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Enhancing Students' Competency-Based Question Handling Skills through Problem-Based Learning: Action Research

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ABSTRACT: *This action research investigated the effectiveness of Problem-based learning (PBL) in enhancing students' competency-based question handling skills in the unique context of Yebilaptsa Middle Secondary School. This study employed a quasi-experiment mixed-methods design, incorporating pre-tests, post-tests, and student interviews to examine the impact of PBL on students' abilities to comprehend and respond to competency-based questions. A total of 48 grade ten students participated in this study, with 24 students assigned to the experimental group (EG) and 24 to the control group (CG). The findings revealed that despite an initial lack of significant differences in pre-test scores (p = .679) between the CG and EG, the PBL strategy can led to statistically significant (p = .001) improvements in the EG. Similarly, the qualitative findings also supported quantitative findings, highlighting the value of PBL in encouraging greater comprehension, teamwork, and long-term memory of information. While the study provides valuable information into the potential of PBL in addressing students' challenges with competency-based questions, the study admits its limitations, including the small sample size and single-site focus. Nevertheless, the study adds to the discourse on student-centered learning strategies and provides foundations for continued further research on PBL in a range of educational contexts. This AR concludes with implications and recommendations for future studies.*

KEYWORDS: **Action research, Competency-based questions, Geography, Problem-Based Learning, Student Performance**

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1. Introduction

Action research (AR, hereafter) is a structured method of inquiry intended to improve one's own habits, the circumstance, or both (Stringer, 2004). It involves analyzing a real-world scenario in a classroom or school to comprehend and enhance the effectiveness of activities or education, as noted by Johnson (2012). By engaging teachers in action research, they can actively investigate and reflect on their own practices, identify areas for improvement, and work collaboratively with others to develop effective solutions. As a result, action research can be a valuable tool for promoting professional growth and improving educational outcomes.

The primary goal of education systems around the world has always been to develop and empower young brains to improve their quality of life. One significant transition among the many that have been made in the educational system's numerous facets is in the method of teaching and learning, which gave rise to Competency-Based Education (CBE). In 2011, the Ministry of Education (MoE) of Bhutan adopted Competency-Based Assessment (CBA) in accordance with the current international trend in education (Bhutan Council for School Examinations and Assessment [BCSEA], 2022).

According to studies, many students face challenges when handling competency-based questions, especially when they are presented in a complex or unfamiliar context (BCSEA, 2019; Nurkhin & Prumosinto, 2020). The Bhutan PISA_D national report of (2019) revealed that students tend to perform better in items that requires lower cognitive skills but struggle significantly in more demanding tasks. To address this issue, PBL is considered a promising teaching strategy that involves presenting students with real-world problems and

challenging them to find solutions using critical thinking, collaboration, and creativity (San Tan & Ng, 2006; Tayyep, 2013). Therefore, the main objective of this action research is to investigate whether PBL can improve students' ability to handle competency-based questions.

1.1. Aims and Objective

To evaluate the effectiveness of PBL strategy in enhancing students' problem-solving skills and critical thinking abilities

To investigate the impact of PBL strategy on students' performance in answering competency-based questions

1.2. Research Question

How can problem-based learning enhance students' competency-based question handling skills?

1.3. Reconnaissance

Reconnaissance is a French word "reconnoiter" meaning to look at. Reconnaissance is a diagnostic phase that requires insight to identify the most critical point of attack from which a positive impact can most likely proceed. The primary objective of reconnaissance is to produce a research question that will lead to the improvement. Maxwell (2003) conceptualized reconnaissance as consisting of three parts, namely, situational analysis, analysis of competence of the researcher, critical friend and participants and review of related literature. These three components are discussed below.

1.4. Situation Analysis

Yebilaptsa Middle Secondary School is a boarding school located in a semi-urban area outside the main town, under the Zhemgang dzongkhag. Established in 1993, the school is located at an altitude of 854 meters above sea level, placing it within subtropical climate zone. The school has around 500 students enrolled in classes PP to X and offers Economics and AGFS as optional subjects. The school's primary goal is to equip all children with the appropriate knowledge, skills and values necessary to cope with the challenges of the 21st century.

As teacher educators at Yebilaptsa Middle Secondary School for the past number of years, we have observed that the majority of the students struggle to deal with competency-based questions that involve students' critical and creative thinking skills. This issue can be attributed to various factors, including large number of students in the classroom, students' backgrounds, the absence of parental support and the quality of supports provided by teachers. Further, since students come from diverse backgrounds, all the students may not have the same capacity to comprehend ideas and concepts at the same pace in the class. Some students get help from parents or guardians at home but some are deprived of such facilities.

Dealing with competency-based questions is one of the most difficult tasks for the students of class X as it requires varied interpretations. Moreover, students find it difficult to comprehend the questions. From all these experiences, researchers have realised that this issue deserves immediate attention. Therefore, this proposed study explores the impact of a problem-based learning strategy on enhancing students' ability to deal with competency-based questions.

1.5. Competence

The researchers conducting this AR possess comprehensive competence rooted in their academic backgrounds and professional experiences. Both researchers hold master's degrees in geography from Samtse College of Education, providing them with a solid foundation in the subject matter under investigation. Additionally, their expertise extends to the broader educational landscape, as evidenced by their publication history. They have contributed to scholarly discussions through papers on topics such as educational technology, professional development, and creative education. This diverse knowledge base enables the researchers to approach the study with a nuanced understanding of both geography education and the broader educational context, ensuring a well-informed and rigorous investigation.

1.6. Critical Friend

"The purpose of having a critical friend is to

ensure that the researcher does not make narrow or biased interpretations of data" (Choeda et al., 2018, p.4). According to Stenhouse (1975), a critical friend is a companion who offers advice and support to the teacher-researcher engaged in the AR. In line with this, we have enlisted Mr. Thinley Wangdi M.A, lecturer and researcher at Walailak University, Thailand as our critical friend. Mr. Wangdi is an accomplished educator-researcher with a portfolio that offers significant perspectives on language education, educational technology, pedagogy, and teaching methodologies. The researchers and the critical friend reviewed the role of the critical friend as mentioned in the 'A Guide to Action Research: Enhancing Professional Practice of Teachers in Bhutan' by REC. He is therefore clear about his role in the AR.

2. Literature Review

Competencies are collections of information, skills, and attitudes that students build and apply for successful learning, living, and working, according to Alberta Education (2016). Further, competency-based question handling skills refer to the ability of students to interpret and answer questions that assess specific competencies. The use of problem-based learning strategy has been found to enhance students' competency-based question handling skills (Cross, 1999). The purpose of this literature review is to examine studies that have investigated the use of problem-based learning strategy in enhancing students' competency-based question handling skills.

PBL is a student-cantered approach that involves the use of problems as a starting point for learning. In PBL, students work in groups to identify problems, conduct research, and propose solutions (Savery, 2015). Various studies have shown that PBL is effective at improving students' problem-solving abilities, critical thinking abilities, communication skills and competency-based question handling abilities (Grasas & Ramalhinho, 2016; Ibrahim & Rashid, 2022; Karan & Brown, 2022; Tortorella & Cauchick-Miguel, 2018; Trullas et al., 2022). For instance, Karan and Brown (2022) demonstrated that PBL enhances problem-solving abilities by fostering a deep understanding of content and promoting self-directed learning. Similarly, Ibrahim and Rashid (2022) highlighted the positive effects of PBL on collaboration and communication skills.

Concurrently, a study by Tayyeb (2013), investigated effectiveness of PBL as an instructional tool for acquisition of content knowledge and promotion of critical thinking among medical students. The study involved total of 200 final medical students who were randomly assigned to a PBL group and a traditional instruction group. The results showed that PBL is an effective instructional tool to foster critical thinking and problem solving skills among medical students.

Similarly, Trullas et al. (2022) examined the effect of PBL on students' competency-based question handling skills in the context of undergraduate medical education. The result indicated that PBL is more effective than traditional methods at improving social and communication skills, problem-solving and self-learning skills, and has no worse results in relation to academic performance.

In another study, Ajai et al. (2013) did comparison of the Learning Effectiveness of Problem-Based Learning (PBL) and Conventional Method of Teaching Algebra. The study involved 447 senior secondary students. Findings of the study showed that students taught using PBL achieved significantly higher in the post test than those taught algebra using conventional method.

The reviewed studies suggest that the use of problem-based learning strategy is effective in enhancing students' competency-based question handling skills (Boye & Agyei, 2023; Nurkhin, & Pramusinto, 2020; Tayyeb, 2013). For example, Boye and Agyei (2023) conducted study on 32 first-year pre-service teachers from Akrokerri College of Education in Ghana and found that PBL is effective in improving students' competency-based question handling skills in mathematics. Further, PBL promotes students' engagement in the learning process, encourages collaboration, and enhances students' critical thinking and problem-solving skills. The findings of the reviewed studies have implications for instructional practice, curriculum development, and teacher training in various disciplines.

3. Methodology

The methodology is an essential component of any research study as it establishes the theoretical framework for understanding which strategies to apply in a given circumstance (Creswell & Creswell, 2017). This section discusses the research design, participants, data collection tools and procedures, data analysis methods, and ethical considerations.

3.1 Research Approach and Design

The research approach utilized for this AR was mixed methods since it presents a better process of addressing the research problem than qualitative and quantitative in silo. Creswell and Creswell (2018) asserted that mixed methods research resides in the middle of the continuum because it incorporates elements of both qualitative and quantitative approaches. Concurrently, this AR employed a quasi-experimental design. The study employed a quasi-experimental design, which is appropriate for educational research where random assignment to groups is not always feasible (Gopalan et al., 2020). This design allowed for the comparison of two intact groups (control and experimental) while controlling for extraneous variables to the greatest extent possible. The use of pre-test and post-test measurements helped in assessing the impact of the intervention, providing a robust framework for analyzing changes in students' achievement levels. More specifically, the pretest-posttest control group design was utilized. In this design, the EG takes part in intervention, which can consist of single or multiple intervention classes. The design also includes a pretest and a posttest, in which both the EG and CG participate. The purpose of the pretest is to ensure the comparability of the two groups prior to the treatment, whereas the posttest allows the researchers to determine the immediate effects of the treatment on the outcome variables (Rogers & Revesz 2019). Thus, the researchers opted for a quasi-experimental design because it allows them to grasp the prevalence of attributes within a sample of the population at a single point in time (Creswell, 2014). Figure 1 illustrate the research design.

3.2. Research Participants

By the nature of research design, class becomes the sample of the study. Two sections of grade ten (10 B and 10 C) were selected for the study since the researchers taught geography to these two sections. The CG and EG were chosen based on the students' performances in the mid-term examination. Grade 10 B was selected as the EG because they had obtained lower mean marks in the mid-term examination, while grade 10 C was chosen as the CG due to their higher mean marks. A total of 48 grade ten students participated in this study, with 24 students assigned to the EG and 24 to the CG.

3.3. Research Instruments

This study employed two instruments to

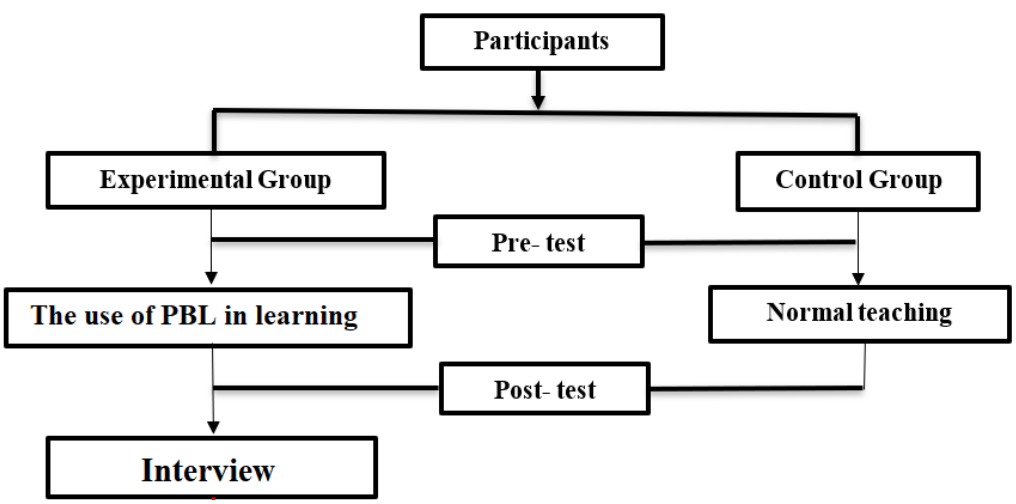

Figure 1. Illustration of the Research Design

collect data, namely pre-test and post-test for quantitative and an interview to collect their opinion on strategy used to enhance their competency based skills.

3.3.1. Pre-test and Post-test

Before the intervention, a pre-test comprising of six competency-based questions on hazard and disaster were prepared from tenth-grade geography textbook and was administered to both EG and CG to assess their prior knowledge. Similarly, at the end of the intervention period, the researchers administered post-test to both groups. PBL strategy was incorporated in EG while CG was taught using normal teaching method. At last, a comparison was drawn between the pre-test and post-test scores of both the groups. The purpose of the pretest is to ensure the comparability of the two groups prior to the intervention, whereas the posttest allows the researchers to assess the immediate effects of the intervention applied on the outcome variables (McKinley & Rose, 2019). The questions for both the pre-test and post was validated by four experts using the Item Objective Congruence (IOC) of Turner and Carlson (2003). According to Turner and Carlson (2003), if the average value of IOC is greater than 0.75 then the items are said to be valid. The average IOC for the tests was 0.91 which indicated that items were appropriate for the study.

3.3.2 Semi-structured Interview

In addition to the pre-test and post-test, a semi-structured interview containing five questions (See Appendix B) was conducted with the EG. Additionally, few questions were prompted in between the interview to give clarity of the questions. A total of six students, comprising three males and three females, participated in the face-to-face interview. The interview served a dual purpose: firstly, to assess the participants' proficiency in competency-based skills, and secondly, to seek their perspectives on the impact of incorporating problem-based learning strategies on the enhancement of these skills. Further, interview questions were oversighted by experts and pilot tested with two students. The modifications were made according to experts' feedbacks and the analysis of pilot test result.

3.4. Intervention Procedures

This study utilised three weeks' sessions comprising of 45 minutes each in both EG and CG. The PBL strategy was adopted in two phases to suit our scenario as described below:

Phase 1:

A baseline assessment was conducted to evaluate students' competency-based question handling skills.

Students were introduced to the concept of problem-based learning and provided with training on how to use problem-based learning to handle competency-based questions.

Students were given with series of problem-based learning tasks that require them to apply their competency-based question handling skills.

Phase 2:

Students participated in a PBL intervention designed to enhance their competency-based question handling skills.

The intervention was evaluated using a pre- and post-intervention assessment to measure the impact of the intervention on students' competency-based question handling skills.

Students were given the opportunity to provide feedback on the intervention, including any challenges they faced and suggestions for improvement.

3.5. Intervention Plan

Researchers used following interventions for enhancing students' competency-based question handling skills through PBL strategy of Liu and Pásztor (2022).

Explain the concept of problem-based learning: Prior to executing the PBL intervention, it is imperative to instruct students on the concept of PBL and its potential applications in addressing competency-based inquiries. It ought to explain the essential elements of PBL, including the discovery, investigation, analysis, and assessment of problems.

Provide problem-based learning tasks practices: Assigned PBL tasks that require students to apply their competency-based question handling skills. These tasks assigned were relevant to students' interests and abilities

and provide opportunities for collaboration and critical thinking.

Provide feedback: Provided students with regular feedback on their PBL tasks. The feedback was focused on specific areas of improvement and included suggestions for how to enhance their competency-based question handling skills.

Collaborative learning: Used collaborative learning strategies, such as group work, to facilitate PBL. Through collaborative learning, students can improve their ability to work as a team and gain insight from one another's abilities and weaknesses.

3.6. Data Analysis

Prior to data analysis, the researchers together cleaned both the quantitative and qualitative data. The purpose of this procedure was to ensure that the dataset was correct, comprehensive, and prepared for analysis. The Statistical Package for the Social Science (SPSS-25) software was used to analyse the quantitative data. The data analysis consisted of two parts: the first part focused on analyzing the test scores, while the second part involved the analysis of students' opinions collected through semi-structured interviews. The quantitative data was analyzed using inferential statistics such as independent t-test and paired sample t-test to determine the differences in the pre-test and post-test scores. Moreover, Pearson's correlation coefficient was conducted to assess the relationship between pre-test and post-test scores. Shapiro Wilk's normality test was applied to both pre-test and post-test data before data analysis. Allen et al. (2014) stated that Shapiro Wilk test technique of normality is applied to determine whether the data are normal, when the sample size for this particular study is ≤ 50. The data collected from semi-structured interviews were transcribed, coded, and categorized into different themes based on research questions and then forwarded them to the participants for member checking. Additionally, the qualitative data was analyzed using Braun and Clarke's (2006) thematic analysis method. Creswell and Miller (2000) stated that member checking enhances the credibility of the research process which is a crucial component of building trustworthiness in a study involving qualitative data.

4. Results

4.1. Demographic Details

The data was gathered from grade ten students through pre-test and post-test and interviews. A total of 48 grade ten students participated in this study, with 24 students assigned to the EG and 24 to the CG.

Prior to quantitative data analysis, the Shapiro-Wilk test was conducted for both pre-test and post-test scores to examine the normality of the data. The Shapiro-Wilk test in pre-test was ($w = 0.959$) and ($p = .096$) and likewise in the post-test ($w = .963$) and ($p = .130$) wherein both the cases, the dependent variable, test scores in Table 2 is non-significant ($p > 0.05$). Therefore, the normality assumption is considered normal for the present study. Based on this outcome, we decided to use a parametric test.

Table 1. Demographic Profile.

Gender	CG	EG	Frequency	Percent
Male	10	10	20	41.7%
Female	14	14	28	58.3%
Total	24	24	48	100%

Table 2. Tests of Normality.

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.124	48	.060	.959	48	.096
Post-test	.082	48	.200*	.963	48	.130

*. *This is a lower bound of the true significance.*

4.2. Comparison of Pre-test and Post-test Between Groups

Table 3 presents comparison of pre-test and post-test between groups. An independent samples t-test was conducted at a 95% confidence level to examine whether there was a statistically significant difference between two groups: The CG and the EG in terms of their improvement in competency-based learning skills through the implementation of a PBL strategy. Students in CG (*n=24*) scored, on average 8.47 (*SD = 3.46*) in the pretest, while students in EG (*n=24*) scored, on average 8.12 (*SD=2.31*) in the pretest. This difference between CG and EG was not statistically significant, $t(23) = .416$, $p = .679$, *Cohen's d* = .11. Thus, the test failed to reject the null hypothesis. The effect size was calculated using Eta squared and it was found 0.11 which translate to low magnitude according to Cohen 1992. On the other hand, students in CG scored an average of 9.81 (*SD = 3.87*), while EG scored an average of 13.33 (*SD = 4.16*) in the post-test. There was a statistically significant difference in the post-test, $t(23) = 3.03$, $p = .004$, Cohen's $d = 0.87$. Hence, the null hypothesis is rejected. The observed effect size of 0.87 indicates a large level of magnitude.

Table 4 presents the comparison of pre-test and post-test analysis within the groups. The paired sample t-test at a 95% confidence interval was conducted to compare the pre-test and post-test within the groups to determine if students in CG and EG has improved or declined from pre-test to post-test. The test for CG revealed that students statistically improved in their test performance from the pre-test ($M = 8.47$, $SD = 3.46$) to the post test ($M = 9.81$, $SD = 3.87$), $t(23) = 1.98$, $p<.002$, Cohan's $d = 0.11$. Similarly, the test for EG has shown that students statistically enhance their test performance from the pretest ($M = 8.12$, $SD = 2.31$) to the post-test ($M = 13.33$, $SD = 4.16$), $t(23) = 8.19$, $p< .000$, *Cohen's d* = 0.87.

Furthermore, a Pearson correlation analysis was conducted to assess the relationship between pretest and post-test scores. The result indicates a statistically significant and moderately positive correlation, with a Pearson correlation coefficient $r = 0.536$. This finding suggests that a strong tendency exists for students who excel on the pretest to also perform well on the post-test, and conversely, those who perform poorly on the pretest tend to exhibit lower scores on the post-test.

4.3. Semi-structured Interview

The analysis of qualitative data which was collected through face-to-face interviews revealed that the most of the participants frequently face challenges when it comes to comprehending and responding to competency-based questions. However, many of the interview participants emphasized that the PBL has helped them to deal with real-world situations, thereby enhancing

Table 3. Analysis of Independent Sample T-test

	CG		EG		t(23)	p	Cohen's d
	M	SD	M	SD			
Pretest	8.47	3.46	8.12	2.31	.416	.679	0.11
Post-test	9.81	3.87	13.33	4.16	3.03	.001	0.87

Table 4. Analysis of Paired Sample T-test

	CG		EG		t(23)	p	Cohen's d
	M	SD	M	SD			
Pretest	8.47	3.46	8.12	2.31	1.98	.002	0.11
Post-test	9.81	3.87	13.33	4.16	8.19	.000	0.87

Table 5. Pearson's correlation between Pre-test and Post-test

		Pre-test	Post-test
Pre-test	Pearson Correlation	1	.536**
	Sig. (2-tailed)		.000
	N	48	48
Post-test	Pearson Correlation	.536**	1
	Sig. (2-tailed)	.000	
	N	48	48

***. Correlation is significant at the 0.01 level (2-tailed)*

their ability to address competency-based questions. For instance, P1 articulated, "When we research, we gather ideas through different individuals that can be applied while answering competency-based questions." Furthermore, P4 mentioned, "Yes, it helped us gain better understanding of the concepts as we explore and share our understanding to the mates, which aids in long term retention of concept learned."

5. Discussion

The findings revealed that there was no statistically significant difference in the average scores of the students in the CG and EG during the pre-test conducted before the intervention. However, there was a statistically significant difference in the average scores during the post-test for both groups. Particularly, the post-test average score of the EG was significantly higher than that of the CG. These results suggest that the students in the EG performed better than those in the CG. Thus, it can be concluded that the PBL has enhanced students (EG) ability to comprehend and respond to competency-based questions in geography when compared to the CG. Similarly, all interview participants unanimously indicated that the PBL strategy has been helpful in preparing them to handle competency-based questions. The participants further expressed that PBL facilitated them deeper understanding of the concepts, as it enabled them to explore concepts collaboratively with their peers. This collaborative approach contributed to enhanced long-term retention of the concept learned.

PBL has emerged as a popular and effective teaching strategy for enhancing students' ability to handle competency-based learning. Various studies have been carried out to explore the effectiveness of PBL as a teaching strategy in learning different subjects. The studies have shown positive results, indicating that PBL can enhance students' ability to comprehend and respond to competency-based questions. The findings of the current AR align with the findings of Ulger (2018) who conducted a study on the effectiveness of PBL on the creative thinking disposition of students in visual arts education and found that students who were instructed using PBL approach outperformed students who were instructed through traditional teaching method. Similarly, Tayyeb (2013) claimed that when PBL was employed as an instructional tool, it significantly enhanced students' critical thinking and problem-solving skills. Furthermore, a study by Othman and Shah (2013) in language skills revealed that students in the PBL group were able to present their arguments in a more critical manner.

The students' enhancement in critical thinking, communication skills and problem-solving skills can be attributed to its emphasis on presenting real-world contextual challenges, which encourages students' active engagement in problem-solving and collaboration with peers. The findings are also in line with Lambross (2002) who found that PBL encourages students to take ownership of their own learning by fostering self-directed inquiry and problem-solving. Furthermore, as emphasized by Pithers and Soden (2000), student-centered learning is more effective for developing thinking skills, thus nurturing competency-based learning. Additionally, Karan and Brown (2022) confirmed

that PBL improves problem-solving abilities by fostering a deep understanding of content and promoting self-directed learning. Similarly, Ibrahim and Rashid (2022) emphasized the positive effects of PBL on collaboration and communication skills. Therefore, the studies discussed above demonstrate the effectiveness of PBL as teaching strategy in enhancing students' ability to comprehend and respond to competency-based learning and assessment.

6. Conclusions

This AR investigated the impact of PBL on the competency-based learning skills of tenth-grade geography students. The results revealed a significant improvement in post-test scores for the EG compared to the CG after the implementation of the PBL strategy. Both quantitative analyses, including t-tests, and qualitative insights from interviews supported that the use of PBL positively influences students' competency-based learning skills in geography. The AR findings suggest that PBL has the potential to be an effective pedagogical strategy for addressing the difficulties students face when responding to competency-based questions, particularly in complex or unfamiliar contexts. In addition to adding to the body of knowledge in the field of education, this AR offers important insights for educators and policymakers who want to enhance educational outcomes and prepare students for the demands of the 21st century.

7. Implications of the Study

The study's findings highlight the significant impact of PBL on students' academic performance and their ability to handle competency-based questions. The notable improvement in the experimental group's post-test scores suggests that incorporating interactive and engaging learning methods, such as simulations and games, can greatly enhance students' understanding and retention of geography concepts. These results imply that educational institutions should consider integrating PBL strategies into their curriculum to foster better academic outcomes and equip students with critical thinking and problem-solving skills. Additionally, the positive feedback from the semi-structured interviews indicates that students find PBL beneficial in applying theoretical knowledge to real-world situations, thereby improving their overall learning experience and preparedness for future academic challenges.

8. Recommendations & Limitations

The current AR demonstrated that incorporating PBL as a teaching strategy significantly enhanced students' ability to comprehend competency-based questions. Based on these findings, teachers are encouraged to employ PBL as an instructional approach across various subject areas. However, the AR primarily utilized tests and semi-structured interviews for data collection, potentially limiting the depth of insights gained. To achieve a more comprehensive understanding, it is recommended to diversify data collection methods. Incorporating classroom observations, surveys, and focus group discussions alongside tests and interviews could provide a richer and more nuanced perspective on the impact of PBL. Moreover, to effectively implement PBL, educators should provide training and workshops for teachers on designing projects that align with competency-based learning objectives, integrate PBL into the curriculum to promote critical thinking and problem-solving, ensure access to necessary resources, and encourage collaborative learning through group projects. On a broader scale, these findings suggest significant policy implications for Bhutan's education system, including curriculum reform to incorporate PBL, supporting continuous professional development for teachers, revising assessment policies to include project-based evaluations, and ensuring equitable access to PBL across all schools to bridge educational gaps.

The AR employed a small sample size, which might prevent the results from being applied to a larger population. Larger and more varied sample sizes should be taken into consideration to improve the research's external validity. Additionally, the research was carried out in one school. Thus, it might not accurately reflect the variety of educational situations. A broader view might be offered by expanding the study to several schools or regions.

9. Ethical clearance

The researchers got an approval from school management (YMSS/ADM(06)/2022-2023/505) to carry out this AR. Additionally, the researchers explained the purpose of the study and obtained consent from student participants prior to data collection. The purpose of the consent letters was to get both the student participants' and their parents' or guardians' approval. The researchers made measures to ensure the study participants' anonymity and confidentiality as part of their research methodology, abstaining from revealing their identities or any personal information. Further, the researchers sought approval to conduct the study from the school administration through the school research committee.

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