

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION



EXPLORING TEACHERS' PERCEPTIONS ON IMPLEMENTATION OF PROJECT BASED LEARNING (PBL) IN MATHEMATICS IN SECONDARY SCHOOLS. A CASE STUDY OF IN – SERVICE FINAL YEAR DEGREE TRAINING MATHEMATICS SECONDARY SCHOOL TEACHERS AT BINDURA UNIVERSITY OF SCIENCE EDUCATION IN ZIMBABWE.

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONORS DEGREE IN MATHEMATICS EDUCATION

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RELEASE FORM

Title of the dissertation: Exploring teachers' perceptions on implementation of project based learning in mathematics. A case study of in- service final year degree training mathematics teachers at Bindura University of Science Education in Zimbabwe.

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DEDICATION

This project is dedicated to my husband Itai Siabulembu, my son MacDonald and my daughters Cheryl and Lynne for their love, patience, understanding, and support throughout my academic journey. Your unwavering support and encouragement gave me so much courage to move on even when the road gets tough. To my dear friends and colleagues I thank you for all the encouragement and contributions you have given me. I also dedicate it to future generations, with hopes of making a positive impact.

ABSTRACT

Project-based learning (PBL) is a type of pedagogy that has been regarded as an effective approach to teaching and learning of mathematics, but its implementation in secondary schools remains limited in Zimbabwe. This study investigates teachers' perceptions of PBL through the definition of PBL, students' and teachers' benefits of using PBL in mathematics instruction, and challenges in implementation of PBL. Open ended questionnaires were administered to forty (40) in- service degree training secondary mathematics teachers from diverse secondary schools. The teachers ranged from five (5) years to thirteen (13) years of experience in teaching mathematics. Study findings indicated that PBL is a 21st instruction which is, student centred inquiry – based learning which involve authentic projects and real life collaborative learning. Teachers perceived PBL beneficial for today's students as it develop students' problem solving skills; improve collaboration and communication skills among students; enhances creativity and innovation; increase engagement and motivation and it enhances deeper understanding of mathematical concepts. They also perceived PBL as beneficial to teachers as it improve professional growth and development, enhance collaboration and communication skills; and improve teaching practices. They also find PBL challenging as it requires much planning time, lack of resources and teachers training and professional development, difficult in classroom management, and teachers and students resistance. For successful implementation of PBL in mathematics education teachers require professional development and training on how to incorporate PBL in their mathematics instruction. Teachers should be provided with regular teachers' workshops and trainings for professional development to develop their understanding and skills in implementing PBL, and other teaching and learning approaches in mathematics. Adequate resources such as time, ICT and teaching and learning materials which supports successful implementation of PBL should made available.

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CHAPTER 1:INTRODUCTION

1.1 INTRODUCTION

According to Lee & Carrington (2020), Project-based learning (PBL) was discovered by John Dewey in the early 20th century who challenged the traditional way of learning. He stated that true learning is based on discovery guided by mentoring rather than the transmission of knowledge. Teachers may be willing to facilitate this type of learning in the classroom but may not be prepared to teach using the PBL method. Meaningful, hands-on projects provided through PBL pedagogy may be one solution to keep students motivated to stay in school. According to Boss (2011) PBL is based upon a constructivist theory of pedagogy in which students actively engage in hands-on projects that are personally meaningful. Constructivism is a theory that says learners construct knowledge rather than passively take in information (Boss, 2011). In Zimbabwe, according to Director of Communications and Advocacy of the Ministry of Primary and Secondary Education Mr. Ndoro, T. the Ministry of Primary and Secondary Education has currently replaced the Continuous Assessment Learning Area (CALA) with School Project Based Learning (The Sunday Mail online retrieved on 10 March 2024-00.03). Due to this change, the researcher seeks to explore the perceptions of mathematics teachers concerning Project Based Learning (PBL) in the context of mathematics education. It aims to understand how teachers perceive the benefits, challenges and the effectiveness of PBL in mathematics. By exploring these perceptions, it will provide valuable insights into the experiences and attitudes of stakeholders involved in the PBL.

1.2 BACKGROUND OF THE STUDY

The Ministry of Primary and Secondary Education in Zimbabwe has recently replaced the Continuous Assessment Learning Activities (CALA) with School Project Based Learning. This move was done in a bid to revamp the education curriculum and enhance school children's learning experiences and promote hands on approach to education (Ndoro, T. in Sunday Mail Online retrieved on 10 March 2024). The introduction of PBL has generated different perceptions from teachers and learners in educational fraternity in general and in the subject area of mathematics in particular.

As cited in Matriano, (2020), page 215, John Dewey an American philosopher and Educator asserts that “We learn best when we do what we learn,” hence PBL has its background driven by practical problems, breaks the disciplinary boundaries, and integrates multiple disciplines into the projects. He further laments that with PBL the teacher is not in the school to impose certain ideas or to create certain habits in learners, but is there as a member of community to select the influences which shall affect the child and assist him/her in properly responding to the influences. This sentiment expressed by Dewey is referred to as learning by doing and is continuous to receive great support because of its relevance today.

With PBL students spend the majority of time working towards a goal and limited time focused on the teacher, the teacher is only there to give guidelines and direction in problem solving. Therefore in this instance the teacher acts to facilitate learning through teamwork thereby relegating the lectureship role of the teacher. According to Haddad (2022), PBL is very significant in the modern learning because it fosters the growth of experiences and life skills such as communication skills, time management and resilience. Such skills are of paramount importance to the life of the learner even after the completion of their studies as they can help them to thrive in today’s uncertain environment. Hannafin and Hannafin (2010), point out that project based learning is student centered, where students play a role in selecting their learning goals and approaches in order to achieve their intended goals which is important in learner development because their assessment is done through the process of doing the project not after the process.

Mathematics is a field which requires more practical approach than theories, hence the need for project based learning in the subject area. Arnold, (2012) point out that using PBL in mathematics helped students see the connections between mathematics and the real world. More so, they felt that mathematics became something exciting instead of just lessons from the books. He further postulates that he discovered that learners preferred to work in small groups because they had to count on their peers for support, learners felt more comfortable asking their peers questions in a small group setting than asking in a traditional classroom setting. According to Dr T Ndoro as quoted in the Sunday Mail retrieved on 10 March 2024, PBL bridges a gap between theoretical knowledge and real-world applications by providing learners with opportunities to apply their knowledge and skills in practical setting. He further argued that it promotes collaboration,

communication skills, and teamwork and help learners to develop practical skills that are relevant to their future careers or area of interest in education.

1.3 STATEMENT OF PROBLEM

The problem addressed in this study is to explore the perceptions of in service mathematics degree training teachers at Bindura University of Science Education in Zimbabwe on PBL in mathematics. PBL requires specific teaching competencies to achieve its potential benefits to students. The problem is that not enough is known about teachers' perceptions, knowledge and skill in utilizing PBL in mathematics education in Zimbabwe. According to Warr and West (2020), PBL personalizes learning for students by using interdisciplinary collaboration to solve problems and allows students to experience learning through hands-on learning, unlike traditional methods that tell students what they need to know. They also claimed that, traditional methods are not as practical for today's students, whereas PBL allows students to learn throughout the process which promotes flexibility in learning as it shifts from teacher-centered to student-centered learning. Therefore, students take up a more active role in their education and become more engaged in learning. Since PBL is to be introduced in the Zimbabwean curriculum of education, teachers have different perceptions on it which had to be discovered so that it will be successfully implemented.

1.4 BACKGROUND OF THE STUDY

The purpose of this study is to determine the teachers' perceptions on the implementation of the PBL. Understanding the views of teachers concerning the PBL in mathematics will provide valuable understandings into the effectiveness of this instructional approach. According to Kokatsaki et al, (2016), benefits and challenges associated with putting into practice of PBL in mathematics classrooms, helps on the professional development needed by teachers to make knowledgeable decisions about incorporating it into their teaching practices. Holmes and Hwang,(2016), asserts that PBL in mathematics also embraces importance as it improves student engagement and motivation by highlighting the aspects of PBL that positively impact students' engagement, motivation and interest in mathematics which can guide facilitators in designing and engaging meaningful learning. Investigating the perceptions of teachers can also help in identifying barriers and difficulties that can hinder the successful implementation of PBL in mathematics classroom (Fisher et al, (2020). By understanding these challenges the educational stakeholders can develop strategies to address them effectively. PBL is a learner- centered

approach that empowers learners to take ownership in their learning. According to Lee and Galindo, (2018), exploring teachers perceptions on PBL, provide understandings into the extent to which PBL promote active participation, independence, intervention and student -centered learning in mathematics. Teachers play an important role in the successful implementation of PBL, thus understanding how teachers view PBL is essential for providing them with necessary support, skills and knowledge that aligns with the instructional goals in implementing PBL (Han et al, 2015). The study of the perceptions of teachers and learners regarding PBL can serve as a foundation for future investigations. It can inspire future investigations into specific aspects of PBL such as assessment strategies, teacher training or the impact on specific learner groups which will contribute to the continuous improvement and development of PBL in mathematics education. The study's findings can contribute to the advancement of the PBL in mathematics and improve the learning and outcomes for the students.

The research seeks to reveal the perceptions of teachers on the introduction of PBL in Zimbabwe education system particularly in mathematics. It is hoped that the findings of the study will contribute to the successful implementation of PBL in education and in mathematics in general. This study was designed to gain greater insight into preparing teachers to facilitate PBL and also get ready students to successfully apply PBL in their learning of mathematics.

1.5 AIM OF THE STUDY

The aim of the study is to explore the perceptions of teachers and students on the implementation of project based learning in mathematics.

1.6 OBJECTIVES OF THE STUDY

By the end of the study the researcher should be able to:

- 1) Assess the responsiveness and understanding of PBL among teachers.
- 2) Investigate how teachers recognize the impact of project based learning in mathematics.
- 3) Identify teachers' perceptions on how PBL can be integrated into curriculum effectively, ensuring content coverage and projects experiences.

1.7 RESEARCH QUESTIONS

- 1) What are the perceptions of mathematics teachers and students regarding the implementation of PBL in mathematics?
- 2) What benefits and challenges teachers perceive in implementing of PBL in Mathematics?
- 3) What are suggestions and recommendations do teachers and learners have for successful implementation of Project Based Learning in mathematics education?

1.8 SIGNIFICANCE OF THE STUDY

According to Dewey (2004), students' academic achievement increases as the content becomes more relevant and interconnected to the environment surrounding the student. He further states that the idea of relevant content connected to students' environment collaborate in solving multifaceted questions, creates opportunities for deeper meaning and understanding of mathematics. The goal of this study is to determine the students' achievement and motivation that could be impacted by PBL instruction. Results from the study could help the teachers, curriculum developers and policy makers in improving mathematics proficiency in Zimbabwe Education. The study results will add literature to the effects of PBL approach in mathematics. Furthermore, the findings from the study could influence teachers' mathematics practices and teaching methodology, as well as strategies that impact students' motivation and achievement.

1.9 LIMITATIONS OF THE STUDY

Teachers and learners are well knowledgeable in traditional education system that emphasizes rote learning and direct teaching, therefore shifting to project based learning requires a mindset change which some individuals may find challenging. Traditional assessment methods often rely mostly on tests and examinations which not effectively measure the skills and knowledge developed through project based learning. Teachers may have challenges in finding the appropriate assessment strategies that correctly evaluate projects outcomes and individual progress. Implementing project based learning in mathematics can be time consuming, teachers may feel pressured to cover a prescribed curriculum within a limited time frame, making it difficult to allocate enough time for in-depth projects. Learners may also feel overwhelmed by the additional workload and time commitment required for projects. Project based learning often requires additional resources, hence schools with inadequate resources may struggle to fully implement project based learning in mathematics which affects teachers and learners perceptions of its

effectiveness. Lastly, since project based learning deeply relies on student engagement and motivation, some learners may resist this approach which teachers may face difficulties in sustaining student interest and motivation throughout the project duration.

1.10 DELIMITATION OF THE STUDY

The perceptions of teachers and learners on project based learning in mathematics are based on a sample of 40 in-service mathematics teachers who are in studying their degree at Bindura University of Science Education. Therefore the level of knowledge and cultural backgrounds of the teachers can influence the findings and may not generalize to all mathematics teachers and learners. The perceptions of teachers are influenced by the individual beliefs, attitudes, and teaching or learning styles, where some individuals may gravitate towards project based learning and view it positively while others may prefer their traditional approaches. Therefore these individual differences may shape their perceptions and willingness to embrace project based learning in mathematics which will have bias to all mathematics teachers and students in the whole country.

1.11 ASSUMPTIONS OF STUDY

The study assume that both teachers and learners recognize the potential advantages of project based learning in mathematics education. It also assumes that participants believe that project based learning can enhance students' understanding of mathematical concepts, promote critical thinking and promote problem solving skills and increase engagement and motivation to students. It is assumed that both teachers and learners are willing to participate voluntarily and provide honest and meaningful responses regarding their perceptions of project based learning in mathematics which will be of great importance in the implementation of PBL. It assumes that the participants will be open to share their experiences, attitudes, benefits and challenges pertaining the implementation of PBL in mathematics. The researcher also assumes that the participants have the basic knowledge on what project based learning entails in the context of mathematics education.

1.12 DEFINITION OF KEY TERMS

- **Perception** – Is a cognitive process of selecting, analyzing, organizing, interpreting and integrating stimuli of any kind of information received by someone that is meaningful or different from one another Raleigh, (2022).

- **Project Based Learning** - is a teaching and learning model that engages learners in problem-solving activities and provides students with the opportunity to work independently to construct their own learning and at the end produce valuable and realistic result. It is centered on developing tasks or assignments in which learners plan, implement, and evaluate projects that have real world implication beyond the classroom, (Fisher et al 2020).

1.13 SUMMARY

This chapter provide a brief overview of the research topic understudy. The introduction gives a brief insight into PBL and it outlines why the researcher chose to undertake the research in this area. The background of the study further expose the facets of PBL from various Scholars in the Educational fields. Generalized teachers perceptions on PBL were also discussed in the background of the study. The purpose of this study is outlined in this chapter which is to reveal the perceptions of teachers in Zimbabwean education system particularly in mathematics. More so the findings from the research will further improve the implementation of PBL in Zimbabwean curriculum since it has been recently introduced. The aim and objectives of the study are clearly stated and will not be difficult to attain because the research questions are clearly stipulated so as to gather enough facts and knowledge on the existing and assumed views. After the completion of this study as highlighted in the significance of the study will be very relevant to education of Zimbabwe, Africa and the World as a whole. Definition of key terms were also provided for clarification and simplification on the concepts in the study.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The objectives of this chapter is to review relevant literature on definition of PBL, perceived teacher benefits in incorporating PBL in mathematics , perceived benefits of students on using PBL in mathematics, challenges in implementing PBL in mathematics, impact of implementing PBL in teaching and learning of mathematics and assessment of students learning in PBL situation in mathematics.

2.2 DEFINITION OF PBL

Several researchers defines PBL as a student centered approach which allows the students to learn through actively engaging in real world activities and problems (Alyani & Ratmanida, 2021; Amin et al, 2022; Almulla, 2021). According to Kamal et al, (2022), PBL is an instructional approach that involves students working on projects to gain deeper knowledge and understanding of the topic and it focuses on solving real- world problems which encourage students to explore, analyze and present their solutions. PBL encourages exploration and autonomy, it is naturally structured around specific projects or tasks that is provided by the teacher and it is frequently done in collaborative groups, which enhances 21st century skills such as communication skills, teamwork, interpersonal skills and project management in addition to practical knowledge (Kamal et al, 2022). Fisher et al (2020), viewed PBL as a teaching and learning model that engages learners in problem-solving activities and provides students with the opportunity to work independently to construct their own learning and at the end produce valuable and realistic result. The main idea in project-based learning centered on developing tasks or assignments in which learners plan, implement, and evaluate projects that have real world implication beyond the classroom. In project-based learning, learners are required to take an active role in understanding concepts and context, and it allows learners to develop the skills which foster curiosity and hunger for knowledge (Bradley-Levine & Gina, 2014). In mathematics classroom context, project-based learning enables learners to build mathematical knowledge solving mathematical problems and solve problems that arise in mathematics and other context (NCTM, 2000) as cited in Chomunorwa and Masataka, 2023). National Council of Teachers of Mathematics (NCTM),further states that this approach also enables learners to develop better mathematical skills, develop a deeper

understanding of mathematical concepts, making mathematics relevant and engaging to learners. Project-based learning allows learners to develop their own mathematical ideas and understanding, connecting their mathematical experiences to the real world (Kokotsaki et al, 2016). Project-based learning appears as an immersive, student-centered educational approach that stimulates learners to independently explore solutions to real world challenges (Kundu & Perwez, 2022). Scholars (Kokotsaki et al., 2016; Larmer et al., 2015) have defined PBL as a student-centered learning process in which students are empowered and actively involved. They have found related important characteristics that comprises of PBL and which distinguish it from other instructional approaches which are using real-world questions and problems, encourages students to develop their conceptual knowledge of subjects and connect this knowledge with its application. According to McLeod, (2018), PBL also evolved from the socio cultural theory which is viewed as a process in which children acquire their cultural values, beliefs, and problem-solving through collaborative social interaction. As indicated by Larmer et al, (2015), PBL is an instructional strategy vital for preparing young people for the modern world that provide world that provides opportunities for students to develop:

- Problem solving skills and critical thinking skills;
- Communication and collaboration skills;
- Ability to work independently, work effectively and manage time; and
- Overall confidence and responsibility

2.3 BENEFITS PERCEIVED BY MATHEMATICS TEACHERS IN TEACHING THROUGH PBL.

This section gives the literature review examined how teachers and students in a PBL environment benefit. According to Cintang et al. (2017), teachers felt the positive impact of applying PBL in their classes if proper time management was utilized. He further explained that the teachers found three positive results, which include:

- PBL could improve teachers' creativity and drive the teachers' will to learn. As a new concept to some teachers, the PBL method grows as the curriculum and learning ideas change.
- PBL familiarizes teachers with time management. The main obstacle in the implementation of PBL is the time limitation. Therefore, when the teacher tries to implement PBL, the

teacher must adapt to timing. Time management should be employed to avoid missing material.

- PBL is student-centered. In the PBL activities, the teacher does not have to explain too much because the students' activity is increased.

Teaching science with PBL improved student–teacher relationships and enhanced students' enjoyment (Hugerat, 2016). In his study teachers were able to motivate their students so that the students could research and explore on their own through real-life experiences, discovery and research with the help of their teachers who apply the PBL method in their classrooms. Uyen et al. (2023) conduct a systematic review on online PBL adoption in teacher education, and found that, PBL enhances pre-service teachers' knowledge, skills, and attitudes. Zenkov et al (2023), in their research found that teaching through practical and real-world experiences can play an essential role in shaping teachers' instructional approaches and identities which provide valuable insights for educators seeking effective strategies to enhance student learning outcomes and engagement across diverse subjects and educational levels. In a study by Rehman et al (2023), teachers stressed on collaborative learning and highlighted that PBL shifts from focusing on teacher to student centered learning. They also highlighted that PBL enhances connections between teachers and students and among students leading to greater classroom discipline and more pleasant learning environment and helps students enhances their skills through application of real – world situations.

2.4 STUDENT BENEFITS IN LEARNING THROUGH PBL.

Amanda et al., (2014); Musta'in & Handrianto, (2020), argued that PBL is a contextual learning model because it changes student learning styles more individually by increasing learning motivation, as well as student creativity in working, generating creative ideas, and practicing critical thinking, in dealing with problems faced at school. PBL involve students actively in constructing their own knowledge and involve collective work to produce a project as an application of the principles or concepts that have been obtained (Arafani et al., 2021). PBL provides opportunities for students to explore materials using various methods and are given the opportunity to study materials in various ways, engage in problem solving, and engage in project design activities (Ramadhani et al., 2021). Furthermore, In a PBL classroom students are

comfortable to working collaboratively; assessments are carried out authentically, and learning resources can be highly developed (Handrianto et al., 2021; Utami et al., 2021). Nurfitriyanti (2016) states that PBL approach has the following benefits to the learners, it increase students' motivation to learn, promotes and increase the ability to solve problems, make students more active and successful in solving complex problems, increasing cooperation, encourage students to develop and practice communication skills, improve students' skills in managing resources and provide students with learning and practical experience in managing projects and making allocations of time and other resources such as equipment for preparing assignments. According to Khan & Ibrahim (2020), benefits of PBL to students are, it promote positive attitudes toward learning, enhances problem-solving skills, increase self-esteem, motivation and interest in topics and students become self-regulated learners. Culclasure et al. (2019), their results showed that PBL increased students' macroeconomic competencies as compared to traditional methods and students with low to midrange verbal abilities learned more in PBL classes than in lecture or discussion classes. A study Holmes & Hwang (2016), which investigated the benefits of PBL on secondary mathematics students' academic skill development and motivated strategies for learning and focused on academic skill development in algebra and geometry assessment scores and other factors in connection to secondary mathematics learning, found out that through PBL students were intrinsically motivated and displayed higher critical thinking abilities and appreciate peer learning.

MacMath et al. (2017), found that implementation of PBL increased students' critical thinking skills, improved presentation and research skills, increase in students' self-regulation skills, confidence, and ability to work independently as they critically think through solving problems. According to Cintang et al. (2017), teachers believe that PBL benefits student learning because what is learnt stays in the long-term memory and develops children's skills through real-life experiences. In a study done by Giri (2021); Trisdiono et al (2019); Lee et al, (2015), PBL enhances critical thinking skills in students, improves students' informational reading skills, collaboration, problem solving skills and critical thinking skills. In the research done by Issa and Khataibeh (2021), who focused on mathematics in PBL classrooms, regarded critical thinking as one of the essential features of success in the 21st century. They also reported that students' critical thinking skills improved with PBL and it develop students' communication, cooperation, and creativity abilities. As cited in Syahril et al (2021), Karacalli and Korur, (2014), and Saduakassova

et al. (2023), in their studies found that implementation of project-based learning in mathematics showed that students increase math concepts understanding, they improve in problem-solving abilities, they improve in collaborative skills and having a positive attitude towards mathematics and it enhances 21st century skills such as communication skills, teamwork, interpersonal skills and project management. Warr and West (2020) found that students learned better with PBL than traditional learning methods where students learned how to meet deadlines and how to collaborate with others. McKenna et al. (2018), found that PBL enhances skills in students, such as innovation, communication, teamwork, and project time management. They also found that students who used PBL had higher-order critical and creative thinking with positive outcomes. PBL in mathematics creates an active, collaborative, responsible and problem solving learner. (Harianja, 2020; Dinantika et al., 2019), point out that PBL is able to increase students' self-confidence, critical and analytical thinking, deeper understanding of mathematical concepts and improves students' activities and learning outcomes (Erliadi, 2021; Shalihah and Prastiti, 2020), and is able to increase students' self-confidence. (Erliadi, 2021).

2.5 CHALLENGES PERCEIVED BY TEACHERS IN IMPLEMENTING PBL IN MATHEMATICS

PBL has also its challenges which were perceived by teachers. In a research on the challenges high school mathematics teachers face on integrating PBL which was done by Chomunorwa & Koyama, (2023), in Japan they have found out that mathematics teachers face six challenges when practicing project-based learning in mathematics classroom which are;

- designing authentic mathematical tasks,
- arousing students' interest,
- the degree of learning support for students,
- collaborative activities in groups,
- securing time, and
- Evaluating learning outcomes.

Secondly, it was explained that mathematics teachers are trying to solve these problems by creating project-based learning tasks in small scale and for a short time, collaborating with mathematics teachers at the same school, collaborating with teachers of other subjects at the same school, collaborating with students, collaborating with experts in mathematics

education, and investigating previous studies on project-based learning. Baysura et al (2015), who researched on Perceptions of teacher candidates regarding project-based learning found out that PBL is time-consuming, students may wander off topic when the boundaries of the project are not clear, it may be costly, and it may be difficult for students who are not well-informed about scientific research methods. There may be problems in the individual assessment of students, families may expect an examination-based instructional approach, and teachers may not be equipped with the skills and knowledge to manage PBL (Baharuddin et al, 2022). They also argued that if teachers are not well-informed about PBL they are unable to adequately guide the students in this process. One of the reasons why teachers face difficulties in implementing PBL in Turkey is a lack of training opportunities (Zeren-Ozer & Ozkan (2012). They noted that, teacher candidates should have successfully create and manage a project themselves in order to be able to support their students in carrying out projects in the future. According to Harianja (2020), & Baharudin et al. (2021) apart from having various benefits, the implementation of project-based learning also has several challenges, namely:

- It takes a lot of time to solve the problem.
- Many teachers feel comfortable with traditional classrooms, where the teacher plays a major role in the classroom.
- The amount of equipment that must be provided is a lot.
- Students who have weaknesses in experiment and information gathering will have difficulty.
- Students are less active in group work.

More challenges with PBL for teachers were studied by Aldabbus (2018), who found that, teachers found it challenging to implement PBL due to a lack of practical training which include curriculum was challenging to create for the teachers as textbooks were not used in PBL lesson planning. They also found it challenging to implement PBL within the school schedules since it takes more time than traditional education. The role shift from teacher to facilitator in PBL can be challenging. Condliffe (2017) found that teachers' beliefs about their classroom role from director to facilitator are a problem for PBL. In his research he found that the main challenge for teachers in PBL is the teachers' willingness

to change their position in the classroom and alter their perceptions of classroom and control. He further postulate that some teachers found PBL risky because of traditional teaching style changes which included noise level, student movement, student collaboration.

2.6 SUMMARY

This chapter looked at the review of the relevant literature on the definition of PBL, benefits of PBL to teachers and students and challenges in implementing PBL in mathematics. The researcher used a variety of literature sources to find out what other authorities said about the topic. The next topic will focus on research methodology.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter focused on the research design and research methodology. It looks on research instruments used to collect data, population of the study, sample, sampling techniques, data collection procedures, and data presentation and analysis procedures.

3.2 RESEARCH DESIGN

James H McMillan cited in <http://www.alibris.com> – defines research design to obtain evidence to answer the research questions. Research design describes the procedures for conducting the study, including when, from whom and under what condition the data will be obtained. In this study, descriptive survey research design was used since the study was exploratory in nature. This design was chosen because it saves time and cost- small sample can be studied in a limited time and total cost of sample study is very small. This design is a qualitative approach aiming to explore the perceptions of teachers regarding the implementation of PBL in mathematics. According to Shorten & Smith (2017), qualitative research is a type of research that explores the meaning, experiences and perspectives of people or groups in a natural settings. The qualitative data collection and analysis tools which were used in data collection are open ended questionnaires. The population of 171 in- service final year undergraduate mathematics teachers at Bindura University, a sample of 40 mathematics teachers was chosen. Open ended questionnaires were used as research instruments. Questionnaires were used in this study as they save time and can ensure anonymity. Open ended questions was used to encourage participants to provide detailed responses and share their views freely. The questionnaires were distributed to the respondents and they were asked to complete at their own time. Thematic analysis was employed to analyze the data obtained from open ended questionnaires. Themes were identified through a systematic process of reviewing data, identifying patterns, and categorizes participants' responses. The emerging themes were refined and organized into coherent narratives that represents the teachers' perceptions on PBL in mathematics. Ethical consideration were carefully addressed throughout the research process. Informed consent was obtained from all participants, ensuring they were aware of the study's purpose, procedures and their rights. Participants' confidentiality and privacy was maintained and identified information was anonymised.

3.3 INSTRUMENTS USED TO COLLECT DATA

The instruments used to collect data are open ended questionnaires. Teachers were administered open ended questionnaires for data collection on the perceptions of teachers on implementation of PBL in mathematics. Open ended questionnaires were administered to forty (40) undergraduate mathematics secondary school teachers doing an Honors degree in Mathematics at Bindura University of Science Education in Zimbabwe. According to O’Leary, (2014), open ended questions are data collection tools which allows the researcher to generate specific data to their own research, gives participants more options for responding and offers insights that might otherwise not available. Furthermore, he suggests that open ended questions can reach a large number of respondents representing even larger population and it generate standardized, quantifiable empirical qualitative data. Ranganathan and Caduff (2023), defines questionnaires as a data collection tool consisting of series of questions or items that are used to collect information from respondents in a sample. The information gathered through teachers’ questionnaires include the following; Age group, Qualifications and Gender; How teachers are familiar with PBL; challenges and benefits to be faced when implementing PBL in mathematics and teacher requirements for effective implementation of PBL in mathematics.

3.4 POPULATION, SAMPLE AND SAMPLING TECHNIQUES TO BE USED IN THE STUDY

Martinez-Mesa et al, (2014) define population as the entire set of subjects whose characteristics are of interest to the research team. They further define a sample as a finite part or subset of participants drawn from the target population. According to Webster online.com (retrieved on 5 April 2024), sampling is the act, process or technique of selecting a representative part of population for the purpose of determining parameters or characteristics of the whole population. Out of 421 final year undergraduate in-service science and mathematics teachers, the researcher adopted Purposive sampling to select a sample of forty (40) final year undergraduate in-service mathematics teachers which consists of 20 males and 20 females at the Faculty of Science

Education at Bindura University in Zimbabwe. According to Sahoo, (2017), purposive sampling is non probability sampling technique where participants are selected based on their expertise, experience or knowledge relevant to the research study. This sampling method was adopted because according to Iliyasu and Etikan (2021), it is less time consuming and it gives detailed information since the researcher deals with people who have enough knowledge of the subject matter. According to Etikan et al, (2016), the advantages of purposive sampling are; participants are chosen based on their expertise and knowledge, which help in providing valuable insights and information, participants are selected because of their relevance to the research topic, ensuring that the data collected is related and useful. Also purposive sampling allows for in depth exploration of the research and provide rich and detailed data

3.4 PROCEDURES OF COLLECTING DATA

A developed a 10-item questionnaire covering the aspects on teacher's biography, familiarity with PBL, perceived benefits and challenges of PBL to teachers and students and support needed for effective implementation of PBL were administered to 40 mathematics teachers. Validity is the extent to which a research measure what it claims to measure. To ensure validity of research instruments both construct validity which is whether the measure accurately reflects the theoretical concept it is intended to measure and content validity which is the measure adequately covers all aspects of the concept it is intended to measure (Salkind, 2018), were used to check if the questionnaires really measure the concepts assumed to be measured. In order to preserve questionnaire validity, the contents of the questionnaire was prepared by consulting two experts. The contents was discussed by two mathematics experts and their suggestions were included. According to Lundquist et al, (2020), reliability is the consistency and dependability of a research measure or instrument in producing similar results over time across different observers or across multiple measurements. To ensure reliability of the data collected by the researcher, the questionnaire was verified also by 2 experts teachers in the mathematics department who have knowledge to ascertain the degree the degree to which the contents of the questionnaire are in line with the intended purpose. A sample of 40 mathematics teachers will be selected through random sampling from 171 in service final degree training at Bindura University of Science Education to participate in the survey. Selected participants were contacted personally to participate in the survey and were provided paper based questionnaire. The participants returned the completed questionnaires in person within 7 days. Completed questionnaires were kept safely to ensure

confidentiality and anonymity of responses. Descriptive statistics and factor analysis were conducted to identify key themes and patterns in teachers' perceptions.

3.6 DATA PRESENTATION AND ANALYSIS PROCEDURES

The open ended questionnaires were analyzed in response to the aim to explore the perceptions of teachers on implementing PBL in mathematics. Data obtained through open ended questionnaires from participants was presented using pie charts, bar graphs and themes. The advantages of using bar chart is that bar graphs displays particular values, making it easy to read the exact number and it can be used for various data types including definite, numerical and ordinal data. Advantages of using pie charts are that pie charts provide clear visual representation of how different categories contribute to the whole and it highlights the proportion of each group in relation to the whole. Data obtained was also analyzed using qualitative content analysis. As alluded by Yildirim & Simsek (2013), the basic process content analysis is to gather similar data within the framework of certain concepts and themes and categorize those using assigned themes and then interpret them by shaping them in a way the reader can understand. They further explained that, data were conceptualized first, then the resulting concepts are put in order in a rational way and then themes that explains the data will be determined. Themes are underlying patterns, ideas, or concepts that emerge from a data set such as survey responses. The advantages of using themes are that they help to summarize large amounts of data into manageable and meaningful categories, it provides a basis for organizing and structuring the data, making it easier to analyze and report and themes also reveal patterns and relationships in the data that may not be immediately apparent (Marshall et al, (2019)), hence, the researcher read through each response from the question asked and categorized them by creating themes according to the content integrity. The themes obtained as a result of content analysis were provided and the findings were interpreted under each themes and some examples of quotations from the teachers' responses were used in the presentation of identified themes.

3.7 SUMMARY

The Chapter highlighted the research design, data collection procedures, as well as data presentation. It also presents the methodology used for data analysis. The next Chapter will detail the presentation of findings and discussion. Possible interpretation and meaning of the findings will be made.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

The purpose of this study was to explore the perceptions of teachers on implementing PBL in mathematics in secondary schools. It was aimed to gain greater understanding into preparing teachers to facilitate PBL. This chapter represents the research findings in line with the research questions that guided the study. Also the researcher analysed and discussed the results obtained from the open ended questionnaires answered by 40 in-service mathematics teachers showing teachers' perceptions of PBL. Data obtained from mathematics teachers' responses were analysed by content analysis. The themes that emerged from the data on PBL are discussed in detail and comments from the teachers that replicate each theme are presented. The findings was also linked to the related literature.

4.2 RESULTS, ANALYSIS AND DISCUSSION

Questions 1 to 4 shows the general information of the teachers and the results are represented using tables. As a result of content analysis, seven major themes were extracted from the data.

The findings obtained are presented under these themes and shown by quotations of responses.

These themes were

- ✓ definition of PBL,
- ✓ teacher interest in introducing PBL in mathematics classrooms,
- ✓ benefits of mathematics teachers on using PBL
- ✓ students' benefits on learning through PBL,
- ✓ challenges in implementing PBL in teaching mathematics,
- ✓ helpful strategies and resources for PBL in mathematics,
- ✓ Professional development received concerning PBL in mathematics

4.2.1 Teacher's gender

Figure below summarises the gender of 40 participated mathematics teachers. 50% were female and also 50% were male.

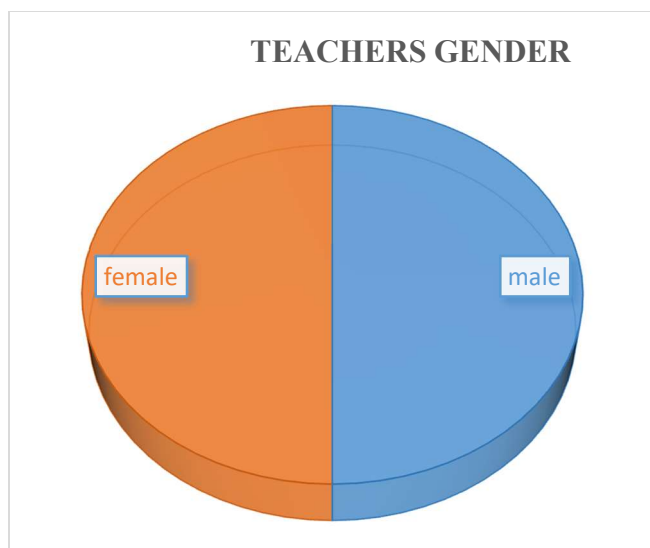


Figure 4.1

4.2.2 Teacher's age range

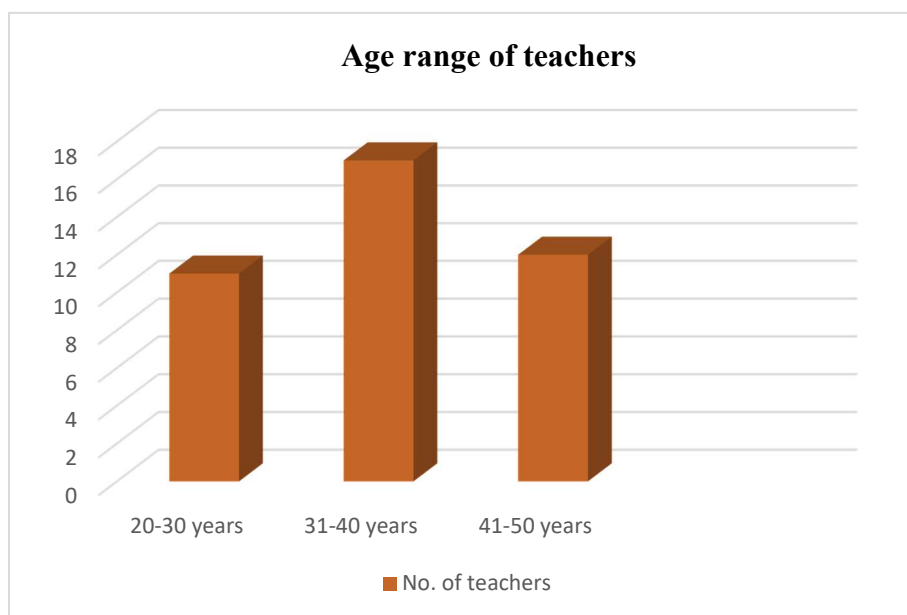


Figure 4.2

The bar chart above summarises the age group of the participated mathematics teachers. 11 teachers were between 20 and 30 years, 17 teachers aged between 31 to 40 years and finally 12 were aged between 41 to 50 years.

4.2.3 Teacher's highest professional qualification

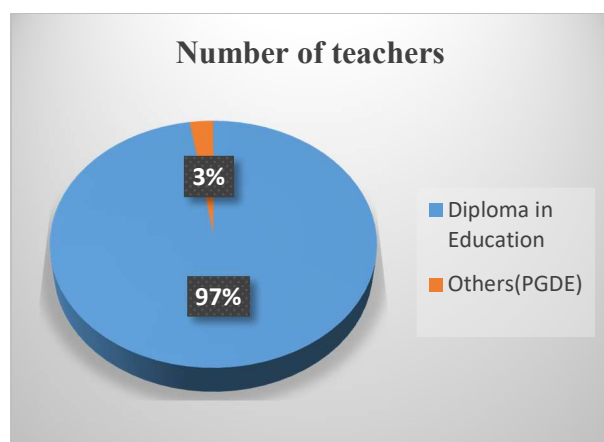


Figure 4.3

The pie chart above summarises highest qualification obtained by respondents. Thirty nine out of forty (97%) were diploma holders majoring with mathematics and one (3%) was a PGDE holder.

4.2.4 Mathematics teachers' teaching experience

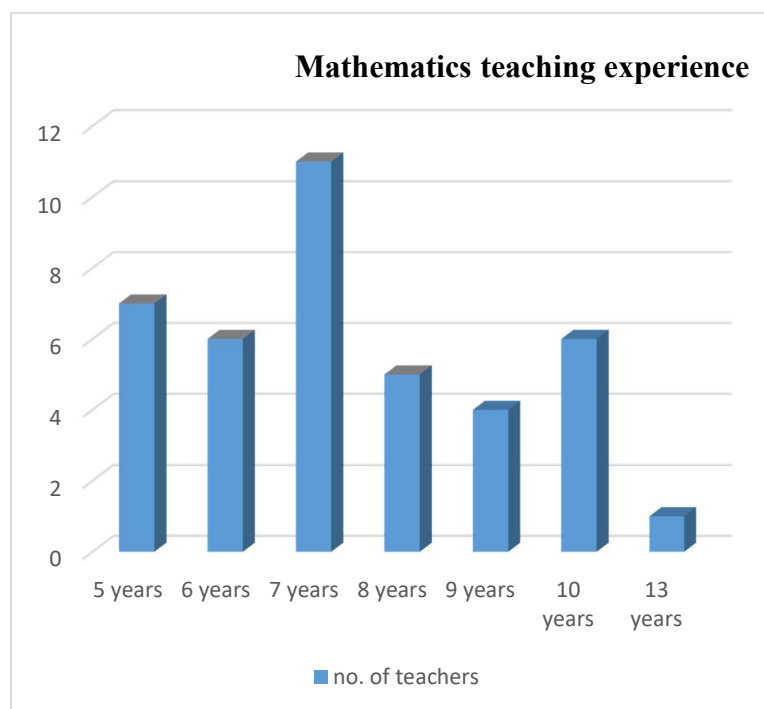


Figure 4.4

Bar graph above summarises the years of experience of teachers teaching mathematics. Results obtained showed that 7 teachers had 5 years teaching mathematics, 6 teachers had 6 year, 11

teachers had 7 years' experience of teaching mathematics. It was also found that 5 teachers had 8 years' experience in mathematics teaching, 4 teachers had 9 years, 6 teachers had 10 years and 1 teacher had 13 years in the field of teaching mathematics.

4.2.5 Definition of project based learning.

From the analysis of 40 teachers' responses on defining the term project based learning three themes were identified:

- ✓ Inquiry – based learning and authentic projects;
- ✓ Student centred learning and real life learning;
- ✓ Collaboration and team work.

40% of the responses emanated from the first theme which is inquiry based learning and authentic projects. One of the responded teachers indicated;

“Is a method of learning which requires critical thinking, problem solving skills and requires students to research on real life projects to be done in mathematics with little or no help from the teacher”.

Another teacher defined it as;

“Project based learning is learning through research and is an inquiry - based learning method which involves critical thinking and problem solving skills and investigation in order to design real projects in mathematics”.

From the findings PBL is defined as an inquiry based method of learning which involve investigation critical thinking, problem solving skills in order to design real projects in mathematics. This agrees with Fisher, (2020).

The second theme is student centered learning and real life learning. 60 % of the respondents defined PBL under this theme. Below are the some of the definitions from the responded teachers which are related to the theme

“It is a learner centered instructional method which support learning through engaging student in a real life investigation of a topic worth learning more about”.

“It is a teaching method which is learner centered, working on real world problems and projects which require problem solving skills”.

“It is student centered learning which allows learners to explore and learn through real world challenges and engaging them in a more active learning process”.

From the findings of this theme PBL is defined as a method of teaching which shifts the focus from the teacher to students making them the main actors of the learning process where students are more active and are the ones who have independence over their learning. Students also learn through real world problems in solving mathematics problems which help them to understand some of the concepts in mathematics. The results obtained agrees with the findings of Ratmaind, (2021), Amin et al (2022) and Almura (2021).

The last theme is collaboration and team work. In this theme 40% of the teachers responded to it together with the first and second theme. Below are some of the responses from the teachers which are related to the theme.

“Project based learning is type of learning which fosters on collaborative learning and team work which helps to motivate learners and sharing of ideas on how to solve problems and design projects”.

“It is a learner centred learning which allows learners to work in small manageable groups in order to complete projects and it promotes collaborative learning which fosters on team work, communication skills , problem solving skills and help students to develop skills in preparing for 21st century skills”.

Through the findings, PBL is defined as an instruction which allows students to work as a team and collaborative in sharing goals and responsibilities in solving real life applications. Students also develops essential skills in communication, collaboration, project management and leadership which all contributed to the development of 21st-century abilities. This is in line with the findings of Karmal et al, (2022) and Saduakassova et al. (2023)

4.2.6 Teachers' interest in introducing PBL in teaching mathematics classes.

On this question 20% of the teachers responded to “yes”, and among them 5% integrate it twice a week and 10% once a week. 80% teachers responded to “no”, and three themes were identified which are:

- ✓ Lack of knowledge;
- ✓ Time consuming and
- ✓ Resistance to change.

Majority of the responses were on the first theme which is lack of knowledge. Below are some of the teachers' responses.

“Lack of knowledge on how to integrate PBL in teaching and learning of mathematics”.

“Because I don't have enough knowledge on how to incorporate it in the teaching and learning of mathematics”.

From the findings, teachers does not have knowledge on using PBL in the teaching and learning of mathematics because it is a new method of teaching to be employed in the Zimbabwe Educational Curriculum and also teachers where not trained on PBL in colleges during their professional training. Therefore teachers doesn't have knowledge on how to teach using PBL. This agrees with Baharuddin et al, (2021).

Second theme was responded by 60% of the teachers where 40% of them responded it together with theme one. Some of the given responses are;

“Teaching using PBL is time consuming and lack of knowledge on how, when, and which topics can be used to teach using PBL”.

“PBL requires more time, therefore it is difficult to teach using PBL during normal lesson time of 35minutes”.

From the findings, since in the Educational Curriculum System of Zimbabwe PBL is not included in the syllabi hence it is difficult to teach using it within the 35 minutes of the lesson as it require more time. The finding concurs with Chamunorwa & Koyama, (2023) and Baysura et al, (2015).

The third theme which was identified is resistance to change. A response with respect to issue of resistance is;

“It is difficult to finish the syllabus using PBL since the students are the ones who are more active in PBL classes”.

From this response most teachers mainly use traditional methods of teaching which is teacher centered. The findings agrees with Harianja, (2020) and Baharuddin et al, (2021) who elaborate that many teachers feel comfortable with traditional classroom where the teacher is the pivot in teaching and learning.

4.2.7 Mathematics teachers benefit on using PBL.

The analysis of the of 40 teachers’ responses of this question identified benefits of teachers on using PBL in mathematics classes. These were three themes identified:

- ✓ Professional growth and development;
- ✓ Collaboration and communication skills; and
- ✓ Improve teaching practices.

The first benefit is professional growth and development. 60 % of the respondents mentioned that PBL provide some opportunities for teachers’ professional growth and development through learning on how to use ICT to research new knowledge, new teaching instructions and content knowledge. One of the teacher’s response indicated,

“It will help in motivating the teacher to research on new knowledge through the use of ICT tools and improves teachers’ creativity , deeper understanding of mathematics concepts and development of problem solving skills”. Another teacher explained “it helps the teachers to develop new teaching strategies, mastering of new knowledge and increase professional growth by improving his / her own mathematical content knowledge”.

From the findings, PBL enhances teacher’s professional growth and development on how to teach mathematics. It also improves teacher’s knowledge, skills and attitudes and drive teacher’s will to learn new methods of teaching. These findings consent with Uyenit et al (2023) and Condillife (2017).

The second benefit is collaboration and communication skills. Below are sample responses of teachers about this theme;

“It enhances teacher- student relationship through collaboration which makes teaching mathematics more enjoyable and fun through hands on approach and real world application”.

“Teachers will benefit from collaboration and communication with other teachers and students which fosters a sense of involvement and teamwork in teaching and learning of mathematics which increase confidence and motivation to learners”.

From the findings teachers act as facilitators and mentors, building stronger relationship with learners which enhances teacher - student interaction and connections between teachers and students and among students leading to greater classroom discipline and more pleasant learning environment which helps students to enhance their skills through application of real-world situations. This agrees with the findings of Hugerat, (2016) and Rehman et al (2023).

The third benefit is improve teaching practices. Below are some of the responses from the teachers,

“It empower students to be the centre and engineer of their own learning which promote deeper understanding of the concepts rather than being spoon fed and teachers will be there as facilitators who guides them.”

“PBL will present mathematics teachers with unique opportunities to engage in professional development and improve teaching and learning outcomes”. “It helps the teacher to develop new teaching strategies, enhances teacher’s own mathematical content”.

The findings agrees with that of Zenkov et al, (2023), who argues that PBL plays an essential role in shaping teachers’ instructional approaches and effective strategies to enhance students’ learning outcomes

4.2.8 Students benefits on learning using PBL in mathematics

When responding to the question on students benefits on implementation of PBL, 5 themes were identified which are;

- ✓ Development of problem solving skills;
- ✓ Improve collaboration and communication skills;
- ✓ Enhances creativity and innovation;

- ✓ Increase engagement and motivation;
- ✓ Deeper understanding of mathematical concepts.

The first theme is development of problem solving skills. Majority of the responded teachers mentioned that PBL encourages students approach problems from different angles, developing critical thinking and creativity. Below are some of the responses from the teachers.

“Through PBL students develop problem solving skills to tackle complex problems in mathematics”

“PBL promotes the development of critical thinking and problem solving skills”, “PBL help students to develop critical thinking, problem solving skills and collaborative learning”.

This suggests that through PBL, students develop essential problem solving skills, including critical thinking in solving complex problems in mathematics. The findings are in line with what Khan and Ibrahim (2020), and Ramadhani et al., (2021) found in their studies.

The second theme is improve collaboration and communication skills. Below are some of the responses from the teachers,

“Through PBL students develop critical thinking, problem solving skills and collaborative learning which will help them to solve mathematical problems as a team in small groups”.

“This approach allows students to develop deeper understanding of mathematical concepts though sharing of ideas through group work and collaborative learning”.

“Development of 21st century skills such as team work, critical thinking, problem solving skills, collaborative learning and communication skills which prepare them for future challenges in the world”.

From the above I conclude that PBL has a great advantage to students as it allows students to work as a team and collaboratively in order to solving mathematical problems which motivates them and allows them to share ideas and improve their communication skills. Results obtained agrees with Kamal et al, (2022), who postulates that PBL enhances 21st century skills such as communication skills, teamwork, interpersonal skills and project management in addition to practical knowledge

The third theme is enhances creativity and innovation. The analysis results also noted that responded teachers have identified that PBL enhances creativity and innovation to students. Some of the following are the responses from the teachers.

“PBL connects learning to real world applications, allowing students theory to practical problems which promote creativity and innovative thinking”. Other responses were,

“It encourages students to explore many solutions, think creatively, and develop innovative thinking”.

“PBL helps students develop skills such as critical thinking, problem solving, creative and innovation which prepare them for working in this 21st century world”.

From the responses of the teacher I conclude that by incorporating PBL in teaching and learning create an environment that encourages creativity, innovation, and problem solving skills which prepares students to success in an ever changing world. This agree with the findings of McKenna et al. (2018), who argues that, PBL enhances skills in students, such as innovation, communication, teamwork, and project time management, higher-order critical and creative thinking with positive outcomes.

The fourth theme is increase engagement and motivation. Majority of the teachers’ responses shows that by applying PBL in mathematics classes increases students’ engagement and motivation. Some of the teachers had this to say under this theme, *“PBL promotes real world problems which makes learning meaningful and increase student engagement”*.

“It increases students’ engagement through exploring, discovering and investigating which stimulates curiosity and engagement”.

“PBL promotes student – centered learning which makes students to take ownership in their learning and make decisions. Also it connects learning to real life situations which increases motivation in learning mathematics”.

From the analysis of the responses of the teachers PBL in mathematics creates an engaging and motivating learning environment that promotes student centred learning which increase student engagement in learning mathematics. The findings agrees with what Musta’in & Handrianto, (2020) found in their study.

The last theme which was identified is deeper understanding of mathematical concepts. Analysis of results also noted that responded teachers identified that through PBL, students gain a deeper understanding of mathematics concepts. Below are the responses from some of the teachers.

“This approach allows students to develop a deeper understanding of mathematical concepts by applying them to meaningful projects”.

“Learning through PBL prepares students to apply mathematical concepts to complex problems which promotes a deeper understanding of mathematical values”.

From the above responses I conclude that PBL benefits students to link mathematical concepts to real life situations and exploring complex problems, making them more meaningful, memorable and understandable. It increase student’s self-confidence, critical and analytical thinking, and deeper understanding of concepts and improves students’ activities and learning outcomes in mathematics. Also it creates a learning environment that promotes deeper understanding of mathematical concepts and prepares students for real world- applications. The results consent with Lee et al, (2015), Trisdiono et al, (2019), Erliadi, (2021) and Shalihah& Prastiti, (2020).

4.2.9 Challenges perceived by mathematics teachers in implementing PBL.

Analysis of 40 teachers’ responses to this question identified challenges mathematics teachers perceived in implementing PBL. Four themes that were identified are,

- ❖ Availability of time;
- ❖ Lack of resources and training;
- ❖ Classroom management;
- ❖ Teacher and student resistance.

The first theme is availability of time. 100% of the responded teachers mentioned availability of time as a challenge in implementing PBL in mathematics. Some of the responses with respect to the issue of time are,

“Time constrains because PBL requires a significant investment of time to carefully plan and allocate time to ensure that projects are completed within given time frame”.

“Since PBL requires more time, it is difficult to manage time to complete the syllabus, you cannot cover as much as topics as compared to traditional methods of learning”.

“It is time consuming”. “Due to 35mins of each lesson, especially in secondary schools it is difficult to implement project-based learning that takes more hours”.

From the above, PBL is time consuming, it requires more time to teach using it which become a challenge in trying to meet the requirements of mathematical syllabus. This agrees with Baysura et al (2015) and Chamunorwa & Koyama, (2023), who also had such findings.

The second theme is availability of resources. The analysis results also noted that 70% of the responded teachers have challenges in resources and incorporating technology in their PBL classes. Some of the teachers’ responses are,

“Due to shortage of resources and ICT tools to incorporate PBL in mathematics classes, it is difficult to implement it”.

“PBL is difficult to implement in mathematics because teachers lack the knowledge on PBL and does not have enough resources which supports PBL in mathematics classes”.

“Teachers does not have professional training and recourses to implement PBL in mathematics classes. Also limited support from the ministry and school”.

From the teachers’ responses, I conclude that due to lack professional training and development on learning effective PBL strategies it is difficult for teachers to implement it in teaching and learning of mathematics. Here in Zimbabwe implementation of PBL was communicated in the Parliament in the Herald on the 22th of July 2024 without training the teachers on the concept and enhance their mathematics content knowledge in order to implement PBL in their classes. Also lack of recourses, limited support from administrators and ICT tools to research are other challenges in implementing PBL in mathematics classes. This agrees with Aldabbus (2018) who also consent that Pre-service teachers found it challenging to implement PBL due to a lack of practical training and unavailability of PBL curriculum textbooks.

The third theme is classroom management. From 40% of the responded teachers classroom management emerged as a challenge in implementing PBL in mathematics classes. Some responded teachers had this say, *“It is difficult to manage a PBL class”.*

“It is difficult to manage students teaching through PBL”.

“It is difficult to manage classrooms during PBL, in terms of discipline, work progress and ensuring all students are catered for”.

From the responses above it is difficult to manage classrooms during PBL including monitoring each student progress, maintain discipline and ensure that every one is involved in the learning. Here in Zimbabwe teacher - pupil ratio is over 1: 40 which makes it difficult to monitor each and every learner during teaching and learning. Justice will not be done on monitoring and supervising projects of the learners. The findings agrees with those of Chamunorwa & Koyama, (2023).

The fourth theme that was identified is resistance to change from teachers. Majority of the teachers perceived that that it will be difficult to implement PBL in mathematics due to resistance to change from both teachers and learners. Below are some of the responses from teachers regarding this theme.

“I am used to traditional methods of teaching which are fast”.

“It is difficult to handle academic difference ability between groups”.

“PBL is demanding and it is difficult to assess and grade each and every learner’s project progress”.

This data revealed, it difficult for teachers to move away from their traditional methods of teaching which more teacher are centered to modern teaching methods. This challenge attributed from teachers’ resistance to change and lack of skills needed to teach using PBL. The findings agrees with the findings of Condliffe, (2017), found that the main challenge for teachers is to change their position in the classroom and alter their perceptions of classroom control.

4.2.10 Professional development or training on incorporating PBL in mathematics instruction.

On this question 80% of the teachers are interested in receiving professional development and training on incorporating PBL in their mathematics instruction. 20% didn’t respond to the question. Below are some of the responses why teachers need professional development and training.

“It is difficult to integrate PBL in to the existing curriculum, I need training on how involve PBL in the existing curriculum to teach mathematics”.

“Professional training is needed because I don’t have enough knowledge on how to involve PBL in the teaching and learning of mathematics”.

“I need training to develop skills on how to assess and evaluate students in a PBL learning environment”.

“Since PBL is a new pedagogy teachers need professional development and training on how to integrate it in classroom and there is also need for training on how to manage PBL class.

For successful implementation of PBL, from the above responses there is need for professional development and training of teachers. Since PBL is a new pedagogy to be introduced in Zimbabwean curriculum, teachers have little or no knowledge on how to integrate it in their teaching and learning of mathematics. Therefore training of teachers is very essential because it provides them with skills to implement it successfully in their classrooms. This was also noted by Harianja (2020), & Baharudin et al. (2021)

4.3 SUMMARY

The chapter presents the data presentation, analysis and discussion on the perceptions of mathematics teachers on implementing PBL. The study found that teachers perceived PBL as beneficial for professional growth and development of teachers, collaboration and communication skills and on improving teaching practices. Benefits to the students were also found as that it increase students engagement and motivation, promote deeper understanding of mathematical concept. The development of problem solving skills and improve collaboration and communication skills were also found to be the pros of implementing PBL. However, challenges such as lack of resources and infrastructure, lack of knowledge, Availability of time, classroom management and teachers and students resistance were identified as hindrance to successful implementation of PBL in mathematics classes. For successful implementation of PBL teachers should be provided with resources and professional development through trainings, seminars and workshops. From the findings PBL has the potential to enhance mathematics education.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter focuses on summary, conclusion, and recommendations. The chapter will present a summary of the finds of the study on perceptions of teachers on the implementation of PBL in mathematics. The perceptions will be based on the benefits of PBL to the teachers and students, challenges on implementation of PBL and methods of assessing students learning through PBL. It will also outline the recommendations suggested by the researcher.

5.2 SUMMARY

The main focus of this study was to explore the perceptions of teachers on the implementation of project based learning in mathematics. The research was conducted at Bindura University of Science Education in Zimbabwe. From a population of one hundred and seventy one in- service teachers doing their degree in their final year, a sample of forty teachers, twenty females and twenty males were randomly selected. Purposive sampling was also used to select mathematics training teachers since they are the ones who teaches mathematics. The researcher reviewed the related literature of the study. Literature reviewed by the researcher showed that PBL has benefits to teachers and students in the teaching and learning of mathematics. From what the researcher found, PBL has some benefits to students which are development of problem solving skills, improves collaboration and communication skills, enhances creativity and innovation, increases engagement and motivation and promotes deeper understanding of mathematical concepts. This is in line with Harianja (2020), Dinantika et al (2019) who point out that some of the benefits of implementing PBL to the students include the creation of problem solving techniques within an individual. Furthermore, Erliadi (2021), Shalihah and Prastiti (2020) outline the increase in student self-confidence, critical and analytical thinking as some of the pros of implementing PBL in the learning of maths. Cintang et al, (2017) attest that project based learning helps teachers because it enhances their creativity thereby driving ones will to learn and improve themselves in the teaching field. In support of this view that PBL has benefits to teachers Uyen, (2023) laments that PBL familiarises teachers with time management skills which helps them in proper lesson deliveries and classroom management for the benefit of the teaching and learning process. Rehman et al (2023) point out that PBL enhances connections between teachers and students leading to greater classroom discipline and more pleasant learning environment.

Challenges on implementation of PBL were also reviewed, Aldabbus (2018) outline the lack of proper training as a major factor hindering the implementation of PBL. From what the researcher gathered lack of training on how to implement PBL is also a major challenge because there was no training offered to teachers concerning PBL. Information about implementation of PBL was communicated in the parliament on the 22nd of July 2024. Project based learning is a 21st century teaching and learning approach teachers need to be trained on this new pedagogy of teaching and learning which was introduced in Zimbabwe. This was also supported by Harianja (2020), who argues that those without proper and adequate training on PBL are likely to be more resistant on its implementation in schools. More so Harianja (2020) further attest that its implementation in schools requires a lot of time and adequate research for educational institutions to realise its benefits, thus more time on project planning and execution must be taken into account on this approach in education. Time management is also another challenge in designing authentic projects, therefore more time is needed to plan on how to manage time. This was also supported by Chamunorwa and Koyama (2023), who outlined that mathematics teachers face challenges in designing authentic mathematical projects because of the time needed in project designing, monitoring and their execution, this is more likely to further hinder the implementation of PBL since it requires learner attention and interest on carrying out project tasks. Another challenge which was noted is classroom management. For successful application of PBL in mathematics small manageable class is needed. in some schools in Zimbabwe, teacher- pupil ratio is nearly 1:60 which is too big and make it difficult for the teacher to manage such class. This was also noted by Kokotsaki et al, (2016). Lack of resources was also noted as a challenge in implementing PBL in mathematics. So far there is no resources such as textbooks and other which can be used to incorporate PBL in schools and this was also noted by Chamunorwa & Koyama, (2023). ICT tools are another challenge in most of the schools especially in schools located in rural areas which makes it difficult for teachers and students to research for information regarding PBL this was also noted by Aldubbas, (2018).

5.3 CONCLUSION

Basing on the findings from the study, it can be concluded that mathematics teachers have positive perceptions on PBL as an effective method of teaching and learning of mathematics. From the

findings most of the teachers were not interested in introducing PBL in their mathematics classes because they lack knowledge on how to implement PBL in their mathematics classes, it is time consuming and also due to resistance to change. They expressed the benefits of implementing PBL to the teachers, including professional growth and development of the teacher, collaboration and communication skills among teachers and students, and improve teaching practices. Also the finding also highlighted the benefits of PBL to the students which include the development of problem solving skills, improve collaboration and communication skills, enhances creativity and innovation, increase engagement and motivation and promotes deeper understanding of mathematical concepts. However, they also expressed some challenges in implementing PBL which include time management, lack of training, lack of resources and support from the administration. From the study it shows that most of the teachers did not receive any professional development or training on how to incorporate PBL in mathematics instruction and all teachers are interested in receiving such training in order to successfully teach mathematics using PBL. The study's findings also highlighted on methods of assessment to be used to assess students in PBL situation in mathematics which include continuous assessment of practical projects and tests.

5.4 RECOMMENDATIONS

Basing on the findings emerging above, the researcher suggested the following recommendations in order to successfully implement PBL in mathematics. First and foremost, Due to dynamic and promising learning flexibility fashioned along with the proper implementation of PBL, I suggest that pre-service and in-service teachers to be trained in order to respond to the need of implementation of project-based learning approach in mathematics education. The Ministry of Primary and Secondary Education (MOPSE) and other stakeholders which support Education should work together to plan regular teachers' workshops and trainings for professional development to develop their understanding and skills in implementing PBL, and other teaching and learning approaches in mathematics. In addition, the Ministry should ensure that adequate resources such as time, technology and teaching and learning materials which supports successful implementation of PBL are available. The School Administration and staff members should appreciate the benefits of using PBL in the learning activities by providing local support and encouragement needed for implementation of PBL in mathematics. It is also suggested that mathematics teachers should work together to share experiences, ideas, and best practices in implementing PBL. In addition, the school should provide teachers with assistance and guidance

to manage school dynamics and student engagement during PBL activities. Parents and guardians should be also involved to ensure their understanding and support. Learners should also be encouraged to engage in constructing their own knowledge and skills through project-based learning which in turn would benefit them in their future life. Lastly, there is also a need for researchers to explore the perceptions of project-based learning from the student perspective. Viewing it from both the teachers and students' sides it will help us to have a clear understanding of the approach in the teaching and learning of mathematics.

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APPENDICES

APPENDIX I

QUESTIONNAIRE FOR TEACHERS

My name is Mudhunguyo Applonia, an HBScEd Mathematics student from Bindura University. I am conducting a research on exploring teachers' perceptions on the implementation of Project Based Learning (PBL) in Mathematics in secondary schools. The research is expected to contribute to an understanding of how the implementation of PBL is influenced in the teaching and learning of mathematics in secondary education.

Your participation in this questionnaire is voluntary and you do not have to answer any question if you do not wish to. If you do not know an answer to any of the questions, you are free to write "I don't know". Your contribution will remain private, confidential and anonymous and will only be used for academic purposes only.

1. Teacher's gender. (tick where applicable)

MALE ☐ FEMALE ☐

2. Teacher's age range. (tick where applicable)

20-30 ☐ 31-40 ☐ 41-50 ☐ 51 – above ☐

3. Teacher's highest professional qualification (tick where applicable)

Certificate in Education ☐ Diploma in Education ☐

Masters in Education ☐ PHD in Education ☐

Others, (specify)

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4. How many years of experience do you have teaching mathematics?

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5. What do you understand by the term Project Based Learning?

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6

a. Do you see teachers interested in introducing PBL in teaching mathematics classes?

YES ☐

NO ☐

b. If yes, how often do you integrate it in your teaching practice?

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c. If No, what are the reasons for not incorporating it?

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7 In your own opinion how will teachers benefit on using Project Based Learning in mathematics?

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8 In your own opinion, how will students benefit on using Project Based Learning in Mathematics?

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9 What are the challenges you perceive in implementing Project Based Learning in teaching mathematics?

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10. (a) Have you received any professional development or training on incorporating PBL in mathematics ☐ instruction? YES NO

(b) If yes how has it influence your perception on implementation of PBL?

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(b) If no, are you interested in receiving such training?

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Thank you for your cooperation, time, participation and contributions.

Appendix II

SAMED

P Bag 1020
BINDURA
ZIMBABWE

Tel: 0271 - 7531 ext 1038
Fax: 263 - 71 - 7616

 **BINDURA UNIVERSITY OF SCIENCE EDUCATION**

Date:

TO WHOM IT MAY CONCERN

NAME: MUPHUNGUYO REGISTRATION NUMBER: B1336199
APPROPRIATE

PROGRAMME: HBSc Ed B.2 MATHEMATICS PART: 2.2

This memo serves to confirm that the above is a bona fide student at Bindura University of Science Education in the Faculty of Science Education.

The student has to undertake research and thereafter present a Research Project in partial fulfillment of the HBSc Ed MATHEMATICS programme. The research topic is:

In this regard, the department kindly requests your permission to allow the student to carry out his/her research in your institutions.

Your co-operation and assistance is greatly appreciated.

Thank you

 9 APR 2023

Z Ndemo (Dr.)
CHAIRPERSON - SAMED

P. Bag 1020
BINDURA

M.N. OF PRIMARY & SECONDARY EDUCATION
MASHONALAND WEST PROVINCE
HUMAN RESOURCES (DISCIPLINE)
12 JUN 2024
P.O. BOX 328, CHINHOI
ZIMBABWE

Appendix III

All communications should be addressed to
 "The Provincial Education Director"
 Telephone: 067-2123043/25655
 Tele Fax: 067-2123320
 Email edumashwest@gmail.com



Ref :C/246/1/MW

Ministry of Primary & Secondary
 Education
 Mashonaland West Province
 P.O Box 328
 Chinhoyi



The District Schools Inspector
ZVIMBA District

AUTHORITY TO CARRY OUT EDUCATIONAL RESEARCH: SCHOOLS IN
ZVIMBA DISTRICT: MR/MRS/MS. APPLONIA MUDHUNGU
 EC.NO/IDNO 55087717 STATION TTC KARIGAMBE SEC.
 DISTRICT ZVIMBA INSTITUTION BUSE
 REG.NO. 81336799 PROGRAMME HASc Ed B2 (MATHEMATICS)

The above named student has been granted authority by the Provincial Education Director to carry out a research in ZVIMBA District. The student has been advised to visit your office before entering the schools.

Research Topic Perceptions of mathematics teachers on the implementation of Project Based Learning in (PBL) Mathematics
 Period of research April to June 2024
 Targeted school/s Kwadasana High, TTC Karigambe Sch
 Method of research Questionnaires

Please ensure that the learning and teaching programmes at the targeted schools are not interrupted in any way; the student strictly adheres to the activities and topics specified in his/her letter of request and that the research should be conducted according to the given time frame.

The District Schools Inspector is requested to liaise with the researcher on the specific schools where the research will be conducted and advise the Provincial Office of the chosen schools. Furthermore, the District Schools Inspector should ensure that a copy of the research findings is submitted to the Provincial Education Director once the research is completed.

T. MAKONI

FOR: ACTING PROVINCIAL EDUCATION DIRECTOR
 MASHONALAND WEST PROVINCE