, which holds students' interest. TLM are a crucial component of classroom instruction and play a significant role in the development of productive teaching and learning environments.

Major function of TLM is to help learners to have more retention and to motivate more towards learning. “TLM are used in teaching and learning process to support various activities among students. These aids are directly address to the all the senses so the chances of forgetting become less and process of learning becomes more effective” (obodo et al., 2020, p.25). Learning becomes more instructive and aids in greater retention as the use of TLM awakens and activates all of the senses. It helps in more retention as it helps to make the concept more hands on and bring real life experiences. Lumpkin (2020) also reported that best practice in teaching to get effective learning outcome depends on ensuring diverse learning experiences such as experiential, real-life, and problem-solving learning opportunities (p.33). Munna and Kalam (2021) also stated that:

Teachers need to use various resources in the learning process that may include computers, books, smart board, equipment, artifacts, whiteboard, special speakers, games, computer programs etc. It was evident from the research that the more the lesson is interactive, the more the learners are engaged/motivated to improve their learning experiences. (p.2)

The educators need to focus upon integrating TLM in classroom learning for effective knowledge development. Teachers need to conduct research and promote modern and innovative methods to enrich TLM design and creation. Integrating of TLM in the classroom enables learning to be real and interactive. “An effective teacher should be able to make learning an imaginatively vital experience and seeks to foster the creative engagement of both teacher and the learners with the use of TLM”. (Adebiyi et al., 2013, p.2). Therefore, educator needs to find a possible ways to make use of TLM to give interactive and engaging learning experiences. Moreover, it is essential for the educators to possess adequate knowledge and information regarding the use of TLM. The major aspects that need to be taken into account regarding the use of TLM are the grade levels of students, subjects, learning abilities and academic goals.

2.5 The Concept of improvisation

Science is learning through investigation and experimentation. It provides learning through hands on experiences of theoretical knowledge gained in the classroom. However, many students see science as abstract and irrelevant to their lives due to lack of engaging classroom and TLM. TLM are sometimes lacking, not available or not suitable. Non availability of TLM therefore, hinders effective teaching and learning of science in the schools. This makes it imperative for teachers to use locally available materials to make their own teaching and learning to cope with the demands of teaching and learning. Ibrahim et al. (2019) states that

Due to the inadequate instructional materials in most of the schools there are needs to bring new innovative ways of providing available materials for effective teaching and learning. These issues bring about the idea of improvisation which is the art of using materials or equipment obtained from local environment or produced by the teacher and with the assistance of the local personnel to enhance instruction. (p.33)

“Improvisation reveals that there are possibilities of alternatives to teaching and learning aids. It is said to be an act of designing a replica of standard equipment assigned to play some designated roles meet specific teaching and learning situations” (Adebiyi et al.,2013, p.2). The universal task of improvisation is to make teaching and learning real and genuine to the students for increased performance and practical application of the lesson when the real objects are lacking. “Improvisation as a concept can be defined as a technique of originating a totally new tool, instrument, material, devise or modifying existing ones for serving a particular function” (Adu et al.,2014, p.15). Teachers and learners therefore, are obliged to prepare and improvise TLM from locally available resources to teach the concept and fulfill the set objectives.

Improvisation is one option for ensuring effective teaching and learning. Improvisation can be understood as a substitute for the readymade or imported materials. However, improvisation is not just mere substitution of the lacking instructional material with what is available but must serve the purpose of the original material. Improvisation is the provision of alternatives to real things.

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“Improvisation is the making of substitutes when the real equipment or material is not adequate or available. It is the art of providing and using alternative materials or resources in the absence of the real or factory made one” (Ibrahim et al., 2019, p.34). The improvised TLM are made use as alternative materials and resource to facilitate learning instruction whenever there is shortage of some specific first hand teaching aids. It was reported by Ibrahim et al. (2019) that

Improvisation is the process of making equipment and materials by the students or by engaging the services of others in the absence of real or manufactured ones. Generally, improvisation of instructional materials is an attempt to adapt and make use of local resources in the teaching/learning process when the ready-made materials are not available or are in shortfall or not within the reach of users. (p. 34)

Generally, improvisation could be regarded as the act of using alternative materials or equipment obtainable from the local environment prepared by the teacher and learners when the readymade materials are lacking. Improvised TLM give teachers and learners the pride of using their talents, allows reproducing their potentials and increasing knowledge of the subject matter.

It was noted that government and other educational support agencies are not always in position to provide schools with all the materials that are required. Therefore, the schools, teachers and learners might be obliged to use what is available or construct from locally available raw materials. “Teacher should try to improvise instructional materials and encourage students to do the same. This will give students enough understanding of classroom concepts to apply in real life situation” (Ibrahim et al., 2019, p.35). Improvisation plays a pivotal role in helping learners to apply their understanding and learning to apply in real life situation. It enables to bridge gap between what is learned in the classroom with the real life situations.

Every day teachers are challenged to act in accordance with the situational needs and requirements arising in different pedagogical situations. Mostly teacher are challenged with the non availability of readymade TLM in the classroom. However, learning should not be stopped due to unavailability of readymade TLM, the teachers and learners should endeavor to improvise most of the materials with available materials in and around the school. Maheux and Lajoie (2010) illustrated that “improvisation should be part of any moment in teaching” (p.91). Therefore, improvisation should be a part of learning in every situation. Improvisation of instructional materials and equipment becomes necessary when their originals are not readily available and teachers should find every possible ways to improvise TLM to substitute the readymade TLM.

2.6 Importance of improvisation

It is through the availability of proper TLM that schools can render an effective contribution in achieving the desired educational objectives and promoting effective growth and development of students. The major objectives of TLM are to motivate learners, develop skills, and help in longer retention of information and making learning pleasurable and engaging. However due to unavailability of readymade TLM, teachers are obliged to improvise the TLM which will make the learning effective and fulfill the set objectives but improvisation has proved to have lots of advantages in teaching process. Abu et al. (2014) reported that

The process of improvisation gives teachers’ the knowledge of creativity, manipulative skills, and critical thinking. Improvisation helps in saving cost of looking for readymade instructional media which are more costly. It encourages self-reliance and a feeling of confidence during instruction delivery. (p.17)

Due to unavailability of readymade TLM, educators prepare their own teaching materials which helps to generate sufficient awareness in terms of concepts and subject knowledge. This would enable them to facilitate student learning in an appropriate manner. The involvement of teachers and learners in improvising materials gives an opportunity to concretize the creativity, resourcefulness and imaginative skills. It will make learners to have realization about the importance of improvisation. Moreover improvisation will help learners develop sense of belongingness.

Improvisation not only promotes ability to meet the objective of the lesson but also motivates interest towards learning. As the improvised TLM were developed individually, it gives sense of attachment and motivation towards learning. The study has been carried and found that learners taught using improvised TLM performs better in terms of academic. Obodo et al. (2020) reported that

Students taught using improvised teaching-learning materials performed better than students taught without improvised teaching-learning materials. The students’ improvised instructional materials were more effective because these materials are locally made and during captured students’ interest during teaching processes which lead to maximizing comprehension of the subject matter. (p.29)

Improvisation helps to make connection between the classroom learning and real life situations by providing ideas into how to handle different situations. The ability to improvise requires both the teacher and the students to be creative, innovative, and have a solid understanding of the subject matter. “The process of improvisation gives teachers’ the knowledge of creativity, manipulative skills, and critical thinking. It encourages self-reliance and a feeling of confidence during instruction delivery” (Ibrahim et al., 2019, p.35). The use of improved TLM not only helps in developing different skills but also gives teachers the confidence of teaching the lesson effectively.

The focus of improvisation is helping learners to prepare their own resources from which imaginative ideas and critical thinking develops. It should help in proper dissemination of knowledge. According to Adebisi et al. (2013), it was found that “ teachers

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and learners can use local resources in their immediate environment to build, construct and make instructional TLM that can assist in the smooth dissemination and transfer of knowledge from teachers to students” (p.2). Improvisation helps learners to provide cognitive bridge between abstraction and reality of knowledge. It also widens the scope of inquiry which helps to develop necessary process and practical skill. Ibrahim et al. (2019) studied about improvisation and found out following importance.

- Ensures the realization of lesson objectives.
- It gives room for a teacher to demonstrate his creative skills and gives room for the use of cheap local materials as alternative to the expensive foreign materials.
- Improvisation encourages students towards the development of creative abilities.
- Enables teacher to think of cheaper, better and faster methods of making teaching learning process easier for students.
- Affords students the opportunity of becoming familiar with resources in their environment.
- It strengthens enquiry, discovery and investigative methods in sciences. (p.35)

If appropriate TLM are designed and used effectively in lessons, learners would be able to concretize learning, reflect on what they observe, conceptualize them and carry out experiment to verify their understanding. It can also help to substitute the real object with locally available resources. Importantly improvisation enables learners to develop an appreciation of the use of everyday things in their environment in learning science and environmental studies.

2.7 Inhibiting factors for effective implementation of improvised TLM

It is vital to ensure that TLM should be implemented in such a manner that students feel motivated and enhance interest and enthusiasm towards acquisition of education. When the educators are putting into operation the teaching learning methods, they need to ensure that TLM are in accordance to the needs and requirements of the students and grade levels. “Using TLM can be counterproductive if students fail to find the meaning of what is being represented by the resource, if they do not understand it or if they cannot use it independently” (Busljeta, 2013, p.12)

In order to achieve the potential tasks of TLM successfully, it is extremely important the teacher know how to evaluate the advantages and disadvantages of said resources and use appropriately. “Though the teachers might have good intentions of imparting knowledge to the learners but because they lack skills in design and use of TLMs, they turn to be unproductive in the classroom” (Kyeremeh et al., 2020, p.26). While developing the TLM, teachers and learners should possess enough skills and knowledge to effectively develop it. Moreover, for learners and teachers to derive maximum benefits from improvised TLM, the teacher must have adequate knowledge of the particular subject matter. It is equally important for the teacher to have a thorough understanding of the learning process in addition to possessing a good knowledge of available improvised TLM. Ibrahim et al. (2019) reported that

To be able to promote quality instruction in our school system, there is the need to pay attention to improvisation of instructional materials in the teaching/learning process. However, noted that improvisation demands adventure, creativity, curiosity and perseverance on the part of the teacher, such skills are only realizable through wellplanned training program on improvisation. (p 35)

It is essential that to develop TLM, teachers should not only be well aware of subject matter but also have critical and creative skills to develop appropriate TLM. Teachers should have curiosity and perseverance to develop TLM. Improvisation of TLM helps to substitute the real and readymade TLM however, according to Olabiyi, (2015), it was found that improvisation of TLM “required creativity, curiosity and critical skills which can be achieved through proper training” (p.25). This alarming situation may be due to the fact that teachers lack knowledge and skills in the designing and utilization of TLM. Moreover teachers with the knowledge of improvisation are also found to be reluctant to improvise TLM. Ede (2004, as cited in Anibueze, n.d) reported that “lack of finance, control of large class, time constraint and lack of skills and strategies on improvisation have been the major problems that confront teachers and have made it impossible for teachers to improvise instructional materials” (p.33).

The selection of teaching and learning materials can have great or greater impact than the impact of teacher quality on students’ performance. For effective teaching and learning outcomes, teachers should be critical for the selection of raw materials for preparing TLM for the intended lesson. However, Kyeremeh et al. (2020) reported that

The major challenges/difficulties that student teachers face in making their own TLM include: lack of finance, lack of skills in TLM design and time constraints. Moreover it was found that the improvised materials were not so durable and flexible which easily torn upon manipulations. (p.31)

Improvised TLM comes with some technical factors challenge like the degree of accuracy and precision that can be achieved with the improvised materials and equipment. This problem is crucial where experiments those are more sensitive and observations are carried out. Other challenges include the human factors where the problems are associated with the teachers’ professional commitments, creative ability, technical skill, ingenuity and competence. Cakir (2015, as cited in Akinmusire et al., 2019) also reported that “most of the teachers were reluctant to use many of the highly beneficial materials due to reasons including

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overcrowded classes, limited technological knowledge, lack of time for preparation, curricular time constraints, heavy work load and burnout” (p.29). Moreover teachers should be committed enough to work on improvisation as improvisation requires creative imagination and lots of perseverance to better the life of learners. Nevertheless, teachers and learners should have adequate knowledge and skills to improvise the TLM appropriately.

2.9 Summary

Science learning focuses more on providing hands on experience learning through inquiry and discovery learning which helps learners explore vigorously to be independent learners. It also focuses on connecting the classroom learning to the real world situation through participation in the scientific processes of observation, inquiry, investigation, and experimentation. In this case, TLM plays important roles in fulfilling the learning objectives of Science education. Therefore, teaching of science should incorporate the use of variety of TLM which provides an avenue for learners to get in touch with real objects for inquiry and investigating to confirm their classroom learning. It is evident that TLMs enable the teacher to transfer learning effectively. However, due to the inadequate and unavailability of instructional materials in the schools, teachers and learners are obliged to prepare TLM from locally available materials to fulfill the objectives.

Therefore, teachers and educators must pay attention on improvisation of TLM.

METHODOLOGY

3.1 Introduction

This section presents the methods adopted by the researcher to carry out the systematic study on improvisation of TLM and its contribution in teaching and learning of primary science. Research methodology provides and guides the researcher with the research method and appropriate steps of data collection, data analysis and interpretation. It is a framework of the study process. It was illustrated that “research approaches are plans and the procedures for research that extend the steps from the broad assumptions to detailed methods of data collection, analysis and interpretation” (Creswell, 2014). It can be a guideline to make the study manageable, smooth and effective to gather the required information. Singh and Nath (2005) also stated that research methodology involves the procedures by which researcher starts from identification of the problem to its final conclusion. Moreover research methodology section enables reader to critically evaluate a study’s feasibility and reliability. Thus, choosing a relevant design, right data collection tools and appropriate analysis procedures is crucial to determine the success of the study.

3.2 Research Paradigm: Pragmatism

Research paradigm is described as “a way of thinking about and making sense of the complexities of the real world” (Patton, 2020, as cited in Kaushik & Walsh, 2019, p.1). World view or paradigm can be understood as general philosophical view and orientation about the world. Lincoln (2011, as cited in Kaushik & Walsh, 2019) defines paradigm as “word is used to refer to the philosophical assumptions or to the basic set of beliefs that guide the actions and define the worldview of the researcher (p.1). The researcher made use of pragmatism among the four worldviews in the study. Creswell (2014, as cited in Kaushik & Walsh, 2019) states that pragmatism as a paradigm that “claims to bridge the gap between the scientific method and structuralism orientation of older approaches and the naturalistic methods and freewheeling orientation of newer approaches” (p.2). As this study was intended to find out about the improvised TLM that teacher’ uses in the classroom and its contribution in teaching and learning science education; the researcher studied the problem through research questions. Moreover researcher involved various methods of data collection tools to collect intended information and focus on outcome rather than processes conditions of the research. As researcher collected data through mixed method of collection, it is aligned with pragmatism view as “Pragmatism is often associated with mixed methods or multiple-methods” (Creswell, 2013, as cited in Kaushik & Walsh, 2019).

3.3 Research Design: Mixed method (Convergent Design)

Research design can be understood as guideline with a set of plans and procedures to carry out study to generate the findings. Akhtar (2016) defines research design as “the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy and procedure” (p.68). Appropriate research design is essential to generate accurate and reliable end analysis and information. The study was intended to find out about the improvisation and TLM and its contribution in teaching and learning primary science education, researcher felt that mixed method of research design was most appropriate. Creswell (2014, as cited in Doyle et al., 2009) define mixed method of research as “research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study” (p.176). The researchers collected data through semi structured interview questions and survey questionnaire, analyzed the data separately and finally converged to find the similarities and differences in data collected.

The mixed method of research has been found abundantly used as it has advantages of covering all the information which is being left out by one of the methods. Creswell(2014) also reported that “a basic rationale for mixed method is that data collection form one supplies strengths to offset the weaknesses of the other form and that a more complete understanding of a research problem

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results from collecting both quantitative and qualitative data”(p. 543). Creswell (2014, as cited in Doyle et al., 2009) also stated that “the purpose of mixing approaches is to afford opportunity to gain a more complete understanding of research problems” (p.184). Furthermore, Greene (2005, as cited in Doyle et al., 2009) also suggested that “a mixed method approach offers greater possibilities than a single method approach for responding to decision makers agenda, as well as to the interests of other legitimate stakeholders” (p.181). The study was aimed to find out about different improvised TLM and its contributions and therefore mixed method was found appropriate and used for the data collection as it involved finding both quantity and quality. The study begin with the collection of information from the board survey questionnaire and simultaneously focused on collection and gathering of information through one on one interview with semi structured questions and merge the data collected as shown in figure 1.

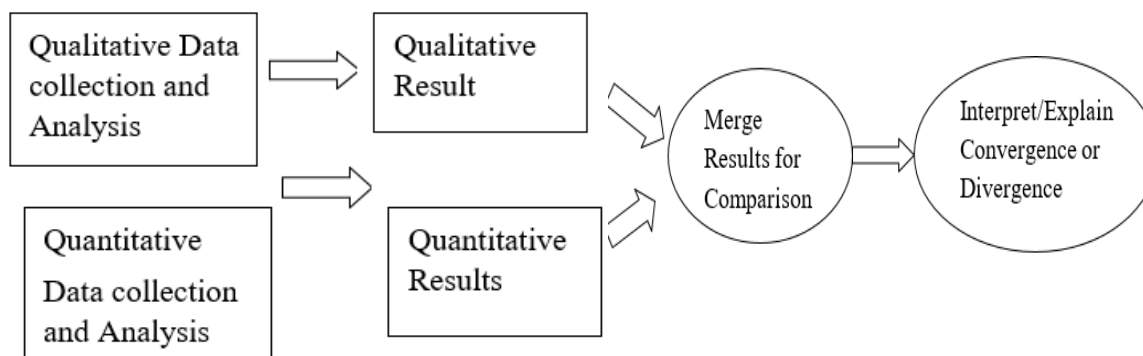


Figure 1: Convergent Parallel Design

Source: Adapted from Creswell, 2014 (p.544)

3.4 Brief information on research sites

The site selection plays a vital role in effective collection of data and information. The selection of research site should be based on the study requirement and relevance to the study topic. Moreover the accessibility and convinance of the researcher should be also considered while selecting the research site. As a researcher comes from remote primary school, he had observed that most of the remote schools were not blessed as the schools in urban areas in term of availability of TLM and different facilities. Moreover due to shortage of teachers in the remote schools, the teachers are found overburdened with lots of other activities in the school. And it has resulted difficulties in managing time for improvisation for unavailable TLM. Therefore a researcher has collected information from three remote schools under Paro dzongkhag.

3.5 Sampling and participants

The process of accurate sampling of participants helps to enhance precision and accuracy for the study. It is very crucial that researcher needs to study which particular population is best suited for studying the research problem. Creswell (2014) stated the importance of indentifying suitable population and sampling. He illustrated that “if a suitable sampling strategy is used, appropriate sample size selected and necessary precautions taken to reduce on sampling and measurement errors, then a sample should yield valid and reliable information”(p.141).

The first step in sample planning is to define the population to be investigated to get data.

According to Creswell (2014), population is defines as “the totality of all units or elements

(individuals, households, organizations, etc.) to which one desires to generalize study results” (p.141). The population can be understood as a group of individuals, objects, or items from which samples will be taken for collection of data. The current study about improvisation of

TLM and its contributions in teaching primary and learning of science was intended to find different improvised TLM adopted by science teachers and learners, all the science teachers teaching in primary classes and students learning science subjects were considered as population for the study. (The details of population from different school are generated from annual education status, 2022). However due to lots of limiting factors, it was hurricane task to collect data involving all the science teachers. Therefore, required data was collected from sample participants. Creswell (2014) defines sampling as “the act, process, or technique of selecting a suitable sample, or a representative part of a population for the purpose of determining parameters or characteristics of the whole population”. Sampling make it easier for the researcher to collect data within given period and it’s more convenient and manageable. Albaum and smith (2010) states that “samples (a smaller number of interviews compared to a census) may result in better interviewing, higher response rates through more call backs, and better measurement in general” (p.125). As the current study aims to find out about improvisation and its contribution in teaching and learning primary science, for the survey questionnaire; the survey questions forms was distributed to teachers and students who have experienced of teaching learning science of three primary schools under Paro Dzongkhag. Researcher intended to involve large number of participants to collect

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data through survey questionnaire. Creswell (2014) states that the larger sample sizes generally produce more accurate analysis. Larger samples tighten the size of the confidence interval, making researcher to estimate much more accurate. However for interview questions, researcher involved purposive sampling where current teachers teaching science were be interviewed to generate the required information. To obtain the suitable number of sample size, the Yamane (1967) formula was used as shown below:

$$n = N / 1 + Ne^2$$

Where: n = number of samples, N = total number of population, e = standard error of not more than .05 confidence

Table 1: The sample of respondent chart for survey calculated using Yamanes' formula.

Sl. No	Site	Student	Teacher	Sample
School A	Primary School	25	7	Sample size of student = 84 Sample size for teacher=15 Confidence level=90% Margin of error= 5%
School B	Primary School	31	7	
School C	Primary School	50	5	
Total Population		106	19	

(Note: Total population from each school was generated from Annual education status, 2022)

3.6 Data collection and procedure

High quality information is essential to have better accuracy and precision of the study. High quality information can be collected if the right and relevant data collection tools were engaged while collecting data. Data collection tools are main components in generating information which can be analysis into end findings. Correct and relevant choice of data collection tools helps researcher to save time in collecting accurate information, guide for future references and draw precision outcomes. As the current study involve mixed method of research design, it is essential to know the general procedures of collecting data in both qualitative and quantitative research.

Before the conduct of interview and distribution of survey questionnaire, researchers carried pilot testing of interview questions to test the relevancy of the interview questions and to check the time required for the completion of the questionnaire. Pilot interviews were carried with 3 teachers who have experienced of teaching science subject. Reliability of the interview questions and others feedback were received and made changes to some of the questions. The interviews were semi-structured in nature and were conducted on an individual basis. The pilot testing enabled the researcher to equip with experiences of conducting interviews and obtain experiences in building rapport and relationships with the participants. Moreover it has helped researcher be well aware about ethical conduct and skills of interviewing the participants to correlate feasibility of the research.

Researchers also checked the reliability of survey questionnaire for both teachers and the learners. Researcher did pilot testing with 10 students and survey questionnaire were sent through Google form. It was resulted that value is .878 for students which is in good level for learners' survey questions and found value was .717 for teachers. This is as per the data information provided by George and Mallery (2003) on the level of cronbach's alpha for the reliability of the questions. It states that "if the levels are >.9 is excellent, >.8 is good, >.7 is acceptable, >. 6 is Questionable, >.5 is poor and <.5 is Unacceptable" (p.231). The survey questionnaires for teachers and learners were used to collect quantitative data that will provided statistical descriptions, relationships and analysis. Creswell (2014) defines questionnaire as "a form containing a set of questions, especially addressed to a statistically significant number of subjects, and is a way of gathering information for a survey. It is used to collect statistical information or opinions about people". Questionnaire was used for the study because it is effective for collecting data from a large number of people within short possible time. Questionnaire included demographic information about the participants and questions about improvisation and its contribution in teaching primary science. The questionnaire was sent through Google docs for teachers and for learners, it was taken in printed form. The form also included the aims and objectives of carrying the research study and assurance about maintaining the confidentiality.

Furthermore for the qualitative design of researching, one on one interview was done with the teachers who are currently teaching science get qualitative data. Creswell (2014) defines interview as "a social encounter where speakers collaborate in producing retrospective and prospective accounts or versions of their past or future actions, experiences, feelings and thoughts". Interview furnished the researcher with accurate and reliable data to gain deep understanding of the study. Punch (2005) states that interview are one of the powerful tools to collect information by assessing through participants perception, meanings, and definitions of

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situations and constructions of reality. The participants were asked about their experiences of improvisation, challenges they face while developing TLM and contributions and hindrance for using improvised TLM. The interviews were broadly guided by the series of questions where respondents can relate their own experiences. The interviews made it possible to explore other themes for further enriching the data. Moreover with the consent form from the respondents; tape recordings were made which will enable the researcher to pay close attention to discussions; and accurately analysis the information later. However, few teachers were not comfortable with tape recordings and their words were captured in notes.

3.7 Data analysis and interpretation

To get final interpretation from the different respondents, data need to analysis and interpreted. Analysis and interpretation of quantitative data was carried using Statistical Package for Social Sciences (SPSS). Mohajan (2017) defines SPSS as a “computer software package that has been used for the data analysis of the primary data various statistical techniques such as, mean, median, standard deviation, etc.,” (P.6). The quantitative data collected were categorized and coded. In this process, the raw data were firstly transformed into numerals to facilitate counting and tabulation of data. Secondly, the organized data were entered into a computer. Thirdly, simple tables and figures were constructed to examine the relationships between variables.

Analyzing qualitative data involved looking for similarities and dissimilarities. Creswell (2014) relates that the qualitative data analysis normally deals with indentifying into themes and classifying into categories. The interview data collected from participants were first transcribed after which they were organized based on the emerging themes as informed by the research questions. The focus was on those patterns of interactions and events that are generally common. Themes were identified, and then data was classified into categories and carried the interpretation to generate result. Finally the collected data and information from both qualitative and quantitative method will be compared and analyzed.

3.8 Ethical consideration

Researchers should be always be guided by ethical guidelines while carrying research study for smooth process of data collection. Nueman (2014) defines ethics “as set of guidelines which states what is or is not legitimate to do or what moral research procedure involves” (p.145). The ethical consideration assures respect and protection for both the participants and researcher. Moreover it helps o value right, opinion and information of the participants. The process of the conduct of the study followed of getting approval for research team of Paro College of education, the chief Education Officer, and concerned letter from school principals. The respondents were assured that the information recorded would be used only for the purpose of the study. Informed written consent was obtained from the respondents after the study aims and objectives, risk and benefits of the participants were explained. Respondents were given the option to refuse to answer any question that they did not feel comfortable with or to decline to be interviewed at any time during the interviewing process. Furthermore, during data collection process confidentiality of participants was also maintained. Thereby, respondents were assured that their names would not be disclosed in the research report.

3.9 Summary

The research methodology is the systematic framework which guides the researcher throughout conduct of the study. Depending on the nature of the research question, the study incorporated mixed method of research design. The right choice of data collection tools enabled to generate accurate information whereby data were collected through survey questionnaire(quantitative approach) and one on one interview(qualitative approach) with science teachers and learners.

Analysis and interpretation of quantitative data was carried out using Statistical Package for Social Sciences (SPSS) whereas for the qualitative purposes, data were transcribed, coded into themes and finally converged and compared with quantitative data collected.

The researcher carried research study with getting approval from research team and others individuals involve in data collection. As mentioned in preceding information, ethical considerations were taken care throughout the conduct of the study. Therefore, it was through the involvement of science teachers and learners using mixed method of design, the researcher generated information about improvised TLM and its contributions in teaching and learning primary science education.

RESULT AND DATA ANALYSIS

4.1 Introduction

This chapter presents the result of data collected from questionnaire and interview to explore about the improvisation of TLM and its contribution in teaching and learning of science education. The first section compiles the reports obtained from the students through survey questionnaire form, and then the reports of data obtained from teachers’ survey question and finally present the data collected through interview for primary science teachers.

Quantitative data which were collected through survey questionnaire were analyzed using SPSS. It contains the demographic information of the participants followed by different descriptors of questions segregated under different themes. However, semi structured interviews were used to collect qualitative data from teachers who have experienced of teaching science subject in their respective schools. Data collected were translated, transcribed and coded under different themes.

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4.2 Quantitative data analysis of students

This section presents results of data collected from survey questionnaire for students under three themes. Out of the 83 questionnaires distributed, 77 responded were retained and analyzed whereby 7 responses were found missing the required information. The data sets were created and analyzed using statistical package for the social sciences (SPSS). To obtain a quantitative measure of respondents' perceptions, the Likert-type rating scales used in the questionnaire included: Strongly Agree=5; Agree=4; Neutral=3; Disagree=2; and Strongly Disagree=1. These rating scales were used as the basis for calculating the mean scores (M) and standard deviation (SD) of the various statements.

To determine the overall ratings, as described by Rigyal (2013) the interval mean mid-scores were calculated, based on the number of interval levels each likert-type rating scales were composed of, by using the following equation:

$$\text{Interval level} = \frac{\text{highest level score} - \text{lowest level score}}{\text{Number of levels}}$$

4.2.1 Demographic information

The term demographics refer to general information and characteristics of individuals who are being studied. "Demographic provides data regarding research participants and is necessary to understand about the participants" Salkind (2010). Accordingly collecting and analyzing of demographic information helps to ensure the comprehensive understanding about the study.

Table 2. Respondents by class and gender

Class	Male	Female	Total
IV	12	13	25
V	14	13	27
VI	13	12	25
Total Participants	39	38	77
Percent (%)	50.64%	49.36%	100%

Data about improvisation and its contributions in teaching and learning of science were collected from three remote schools Paro Dzongkhag. Out of seventy seven (N=77) sample collected, 50.64% were male participants and 49.36% were female participants. To collect diverse and authentic data, different levels of classes were involved. 25 samples were collected from class IV students and 27 and 25 students from class V and VI respectively. Thus, by looking at the demographic information, it was concluded that researchers has to involved equal numbers of male and female participants from different level of classes to generate varieties of responses.

4.2.2. The use of teaching learning materials

Table 3. Responses about the use of TLM

Sl. No	Descriptors	N	Minimum	Maximum	Mean	Std. Deviation
1	The use of TLM helps in learning the concept effectively	77	4.00	5.00	4.8312	.37706
2	The teachers make use of TLM in the classroom	77	3.00	5.00	4.3896	.61035
3	The use of TLM is prescribed in textbook	77	2.00	5.00	3.3247	.67749
4	The use of TLM makes learning interactive and engaging.	77	3.00	5.00	4.7532	.49086
5	TLM helps to motivate my learning	77	2.00	5.00	4.4156	.63558

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6	The school has all the required TLM for learning Science	77	1.00	5.00	3.5065	1.04659
7	The teacher brings locally available TLM when readymade TLM are not available.	77	2.00	5.00	4.0519	.72359
8	Digital TLM are used in absence of readymade or locally available resources.	77	1.00	5.00	4.4545	.81991
Valid N (list wise)		77				

Note. Mean scores: 4.21 – 5.00 = strongly agree (SA); 3.41 – 4.20 = agree (A); 2.61 – 3.40 = Neutral (N); 1.81 – 2.60 = disagree (D); 1.00 – 1.80 = strongly disagree (SD)

Table 3 presents the data collected from participants about the use of TLM while teaching and learning the concept. Overall, the participants reported positive perceptions of using Teaching and Learning Materials (TLM) in various aspects of learning. The mean ratings for most descriptors are above 4, indicating that TLM is generally considered helpful and effective.

However, there are variations in the participants' responses, as shown by the standard deviations. It is worth noting the descriptor 6 ("The school has all the required TLM for learning Science") has a relatively high standard deviation, suggesting a greater diversity of opinions and experiences regarding the availability of TLM in the school. The descriptors which talks about the use of TLM helps in learning concept effectively and the use of TLM helps to make learning interactive and engaging has relatively higher mean value which indicates that participants strongly agrees with the given descriptors.

The standard deviations in most categories were only slightly ≥ 1 , thereby showing there is less variations in the perceptions of the respondents however, the statement about availability of available resources in the schools has higher standard deviation indicating that there are more variations in the responses.

4.2.3 Preparation of TLM

Table 4. Responses about the preparation of TLM

Sl. No	Descriptors	N	Minimum	Maximum	Mean	Std. Deviation
1	Teachers teach the concept through lecture method if readymade TLM are not available.	77	1.00	5.00	3.3896	.96185
2	Teachers prepare their own TLM from locally available resources when readymade TLM are not available.	77	1.00	5.00	4.0519	.95829
3	The teacher also ask us to prepare different TLM	77	1.00	5.00	4.1818	.79019
4	The school provides necessary support for acquiring TLM	77	1.00	5.00	4.2078	1.03030
Valid N (list wise)		77				

Note. Mean scores: 4.21 – 5.00 = strongly agree (SA); 3.41 – 4.20 = agree (A); 2.61 – 3.40 = Neutral (N); 1.81 – 2.60 = disagree (D); 1.00 – 1.80 = strongly disagree (SD)

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Theme two was basically focused on preparation of TLM and four descriptors related to the use of TLM by teachers were included to generate the data. Respondents were asked about the preparation of TLM and data collected shows that they agree or strongly agree with all the given descriptors except the descriptor which says that “teachers teach concept through lecture method if readymade TLM are not available”. The stated descriptors obtained the mean value of 3.3 which is in neutral level which indicates that teachers sometimes teach through lecture method or find some other means to teacher when readymade TLM are not available. The perception of schools providing necessary support for acquiring TLM has a relatively high mean score of 4.2078, with a higher standard deviation of 1.03030. This indicates that while schools generally support acquiring TLM, however, there may be some variability in the level of support provided.

4.2.4. Challenges for effective use of improvised TLM

Table 5. Response about the challenges for effective use of improvised TLM

<u>Sl. No</u>	<u>Descriptors</u>	<u>N</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Mean</u>	<u>Std. Deviation</u>
1	Improvisation helps to substitute the unavailable readymade TLM	77	1.00	5.00	4.2597	.78477
2	Improvisation helps to develop critical and creative thinking skills	77	1.00	5.00	4.3896	.69122
3	School provide support while improvisation of TLM	77	1.00	5.00	4.0649	.83252
4	Improvised TLM are effective as readymade TLM	77	1.00	5.00	4.0649	.89351
5	Improvised TLM have problems of precision and accuracy	77	1.00	5.00	4.1169	.97298
6	Improvisation may not provide correct information	77	1.00	5.00	4.1558	.94681
7	Improvisation of TLM is time consuming	77	1.00	5.00	4.6623	.66115
8	Funding support is required for improvisation	77	2.00	5.00	4.1039	.78781
9	Locally available materials can be used for improvisation	77	1.00	5.00	4.3117	.76536
Valid N (list wise)		77				

Note. Mean scores: 4.21 – 5.00 = strongly agree (SA); 3.41 – 4.20 = agree (A); 2.61 – 3.40 = Neutral (N); 1.81 – 2.60 = disagree (D); 1.00 – 1.80 = strongly disagree (SD)

Table 5 presents about the challenges faced while using the improvised TLM. The data were collected under nine descriptors. The mean value for all the descriptors shows more than four which indicate that all the participants agrees or strongly agrees with the descriptors given in the survey. The use of improvisation in TLM is perceived to positively contribute to the development of critical and creative thinking skills, as indicated by a mean score of 4.3896. Improvised TLM are seen to have some issues related to precision and accuracy, with a mean score of 4.1169. Among all, the descriptors which states about improvisation of TLM as time consuming obtained the highest mean value which indicates that preparation of TLM is found time consuming.

4.3 Quantitative analysis for Teachers

Survey questionnaire was conducted to explore about improvisation and its contribution in learning science from the teacher of three remote schools under Paro dzongkhag. As per the sample size calculated, 15 survey questionnaire were distributed through Google forms however only 5 response were collected and analyzed. As per the information, it was found that teachers were reluctant to carry survey questionnaire as they shared that they have never experienced of teaching science education.

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4.3.2. Gender

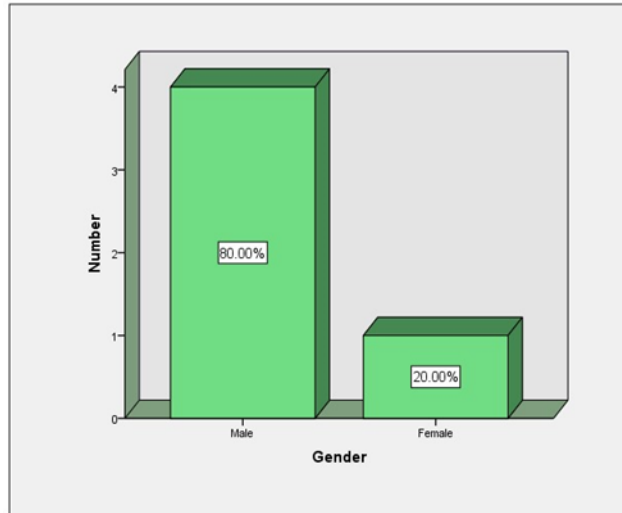


Figure 1 Gender of teachers who are teaching science

The gender information was collected to find out the gender difference in teaching primary science. From the entire sample collected, 80 % of the sample represented male whereas rest 20 % represented female participants. By looking at the statistics from the given figure, male teachers are found dominating in teaching science education to our learners.

4.3.3. Qualification

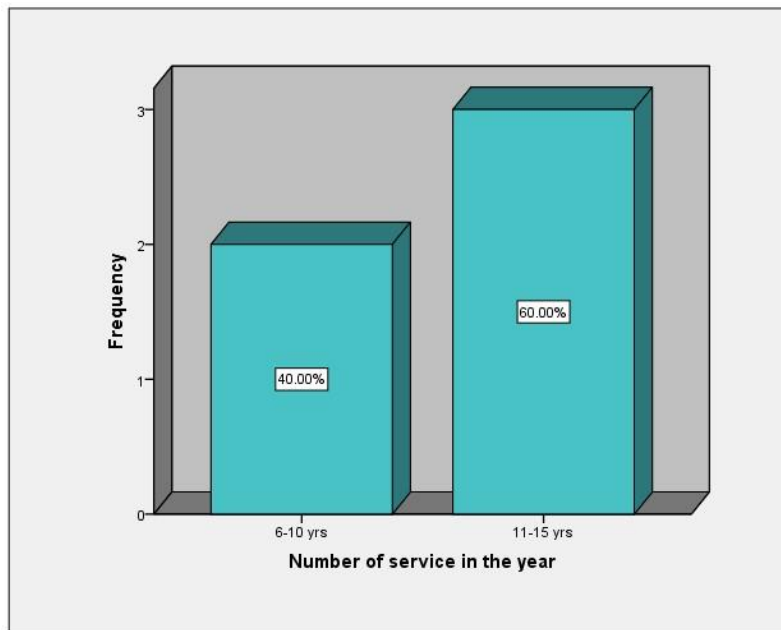


Figure 2 Qualification of teacher respondents

The data about their qualification were collected. However, data collected shows that all the respondents have qualification of Bachelor of education and they were found teaching different levels of primary classes. Information about the number of service was also collected and found that 80 % of respondent has more than 11 years of experience and 40 % of respondents' states that they have 6-10 years of teaching experiences.

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4.3.4. The use of TLM

Table 6. Responses about the use of TLM

Sl. No	Descriptors	N	Minimum	Maximum	Mean	Std. Deviation
1	The use of TLM helps in teaching the concept effectively	5	5.00	5.00	5.0000	0.00000
2	The teachers make use of TLM which are available	5	4.00	5.00	4.2000	.44721
3	The use of TLM is prescribed in textbook/ curriculum Guides	5	3.00	5.00	4.2000	.83666
4	The use of TLM makes learning interactive and engaging.	5	5.00	5.00	5.0000	0.00000
5	The school has all the required TLM for teaching Science	5	4.00	5.00	4.8000	.44721
6	The teacher uses locally available TLM when readymade TLM are not available.	5	3.00	5.00	4.4000	.89443
7	Digital TLM are used in absence of readymade or locally available resources	5	4.00	5.00	4.2000	.44721
Valid N (list wise)		5				

Note. Mean scores: 4.21 – 5.00 = strongly agree (SA); 3.41 – 4.20 = agree (A); 2.61 – 3.40 = Neutral (N); 1.81 – 2.60 = disagree (D); 1.00 – 1.80 = strongly disagree (SD)

The first theme presents about the use of TLM in teaching the concept in learning science education. Looking the responses, the mean value for all the statement were more than 4 which indicates that all respondents agrees or strongly agrees to the statements given. Two statements which talks about the use of TLM help to learn lesson effectively and the use of TLM makes learning interactive and engaging has mean value of 5.000 and standard deviation of 0.000 which indicates that all the participants strongly agree that the use of TLM highly effective in teaching concepts. By looking at the result, researcher can conclude that the use of TLM has great impact on teaching of science education.

4.3.5. Preparation of TLM

Table 7. Responses about the preparation of TLM

Sl. No	Descriptors	N	Minimum	Maximum	Mean	Std. Deviation
1	Teachers teach the concept through lecture method if readymade TLM are not available.	5	3.00	5.00	4.0000	.70711
2	Teachers prepare their own TLM from locally available resources when readymade TLM are not available.	5	3.00	5.00	4.2000	.83666

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3	The teacher receive trainings on preparation of TLM	5	1.00	2.00	1.4000	.54772
4	Teachers understands the concept of improvisation	5	3.00	5.00	4.2000	.83666
5	Teacher is confident in improvisation of TLM	5	3.00	5.00	4.0000	.70711
6	Teacher received training on improvisation of TLM	5	1.00	2.00	1.6000	.54772
7	The school provides necessary support for acquiring TLM	5	3.00	5.00	3.6000	.89443
Valid N (list wise)		5				

Note. Mean scores: 4.21 – 5.00 = strongly agree (SA); 3.41 – 4.20 = agree (A); 2.61 – 3.40 = Neutral (N); 1.81 – 2.60 = disagree (D); 1.00 – 1.80 = strongly disagree (SD)

The table 7 presents the information collected about the preparation of TLM. The respondents responded according to their lived experiences and data collected found that teachers prepare their own TLM when the readymade TLM are not available. However, according to the data analyzed, it was found that teachers were not trained or given training on preparation of TLM. Statement which says teacher receives training on preparation and improvisation of TLM has mean value of less than 1.80 which indicates that they strongly disagree about the statement. Moreover, the mean value for statement which talks about schools providing support in preparation of TLM has 3.6 which fall in agree level which indicates that teachers are not really sure about schools support on improvisation of TLM.

4.3.6 Challenges for effective use of improvised TLM

Table 8. Responses about challenges of using improvised TLM

Sl. No	Descriptors	N	Minimum	Maximum	Mean	Deviation
1	Improvisation helps to substitute the unavailable readymade TLM	5	3.00	5.00	4.6000	.89443
2	Improvisation helps to develop critical and creative thinking skills	5	4.00	5.00	4.8000	.44721
3	School provide support while improvisation of TLM	5	3.00	5.00	3.8000	.83666
4	Improvised TLM have problems of precision and accuracy	5	3.00	5.00	4.0000	.70711
5	Improvisation of TLM is time consuming	5	4.00	5.00	4.8000	.44721
6	Funding support is required for improvisation	5	4.00	5.00	4.6000	.54772

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Valid N (list wise)

5

Note. Mean scores: 4.21 – 5.00 = strongly agree (SA); 3.41 – 4.20 = agree (A); 2.61 – 3.40 = Neutral (N); 1.81 – 2.60 = disagree (D); 1.00 – 1.80 = strongly disagree (SD)

Table 8 shows about the respondents' response about the challenges they face while implementing the improvised TLM in teaching Science in the class. As per the data collected, it was found that teacher prepares their own TLM, however, improvised TLM are found having problem with precision and accuracy. Moreover, with mean value of 4.8, improvisation of TLM is found time consuming. But on the other hands respondents supports that improvisation of TLM develop critical and creative thinking skills.

4.4. Qualitative data analysis and presentation

The researcher collected data through semi structured interview with science teachers who are currently teaching science education to primary learners. This section presents the data collected through one on one interview whereby then the data collected were transcribed and coded under different themes. Participants are also coded under different codes and represented by T1, T2 and T3.

4.4.1. Demographic information

The researcher visited three school under Paro dzongkhag and found that in two school schools, only one teacher is assign to teach all levels of science subject but one schools has assign two teachers for teaching science subject. However for the interview, researcher could only interview 3 science teachers, one each from three schools. A total of three teachers; two male and 1 female teacher were involved in interview and all three respondents have experiences of teaching science for more than 5 years. It was also found that all three participants have the qualification of bachelor of education from two different education colleges in Bhutan. To maintain the confidentiality of the participants, three participants are represented with T1, T2 and T3.

4.4.2 The use of TLM in teaching

The research question was formulated to find out the importance of using TLM in the classroom. It was learned that all the participants thinks TLM as very essential components of any successful educational program. It was shared that TLM provides learners with avenue to get in touch with real objects which will helps them to implement in real life situation. Accordingly, T1 said that

“The use of TLM helps me to gain attention of my learners, arouse curiosity for learning. Moreover it helps to make the learning more interactive and engaging. Teaching with the use of TLM helps to have longer retention of lesson and it helps to have more of independent learning.” (20/03/2023).

The teaching and learning materials plays a critical role in promoting and helps to fulfill the set learning target. TLM can come in wide varieties of shapes and size, however the main aim is to make and empower the learning of the learners. The respondents T1 also states that “TLM can be any learning materials that teachers and learners uses to aid in understanding the concept” (20/03/2023). Learners come in with different abilities and way of learning styles, and TLM helps them to learn the concept effectively. Moreover it can help to make learning more interactive, engaging and helps in longer retention. Similarly T2 also shared the same importance of using TLM in the class. He states “I use different types of TLM in the class and that helps me to activate curiosity of learners”. According to T3, he states that

“Teaching is not only about letting our student to learn concept but we should able to make learners apply the learned knowledge in the real life situation and letting them explore more with hands on experience with TLM can help them achieve it” (15/03/2023).

The response from all participants found that they see t0he importance of TLM in teaching learning effective and making lesson more engaging. Moreover it was also observed that the use of TLM cater to different interests of the learners, educators should pay attention to the learners and maximize the use of TLM to enhance student motivation.

4.4.3 Lack of readymade TLM in the school

Respondents were stating on the importance of TLM in teaching the concept effectively, However, on the other hand they also shared about the concern of readymade TLM not available in their school. Lack of readymade TLM has hindered the effective delivery of lesson to the learners. The concern was shared by T1 where the respondents states that

“Lot of TLM is being prescribe in the science textbook for different activities and experiment, however in reality some of the TLM are damaged and are out of maintenance, few are out of stocks and some are not available”(T1, 20/03/2023)

Science education requires lots of TLM to give learners more of hands on experience. TLM helps Science learners to investigate, practice and experiment the classroom learning. However, situation in reality has some challenges with the TLM. “How can we carry experiment when the required things are not available in the schools? For instance simple things like litmus paper are out of stock in the school forget about science labs with all required equipments” (T1, 20/03/2023). Similar concern was shared by respondents T2. He said that his school do not have particular place as lab but things are all together with library. It was very difficult carrying experiment as he has to collect few available things from library to the class. As per the information received from different participants, researchers concluded that primary school are still lacking with the required science TLM in the

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schools. T3 also shared that “although my school has separate science lab, most of the required materials are not available and it’s very difficult to carry all the experiments”.

Science learning usually involves experiment which provides real hands on experiences to the learners; however, looking at the response from the participants, it was found that most schools lack readymade TLM for the effective teaching and learning process.

4.4.4 Improvisation of TLM

Respondents shared about the unavailability of readymade TLM to teach the concept and to give learners some idea about the particular concept, respondents shared that they do some improvisation of TLM from locally available resources. According to T2, the respondents shared that they cannot leave the lesson without teaching and we have to improvise TLM using the locally available resources. They use bottles to improvise it and make use as measuring cylinder or beaker.

We cannot teach the experiment concept through lecture method as it involves doing it manually. Teaching through lecture method and carrying out experiment gives different levels of learning. Therefore I try to improvise things which are not available and try to carry the experiment. I sometimes let my students to prepare and improvise TLM using locally available resources. It helps to give them more of hands on experience (T3,

15/03/2023)

Similar concern about unavailability of TLM was shared by T1. The respondents shared that most of the TLM are not available however, now due to more advancement of technology; I make my students to watch videos about the concept.

After listening to the data collected from different respondents, it was observed that all the feels the importance of TLM in the class however, most of the required TLM are not available which triggers teachers to improvise various TLM to substitute the unavailable TLM with locally available materials.

4.4.5 Challenges with the use of Improvised TLM

Due to unavailability of readymade TLM, teachers carry out improvisation to substitute the readymade TLM. However, they shared about the difficulties and challenges of using improvised

TLM. The improvised TLM are not as effective as the readymade TLM. T2 shared that “improvised TLM has problem with accuracy”. Similarly T1 also shared that

To teach about the rotation, I have used football as substitute of earth (instead of globe).

I could teach the concept but I couldn’t really describe about the shape of earth which is oblate spheroid with the help of football. Therefore I think improvisation can sometimes leads to misconception of the concept (T1, 20/03/2023)

Although improvisation helps to substitute the readymade TLM, it lacks the precision and accuracy and can lead to misconception. However, as per T3, the respondents said that the very important thing is we teach the concept using improvised TLM.

On the other hand, improvisation of TLM is found very time consuming and needs lots of supports from schools.

Unlike the readymade TLM, we have to search for relevant raw materials, prepare it until we get it right as the readymade one. It is very time consuming and needs lots of resources. We have to procure it if not available in locally and its very challenging and hurricane task (T3, 15/03/2023)

The researcher learned from the respondents that improvisation has been better option to substitute the readymade TLM; however, it comes with the challenges of precision, accuracy and its lot time consuming.

4.4.6 Digital technologies as improvised TLM

With the advancement of technologies, it has become convenient for teacher as well as learners to involve it in teaching and learning sequence. Digital tools have substituted most of the unavailable TLM. Teachers use digital tools to teach the concept. According to T2,

I use digital video when the required TLM are not available. Though it cannot give the real hands on experience to the learners, it helps to teach the concept effectively. I also try to improvise the TLM with locally available things, but sometimes locally resources are also not available. Therefore I use to teach the concept through digital technologies (17/03/2023)

Digital technologies not only involves showing of video to the learners but using different kinds of digital tools can be also used as improvised TLM. Most of the respondents shared that mobile phones has become very crucial for educators.

“We get any information that we want from the click of our mobile phones. It has become very important tools for teaching and learning. We cannot get all the required materials in our school; however, I can always show it through mobile phones. It cannot give the real hand on experience but it helps to make concept clear and effective” (T1, 20/03/2023)

Researcher learned that realizing the importance of ICT integration in our daily learning, school are equipped with new technologies like smart board, projector and desktops which is being use for effective engagement in learning. Moreover, it was found that respondents feel that digital tools can help to substitute the unavailable teaching learning materials and helps in learning the concept.

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4.5 Comparison of perception by teachers and students

The data collected through survey questionnaire from both the teachers and learners were compared to find the differences in regards to their responses. The researcher calculated t-testing value taking the significant value of 0.05.

Table 9. Comparison of perception responses from teachers and students

Sl. No	Descriptors	Student		Teacher		t-value
		Mean	S.D	Mean	S.D	
1	The use of TLM helps in learning the concept effectively	4.8312	0.37706	5	0	0.323
2	TLM helps to motivate my learning	4.4156	0.63558	4.8	0.44721	0.188
3	Digital TLM are used in absence of readymade or locally available resources	4.4545	0.81991	4.2	0.44721	0.495
4	Teachers prepare their own TLM from locally available resources when readymade TLM are not available	4.0519	0.95829	4.2	0.8366	0.737
5	The school provides necessary support for acquiring TLM	4.2078	1.0303	3.6	0.89443	0.202
6	Improvisation helps to substitute the unavailable readymade TLM	4.2597	0.78477	4.6	0.89443	0.354
7	Improvisation Helps to develop critical and creative thinking skills	4.3896	0.69122	4.8	0.44721	0.195
8	Improvised TLM have problems of precision and accuracy	4.1169	0.97298	4	0.70711	0.793
9	Improvisation of TLM is time consuming	4.6623	0.66115	4.8	0.44721	0.694

Note: Significant level at 0.05

Table 9 shows the comparison on perception on improvisation and its contributions of teaching and learning of science from teachers and students. T test was carried to find out the significant different between the responses from two groups of respondents taking the significant level at 0.05. However, from the result generated, it was found that there is no significant difference between the perceptions of students and teachers for all the statement as t- value for all the statement is greater than the significant value.

4.6 Summary

In summary, the analysis of the study has provided many insights into; the importance of TLM, the use of improvised TLM and contributions of improvised TLM in teaching and learning science. Different perspectives about the improvisation of TLM have been collected and analyzed separately for qualitative and quantitative data. Qualitative data which were collected through semi structured interview were transcribed and analyzed thematically whereas quantitative survey questions were analyzed using SPSS software. Moreover, few statements were compared for both teachers and students respondents to find out the significant differences.

DISCUSSION, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

This study aimed to find out about the improvisation of TLM and its contribution in teaching and learning of primary science and data were collected and analyzed separately for both qualitative and quantitative approach. This section presents the discussion and conclusion and is ensued under major theme. (1) Importance of TLM, (2) importance of improvisation of TLM, (3) challenges of using improvised TLM, and (4) Digital technology as improvised TLM.

5.2 Discussion

Data were collected and triangulated to search for convergence among multiple sources of information under different themes or categories. For the purpose of this study, the three sources of data; interviews, questionnaires, and an in-depth literature review are placed at the points of a triangle, where each data source provides a point for the other data sources. Denzin (1994) stated the purpose of triangulation as to obtain confirmation of findings through convergence of different perspectives.

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5.2.1 Importance of TLM

Based on the survey questionnaire and interview with teachers who are teaching the science education it was inferred that TLM hold significant importance in the field of education, providing valuable support and enhancing the learning experience for both educators and students. They expose students to a broader range of ideas and viewpoints, contributing to a more comprehensive and well-rounded education.

The survey questions which aimed to gather information about the use of TLM in their classroom received very high mean score which indicates that the use of TLM makes teaching and learning very interactive and engaging and it was found that teachers recognize the value of incorporating TLM in the classroom.

The interviewees' statements further support the notion that the use of TLM contribute to effective teaching. According to T1, the respondents reported that the use of TLM helps to bridge the gap between abstract concepts and real life applications, making learning process more relatable and accessible to learners. Similarly, respondents T2 also shared similar importance concerns about the use of TLM in the classroom. He says that;

The use of TLM in the class is very crucial and has lots of benefits. The use of TLM not only helps to teach the concept very clearly but also helps in making classroom learning more positive, engaging and motivating.

Additionally, many literature and scholarly articles often highlights the role of TLM in promoting active learning, enhancing student motivation and fostering deeper comprehension. Brown (2019) emphasis that TLM are necessary tools in education which helps students deepens their understanding of subjects and develops critical thinking skills. Furthermore, Smith (2018), also reported that by utilizing a diverse range of TLM enables educators to create engaging lessons, cater to diverse learning styles, and expose students to varied perspectives, fostering a rich and comprehensive learning environment.

The overall findings indicated a strong consensus on the importance of TLM. When utilized effectively, these resources contribute to improved academic performance and student engagement. Moreover, they empower teachers to create dynamic and interactive lessons that cater to diverse learning styles, fostering a rich and inclusive learning environment.

5.2.2 Importance of improvisation

The results from a survey conducted among the teachers and learners to gather perspectives on the importance of improvisation showed that well designed and improvised TLM helps to substitute the unavailable TLM in the school. Furthermore it was also reported that the process of improvisation helps to improve creative and critical thinking. The data was further supplemented by interview insights from teachers who are experiencing the teaching of science education. Most of the teachers revealed that most of the things that are required for carrying the activities are not available in the school whereby they improvise their own TLM. They further emphasized that the process of improvisation enhanced their creativity, give more ownership in teaching and learning and helps to develop innovative ideas. The importance of improvisation was shared by T2, where he stated that

My school is located in remote place and forgets about science lab, we do not have even the necessity equipment to carry simple experiment. And we cannot leave the topic without teaching. Therefore, I improvise my own TLM from locally available resources which helps me to teach concept to certain level. So, when I develop my own TLM, it helps me to develop my innovative skills and creative skills.

From the findings, it was found that the process of improvisation not only helps to substitute the unavailable TLM but enhance creativity, critical thinking skills and innovative ideas.

The importance of improvisation was consistently highlighted in different literature. According to McCashin (1990) the focus of improvisation is on helping learners to discover their own resources from which most imaginative ideas and strongest feelings flow, participants gain freedom as self-discipline and the ability to work with others develops. Further Bonwell and Eison (1991), in their research article "Active Learning: Creating Excitement in the Classroom," reported that improvisation helps to motivate students to take an active role in their learning process and moreover encourage students to think critically, apply knowledge, and develop higher-order thinking skills.

Therefore, researcher can conclude that improvisation in teaching and learning materials plays a crucial role in enhancing the educational experience for students and promoting effective learning outcomes. It involves the adaptation, modification, or creation of instructional resources to meet the specific needs of learners. By incorporating improvisation into teaching materials, educators can create a dynamic and engaging learning environment that fosters creativity, critical thinking, and active student participation.

5.2.3 Challenges of using improvised TLM

The information about the challenges about the use of improvisation was collected through survey questions were questions included relating to precision, accuracy and time constraints for improvising TLM. Survey result indicated that most of the participants feel that although improvisation helps to substitute the unavailable TLM in the schools, it lacks precision and accuracy. Moreover it was also found that improvisation requires lots of support from schools and other stakeholders and more importantly improvisation is very time consuming. And when asked about support rendered by school for improvisation of TLM, result showed that they were not given the required support for it.

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Results from interview do not have much significance differences as compared with the result of survey. Most of the respondents revealed that though improvisation helps to develop creative and innovative ideas, they are doubtful about the precision and accuracy of the improvised TLM. T1 reported that

I try to improvise TLM which are not available in my schools. However, I am not really confident about improvising the required TLM. Firstly I am not trained to improvise the

TLM, secondly required materials are not available to locality and thirdly improvised TLM lacks precision and accuracy.

Importance of improvisation is felt by teachers, however teachers feels that improvisation is really a hurricane task as it requires lots of support and assistance for different stakeholders. The stated problem was shared by T2. The respondents stated that

To improvise the unavailable TLM, we require lots of locally available resources in and around the school. If it's in the school, we need to get permission from higher authorities to make use of those resources and if we go around school searching for locally available resources, we need to pay them. Therefore, improvisation also requires financial support.

The challenges of improvisation were further elaborated in different literature. DarlingHammond (2017) reported that our educators often face time constraints due to other professional responsibilities. Developing high-quality resources demands significant investment in terms of research, planning, and design. The process of gathering relevant materials, structuring content, and aligning resources with learning objectives can be time-consuming, requiring educators to carefully balance their workload. Similarly, Maeland et, al.(2017) also reported the challenge of ensuring quality and alignment with curriculum standards arises when using improvised resources and further stated that the quality and alignment of improvised resources may vary depending on the educator's expertise, knowledge of curriculum guidelines, and access to reliable sources.

While using improvised teaching learning resources offers the benefits of customization and flexibility, it is not without its challenges. After careful analysis of the report, researcher could conclude that although improvisation helps to substitute the unavailable TLM, it comes with several challenges while developing and implementing in classroom. Improvisation requires lots of locally available resources and its very time consuming and further while implementing it, it encounter challenges of precision and accuracy.

5.2.4 Digital tool as improvised TLM

Digital technology offers a wide range of tools and platforms that educators can leverage to develop effective teaching learning resources. With the development of modern technologies, digital tool has taken major role in substituting most unavailable resources in the schools. Survey questionnaire about the use of digital tool was asked and most of the respondents reported that more frequently digital tools are use when readymade TLM are not available in the school.

It was also evident from the interview insights that digital tools are evidently use in the school in absence of readymade TLM. All most all the participants' reported that digital tools are very handy and most accessible tools to use in absences of readymade TLM. According to T1, he stated that

With the development of technology, I don't have to worry about unavailable TLM. The digital tools have helped me to substitute unavailable resources in the school. Although it cannot give same feelings as we use the real object but it's far better than teaching it theoretically. Digital tools help to make concept clear and motivate students to learn.

The importance of the use of digital tool was also felt by another respondent T3. He also stated that

I would like to thank digital tools for making my teaching and learning effective. Before when required TLM are not available, I try to improvise and show it to my students and sometimes it comes to period when we cannot improvise the things with locally available resources. However, today I cannot easily show them through digital tool which give my learners same feeling as leaning with real objects.

Many researchers have done research studies about the importance of digital tool in the classroom and many literatures supports the use of digital tools. Mayer (2009) stated that digital technology helps the educators to create visually appealing and interactive resources that cater to diverse learning styles and preferences.

As per the analysis, it was found that digital tools have revolutionized the way educational materials are created, delivered, and accessed and these tools offer innovative ways to engage students, facilitate collaboration, and provide access to a wealth of educational resources.

5.3 RECOMMENDATIONS

Based on the findings and the analysis made above, the following recommendations are hereby suggested:

- I. It was found that only few teachers received trainings and workshops on improvising the TLM whereas majority of the respondents were never given training and workshop on improvisation. Therefore Ministry and other relevant stakeholders should plan and initiate trainings on preparation and improvisation of TLM from locally available resources.

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- II. Digital tools has proven much effective in delivering the content and recommend teachers to use it.
- III. Regular supply of instructional materials should be embarked on by the Governments at all levels for effective teaching and engagement learning.
- IV. School administration should helps teachers and students while improvising the TLM by providing materials which are available resources in the school

5.4 LIMITATIONS

- I. The study on improvisation and its contributions was focused only on remote schools and data collected cannot be generalized to all schools across the country.
- II. Some teachers informed that they were provided trainings on improvisation of TLM whereas some refused to agree with the statement. Therefore further research is required to find out about trainings provided for improvisation on TLM.
- III. Further research can be done on module provided in education colleges which teach about preparation of TLM and improvisation.

5.5 CONCLUSION

The place of TLM in the effective implementation of any education programme cannot be undermined. TLM perform such functions as the extension of the range of experience available to learners, supplement and complement the teacher's verbal explanations thereby making learning experience richer and providing the teacher with interest into a wide variety of learning activities. TLM supplement, clarify, vitalize, emphasize instruction and enhance learning in the process of transmitting knowledge, ideas, skills and attitude.

Based on the data collected from the respondents, the researchers found that teaching and learning materials were essential for effective learning. The use of TLM not only helps to engage learners productively but also helps for longer retention. However, many schools lacked the necessary ready-made materials, leading teachers to improvise using locally available resources. While improvisation helps to substitute the unavailable resources, it presented challenges such as maintaining accuracy and precision. Furthermore, improvisation required creativity and support from relevant stakeholders. The advancement of technology, particularly digital tools (YouTube videos), was found to be beneficial for teachers in substituting non-available ready-made materials.

The researcher believes that the findings from the study can potentially contribute to further enhance the educational practices in our country. The data analysis from the study have leave a space for future researcher to find out more about how digital tools helps in substituting unavailable TLM and further study about different module provided in two education colleges which equip pre service teachers about preparation and improvisation of TLM.

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Appendix A: Semi structured interview questions for science teachers.

Paro college of Education

Royal university of Bhutan

Paro: Bhutan

Improvisation of Teaching learning materials and its contributions in learning science

Semi structured interview questions for science teachers

A. Demographic information

1. Name of Interviewee (Optional):.....
2. Gender:.....
3. Name of the school:.....
4. The class you are teaching:.....
5. Number of service:.....
6. Location of interview:.....
7. Date of interview:.....

B. Interview questions of improvisation and its contribution

1. What are your views about the use of TLM in your classroom teaching?
2. What do you do if TLM are not available?
3. What is your opinion about improvisation of TLM?
4. What are the challenges while improvisation of TLM locally?
5. What do you say about digital tools as TLM?
6. What constraint do you face while using digital tools as TLM?

Appendix B: Survey questionnaire for science teachers

Paro college of Education

Royal university of Bhutan

Paro: Bhutan

Improvisation of Teaching Learning Materials (TLM) and its contribution in learning science

Improvisation of Teaching Learning Materials (TLM) and its Contribution in Teaching and Learning of Primary Science

Survey Questionnaire for science teachers

Respected participants,

I am Sonam Dakpa, currently pursuing Master in Primary Science Education at Paro College of Education. This study is a part of the research project in partial fulfillment of the course and is carried out with the objectives to find out about improvisation of Teaching learning material (TLM) and its contribution in teaching primary science. The data collected through the questionnaire will be used only for academic purposes and confidentiality of the participants will be strictly maintained.

Please tick to confirm your participation in the survey.

Yes No

Your Signature of consent/agreement to participate:.....

Part A: Demographic information

Gender: Male Female: Others:

School location: Urban Semi Urban Rural

Class level you are teaching: PP-III IV-VI VII-X XI- XII

School level: Primary: Lower: Middle: Higher:

Your qualification: B Ed PGDE M Ed

Others

Did you attend any training related to preparation of TLM and improvisation: Yes No

If yes, how many times:

Part B: Information on teaching learning materials and improvisation

Direction: Tick the box that best suits your agreement level as indicated below;

Note: 5-SA: Strongly agree, 4-A: Agree, 3-N: Neutral, 2-D: Disagree, 1-SD: Strongly Disagree

Theme 1: The use of teaching learning materials (TLM)

Sl. No	Statements	SD	D	N	A	SA
1	The use of TLM helps in teaching the concept effectively					
2	The teachers make use of TLM which are available					
3	The use of TLM is prescribed in textbook/ curriculum Guides					
4	The use of TLM makes learning interactive and engaging.					
5	TLM helps to motivate learning.					
6	The teacher uses locally available TLM when readymade TLM are not available.					
7	Digital TLM are used in absence of readymade or locally available resources					

Theme 2: Preparation of teaching learning materials (TLM)

Sl. No	Statements	SA	A	N	D	SD
1	Teachers teach the concept through lecture method if readymade TLM are not available.					

Improvisation of Teaching Learning Materials (TLM) and its Contribution in Teaching and Learning of Primary Science

2	Teachers prepare their own TLM from locally available resources when readymade TLM are not available.					
3	The teacher receive trainings on preparation of TLM					
4	Teachers understands the concept of improvisation					
5	Teacher is confident in improvisation of TLM					
6	Teacher received training on improvisation of TLM					
7	The school provides necessary support for acquiring TLM					

Theme 3: Challenges for effective use of improvised TLM

Sl. No	Statements	SA	A	N	D	SD
1	Improvisation helps to substitute the unavailable readymade TLM					
2	Improvisation helps to develop critical and creative thinking skills					
3	School provide support while improvisation of TLM					
4	Improved TLM have problems of precision and accuracy					
5	Improvisation of TLM is time consuming					
6	Funding support is required for improvisation					

Appendix C: Survey questionnaire for students

Paro college of Education

Royal university of Bhutan

Paro: Bhutan

Improvisation of Teaching Learning Materials and its contributions in learning Science

Survey Questionnaire for Students

Dear Participants,

I am Sonam Dakpa, currently pursuing Master in Primary Science Education at Paro College of Education. This study is a part of the research project in partial fulfillment of the course and is carried out with the objectives to find out about improvisation of teaching learning material (TLM) and its contribution in teaching primary science. The data collected through the questionnaire will be used only for academic purposes and confidentiality of the participants will be strictly maintained.

Improvisation of Teaching Learning Materials (TLM) and its Contribution in Teaching and Learning of Primary Science

Please tick to confirm your participation in the survey. Yes No

Your signature of consent/agreement to participate:.....

Part A: Demographic information Name (optional):

Gender: Male Female: Others:
 School location: Urban Semi Urban Rural
 Class level you are studying: IV V VI
 School level: Primary: Lower: Middle: Higher:

Part B: Information on teaching learning materials and improvisation

Direction: Tick the box that best suits your agreement level as indicated below;

Note: SA: Strongly agree, A: Agree, N: Neutral, D: Disagree, SD: Strongly Disagree

Theme 1: The use of teaching learning materials (TLM)

Sl. No	Statements	SA	A	N	D	SD
1	The use of TLM helps in learning the concept effectively					
2	The teachers make use of TLM in the classroom					
3	The use of TLM is prescribed in textbook					
4	The use of TLM makes learning interactive and engaging.					
5	TLM helps to motivate my learning.					
6	The school has all the required TLM for teaching Science					
7	The teacher brings locally available TLM when readymade TLM are not available.					
8	Digital TLM are used in absence of readymade or locally available resources					

Theme 2: Preparation of teaching learning materials (TLM)

Sl. No	Statements	SA	A	N	D	SD
1	Teachers teach the concept through lecture method if readymade TLM are not available.					
2	Teachers prepare their own TLM from locally available resources when readymade TLM are not available.					
3	The teacher also ask us to prepare different TLM					
4	The school provides necessary support for acquiring TLM					

Improvisation of Teaching Learning Materials (TLM) and its Contribution in Teaching and Learning of Primary Science

Theme3: Challenges for effective use of improvised TLM

Sl. No	Statements	SA	A	N	D	SD
1	Improvisation helps to substitute the unavailable readymade TLM					
2	Improvisation helps to develop critical and creative thinking skills					
3	School provide support while improvisation of TLM					
4	Improvised TLM are effective as readymade TLM					
5	Improvised TLM have problems of precision and accuracy					
6	Improvisation may not provides correct information					
7	Improvisation of TLM is time consuming					
8	Funding support is required for improvisation					
9	Locally available materials can be used for improvisation					

Appendix D: Participants consent form

Paro college of Education
 Royal university of Bhutan
 Paro: Bhutan

Improvisation of Teaching Learning Materials and its contribution in teaching primary science

Participants consent form

I Mr/Mrs..... hereby willingly volunteer to participate in research conduct on the topic improvisation and its contribution in teaching primary science. I fully agree and understand the following:

1. This research is undertaken for academic purpose only
2. I can withdraw from participation if I feels uncomfortable during the conduct of the study
3. Researcher assures to maintain confidentiality.

.....
 Participants' signature

.....
 Researchers' signature



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PARO COLLEGE OF EDUCATION, PARO: BHUTAN



PCE/ADM(08)/2022-2023/ 1147

Date: 10th March, 2023

Ethical Clearance

MEMORANDUM TO: Sonam Dakpa

This is to advise you that the Centre for Educational Research and Development/College Research Ethics Committee has approved the following:

PROJECT TITLE: Improvisation of Teaching Learning Materials (TLM) and its contribution in teaching primary science.

APPROVAL No: CRE/2023/418

COMMENCEMENT DATE: 28th November, 2022

APPROVAL VALIT TO: 30th June, 2023

The CERD/College Research Ethics Committee grants approval for up to a period of maximum three years. For approval periods greater than 1 year, researchers are required to submit an application for renewal at each 1-year period. All researchers must submit a Final Report at the completion of their project.

The researchers must report immediately to the CERD/College Research Ethics Committee for anything that might affect ethical acceptance of the protocol. This includes adverse reactions of the participants, proposed changes in the protocol, and any other unforeseen events that might affect the continued ethical acceptability of the project.

In issuing this approval, it is also required that all the data and consent forms are stored in a safe location for a minimum period of five years. These documents may be necessary for compliance audit processes during that period. If for any data and documentation that are retained is changed/or in case damaged accidentally, within that five year period, the CERD/College Research Ethics Committee should be informed of the new change.


JEAN
Research & Industrial Linkages
Paro College of Education
Royal University of Bhutan
Paro : Bhutan

(Dr. Kezang Sherab)

Dean, Research and Industrial Linkages, CERD

Copy to:

1. RO, CERD, for kind information and follow up. Office file.

PABX: +975 08 271487, FACSIMILE: +975 08 271917, WEBSITE: www.pce.edu.bt



འབྲུག་རྒྱལ་ཁོངས་དཔུང་སྡེ་གསུམ་སྡེ།
PARO COLLEGE OF EDUCATION
PARO II BHUTAN



PCE/ADM(10)/2022-2023/1159

Date: 06 March 2023

The Chief DEO / TEO
Dzongkhag/Thromde Education Sector
Chukha / Monggar / Paro / Trashigang / Trashiyangtse / Tsirang Dzongkhag/Thromde

Subject: Requesting access to schools for student data collection

Dear Sir/M'm,

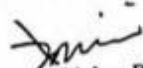
This is to inform you that in-service teachers undergoing Master of Education in primary studies are required to carry out a research project as part fulfilment of the programme of studies prescribed by the Royal University of Bhutan.

M Ed students of this College will be in the field from 11th to 27th of March 2023 in their chosen Dzongkhag/Thromde of study for data collection. Therefore, the College would like to request the Dzongkhag to please grant access to the identified schools for the said period. The M Ed students are advised to abide by the teachers' and students' (PCE) code of conduct and must adhere to the research ethics approved by the College research Committee. The student list is attached for your reference.

The College acknowledges for your continued support.

With best regards

Yours sincerely,


(Dorji Thinley, PhD)
PRESIDENT

- Cc to:
1. Concerned Principal for necessary support.
 2. M Ed students, PCE Paro for Affairs, for necessary action.
 3. Programme Leader, M Ed Primary Science, PCE for necessary action.
 4. Research Project Supervisor for continued support during data collection.
 5. Office copy

*Principals All school A:
Pl. provide necessary support during the visit to your school.
Ashley
14/3/2023*

PABX: +975 08 271487, FACSIMILE: +975 08 271917, WEBSITE: www.pce.edu.bt

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