A Research on

Effect on the Quality and Interest of Students in Learning through Project Based Learning: A Case Study of 4th-Semester Electronics Technology at Barishal Polytechnic Institute.

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Effect on the Quality and Interest of Students in Learning through Project Based Learning: A Case Study of 4th-Semester Electronics Technology at Barishal Polytechnic Institute.

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Abstract

This research explores the impact of project-based learning (PBL) on the quality and interest of students in learning, with a focus on 4th-semester electronics technology students at Barishal Polytechnic Institute. The study involves 63 students, 7 teachers, and the head of the department. Quantitative data were collected through structured questionnaires with closed-ended questions evaluated on a 5-point Likert scale and qualitative data is collected through FGD and KII. Central tendency and normality tests were used for quantitative data analysis and thematic analysis was used for qualitative data. The findings indicate that PBL increases knowledge acquisition, interest in learning, skills development, and innovative idea generation among polytechnic students. While there are some disadvantages associated with PBL, the study suggests that they can be addressed by taking some actions such as teacher training on PBL, developing a detailed syllabus for PBL, ensuring the availability of updated raw materials and machinery, and further research also. The research has several implications for educators and policymakers, highlighting the importance of adopting PBL as an effective pedagogical approach to improve student outcomes and promoting active learning, critical thinking, and problem-solving skills. The study also provides practical recommendations to enhance the effectiveness of PBL in polytechnic institutions of Bangladesh. Further research with a larger sample size from different institutions can provide a more comprehensive understanding of the impact of PBL on TVET in Bangladesh.

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Chapter 1: Introduction

1.1 Back Ground

Polytechnic institutes in Bangladesh have been facing a significant challenge in recent years with many students showing a lack of interest and engagement in their classes. This problem has been acknowledged by both parents and teachers, who have identified a general disinterest in learning and a lack of innovative ideas among students.

The use of effective teaching methodologies that enhance students' learning outcomes is a crucial aspect of modern education. Project-based learning (PBL) is an approach that engages students in active learning, In PBL, students typically work in small groups to explore the project topic, conduct research, and apply what they learn to develop a solution or product that addresses the problem or question. This process involves critical thinking, problem-solving, collaboration, communication, and creativity, as well as the development of subject-specific knowledge and skills. However, there is a need to evaluate the effectiveness of PBL in technical and vocational education, particularly in polytechnic institutions. This study aims to investigate the impact of PBL on the quality and interest of learning among 4th-semester electronics technology students at Barishal Polytechnic Institute.

This study will use a case study approach to investigate the effectiveness of PBL among 63 students in their 4th semester of electronics technology, seven teachers, and the head of the department of electronics technology at Barishal Polytechnic Institute. The quantitative data collection were involve structured questionnaires with closed-ended questions and the qualitative data were collected from FGD and KII. Data analysis for quantitative data used descriptive methods by central tendency and normality tests. and thematic analysis was used for qualitative data.

Finally, this study's findings can inform policymakers and educators about the benefits and drawbacks of PBL and help design effective teaching methodologies that enhance students' learning outcomes in technical and vocational education. The practical recommendations provided in this study can help educators enhance the effectiveness of PBL in polytechnic institutions and improve student outcomes.

1.2 Statement of The Problem

In polytechnic institutes in Bangladesh, lack of interest and engagement among students is a persistent issue, with both parents and teachers reporting low motivation and poor practical performance. This study seeks to address this problem by investigating the effectiveness of project-based learning in increasing students' interest and improving the quality of their learning experience in the Diploma in Engineering program.

1.3 Importance and Rationale of Study

The technical and vocational education and training (TVET) system in developing countries like Bangladesh is still evolving, and teachers may not always be equipped with the necessary resources to supplement students' practical knowledge with theoretical concepts. This can lead to a lack of interest among students and poor performance in practical applications. To address this issue, project-based learning has gained popularity as an effective approach to improving students' learning quality and interest in their education.

In recent years, more TVET institutions have recognized the potential of project-based learning to provide students with hands-on work experience and boost their confidence in their skills. This approach bridges the gap between theoretical concepts and real-world applications, preparing students for success in the modern workplace. Therefore, it is imperative to enhance

teaching techniques, curriculum development, research involvement, and practical training opportunities for TVET students in Bangladesh.

This study focuses on investigating the impact of project-based learning on enhancing students' interest and quality of learning in polytechnic institutes in Bangladesh. It is the first comprehensive investigation of its kind in the TVET system of the country, and its results will be crucial for informing policy decisions and recommendations for teachers and education boards. By emphasizing practical training and skills development, this research will contribute to improving the quality of technical education in Bangladesh and preparing students for a successful future in the globalized world.

1.4 Scope and Limitations of Study

The limitations of this study include the focus on just one institution and a specific discipline. Future research can expand on this study's findings to examine the effectiveness of PBL across various technical and vocational education disciplines and institutions. The findings may provide valuable insights for similar TVET programs in Bangladesh and other developing countries. Future research could expand the scope to include a larger and more diverse sample of students to gain a more comprehensive understanding of the impact of project-based learning on TVET education.

1.5 Objective of Study

The main goal of this research is to investigate the impact of project-based learning. To achieve this goal, the study seeks to answer the current status of subject-based knowledge of students, the impact of PBL on student interest in learning, skill development, innovative idea generation, and the advantages and disadvantages of PBL. The findings of this research can

provide valuable insights into the effectiveness of PBL in enhancing student learning outcomes and improving the quality of technical and vocational education in polytechnic institutions.

1.6 Research Question

To fulfill the objectives of the study, the following research questions are prepared.

1. What is the status of subject-based knowledge of students of 4th-semester electronics technology at Barishal polytechnic institute?
2. What is the effect of project-based learning on students on interest of learning?
3. What is the effect of project-based learning on students on skills?
4. What is the effect of project-based learning on making innovative idea generation?
5. What are the advantages and disadvantages of project-based learning?

Chapter 2: Literature Review

PBL has become increasingly popular in educational settings due to its potential to enhance students' engagement, learning, and skills development. The purpose of this literature review is to examine the existing research on the effects of PBL on student learning outcomes and to identify the advantages and disadvantages of this approach to teaching and learning. Specifically, this review will focus on the case of 4th-semester electronics technology students at Barishal Polytechnic Institute.

Status of Subject-Based Knowledge of Students: According to Anderson and Krathwohl's (2001) taxonomy, the acquisition of subject-based knowledge is an essential component of effective learning. The literature suggests that traditional teaching methods, such as lectures and memorization, may not be sufficient to develop students' understanding and retention of subject-based knowledge ((Alkharusi and Al-Musawi, 2017). However, PBL has been found to improve students' understanding and retention of subject-based knowledge in various fields, including science, technology, engineering, and mathematics (STEM) subjects (Hmelo-Silver, 2004; Larmer, Mergendoller, and Boss, 2015).

Effect of PBL on Student Interest: PBL has been found to increase students' interest in learning by providing them with an opportunity to engage in real-world problem-solving activities and to apply their knowledge in practical contexts (Thomas, 2000). This approach to learning has been found to enhance student motivation, engagement, and enjoyment of the learning process (Duch, Groh, and Allen, 2001; Hung, 2009). Research also suggests that PBL can enhance students' interest in STEM subjects, which are often perceived as challenging and difficult (Gallagher and Stepien, 1996).

Effect of PBL on Student Skills: PBL has been found to enhance a range of skills in students, including problem-solving, critical thinking, creativity, and collaboration (Barron et al., 1998; Torp, L., and Sage, S. (2002). PBL provides students with an opportunity to develop and apply these skills in real-world contexts, which is believed to enhance their transferability and application in future professional settings (Thomas, 2000). Additionally, PBL has been found to enhance students' metacognitive skills, such as self-reflection and self-regulation, which are essential for effective learning (Savery and Duffy, 1995).

Effect of PBL on Innovative Idea Generation: PBL has been found to enhance students' innovative idea generation by providing them with opportunities to explore and develop creative solutions to real-world problems (Kolodner et al., 2003; Walker and Leary, 2009). Research suggests that PBL can enhance students' divergent thinking skills, which are essential for generating innovative ideas (Runco and Jaeger, 2012). Additionally, PBL has been found to enhance students' entrepreneurial skills, such as identifying and exploiting opportunities, which are increasingly valued in today's job market (O'Connor, 2012).

Advantages and Disadvantages of PBL: While PBL has been found to have numerous advantages for student learning outcomes, there are also some potential disadvantages to consider. One potential disadvantage is that PBL can be time-consuming for teachers and students, requiring extensive planning and implementation (Hmelo-Silver, 2004). Additionally, PBL may not be suitable for all students or subject areas, as it requires a high degree of student autonomy and collaboration, which some students may find challenging (Dochy et al., 2003).

In conclusion, this literature review suggests that PBL could be an effective approach for enhancing the subject-based knowledge, interest in learning, skills development, and innovative idea generation of 4th-semester electronics technology students at Barishal Polytechnic Institute.

However, the implementation of PBL requires careful planning and preparation, and the availability of resources and time could be a challenge. Overall, this review provides a foundation for further research on the use of PBL in the context of technical education.

Chapter 3: Methodology

3.1 Research Design

To assess the impact of project-based learning on knowledge, interest, skills, and innovative idea generation, it is necessary to gather pre-intervention data, implement project-based learning with students, and then collect post-intervention data on these outcomes. The proposed study utilizes a conceptual model to guide this process, as shown in Figure 1. By following this methodology, the study aims to provide insights into the effectiveness of project-based learning in enhancing students' engagement and learning outcomes.

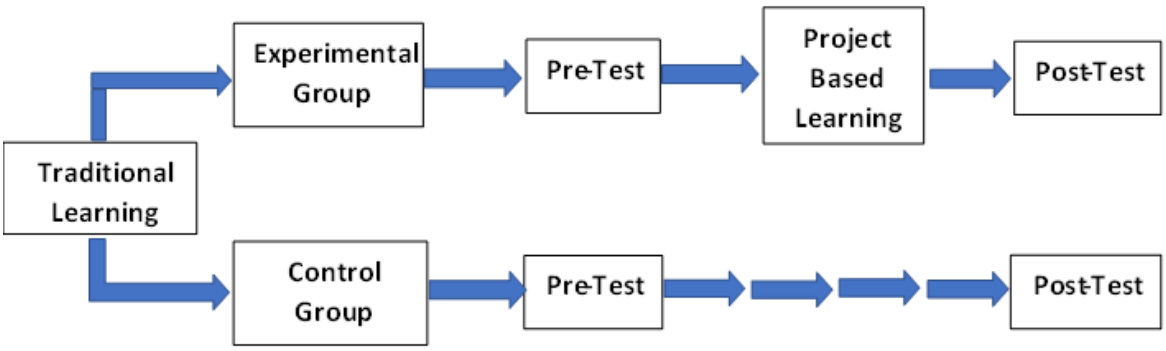


Figure 1. Conceptual model

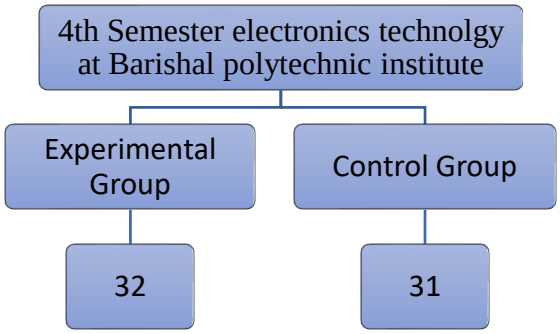
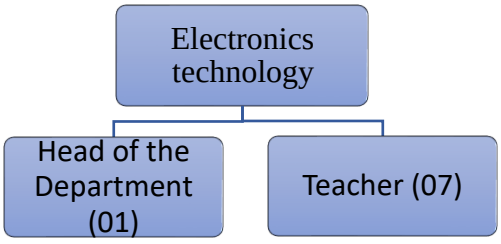
This study employs a mixed-methods approach, combining quantitative and qualitative research methods. The quantitative part of the research used descriptive and statistical analysis to evaluate the impact of PBL on students' interest in learning, quality of learning, skills, and innovative idea generation. The study begins with a pre-test, then divides students into two groups: an experimental group and a control group. The experimental group was exposed to PBL, while the control group followed the traditional method. Then take the post-test and find out the difference between the pre and post-test. The groups are distributed based on the student's

previous exam results, and a normality test was conducted to ensure the distribution is appropriate. In addition to the quantitative analysis, qualitative research methods were used to better understand the advantages and disadvantages of PBL.

3.2 Research area, sample, and sampling size

An adequate sample size of 63 students from the 4th semester of electronics technology at Barishal polytechnic institute was divided into two groups: an experimental group and a control group. The experimental group consists of 32 students and the control group has 31 students. The group is distributed by the statistics value of previous results of the exam. Shown in Table -1.

Table 1. Sample and sample size

Data Source	Sample Size & Design	Sampling
Student of Barishal polytechnic institute.		Normally distributed by mean GPA of the previous 03 semester
Teacher & Head of the Department of Electronics Technology at Barishal Polytechnic		All Teachers & Head of the Department of electronics technology at Barishal polytechnic institute

3.2 Data sources, tools, and methods of data collection

The study used a mixed-methods approach to collect data from the 4th-semester students of electronics technology at Barishal polytechnic institute. The study begins by dividing the students into two groups: an experimental group and a control group. Questionnaires were used to collect primary data from both groups, both before and after the intervention. Each questionnaire includes close-ended questions, and each variable was assessed using a 5-point Likert scale.

In this study, primary 63 pre-test and 63 post-test quantitative data were collected from 63 students in the 4th semester of electronics technology at Barishal polytechnic institute and finally, 58 valid Pre-test and 58 valid post-test data were selected for analysis from both the experimental group and the control group through hard-copy questionnaires.

In addition to the questionnaires, qualitative data was collected through one focus group discussion (FGD) with the teacher and one key informant interview (KII) with the head of the department. Additionally, valid data from the questionnaire same students' observation checklist data were collected from teachers through observation checklists.

The study also collected previous results of the students from the Head of the Department of electronics technology of Barishal polytechnic institute and selected 58 data for analysis

The details of the data collection process are summarized in Table 2.

Table 2. Details of the number of collected data

Data Source	Data Collection Tool	Total Data	Data for Analysis
Students	Questionnaire Hard Copy	63	58
Teacher	Observation Checklist	63	58
Teacher	FGD	01	01
Head of the Department	KII	01	01
Head of the Department	Documents (previous results, attendance, etc.)	As per needs	As per needs

Chapter 4: Result and Discussion

4.1 Demographic characteristics and normality test

This section of the study presents the demographic characteristics of the participants, percentage, and frequency measurement. Table 3. are depict the findings of demographic characteristics.

Table 3. Percentage and frequency distribution of demographic characteristics

Group	Parameters	Frequency	%
Experimental	Total Students	32	
	Data for Analysis	29	100.00
	Male	27	93.10
	Female	02	6.90
Control	Total Students	31	
	Data for Analysis	29	100.00
	Male	26	89.66
	Female	03	10.34

The study recruited a total of 63 students from the 4th semester of electronics technology at Barishal polytechnic institute, out of which 58 provided valid data and was divided into two equal groups: the experimental group comprising 29 students (50%) and the control group also comprising 29 students (50%). In the experimental group, 27 (93.1%) out of 29 students were male and 2 (6.9%) were female, while in the control group, 26 (89.7%) out of 29 students were male and 3 (10.3%) were female. It shows that both groups are approximately equally distributed.

Regarding the previous semester's level of liking and understanding, approximately 90% of students in the experimental group and 93% of students in the control group liked it roughly. Moreover, 79.3% of students in both groups fairly understood it while 20.7% did not understand much. (Table 4 and Table 5). In criteria of liking and understanding also shows that both groups are approximately equally distributed.

Table 4. Liking status in the previous semester

How did you like studying in the polytechnic institute in the already completed semesters?			
Group Name		N	%
Experimental Group	Bad	3	10.3%
	Roughly	26	89.7%
Control Group	Bad	2	6.9%
	Roughly	27	93.1%

Table 5. Understanding of the previous semester

How did you understand the subjects studied in the polytechnic institute in the already completed semesters?			
Group Name		N	%
Experimental Group	Don't understand much	6	20.7%
	Understand Fairly	23	79.3%
Control Group	Don't understand much	6	20.7%
	Understand Fairly	23	79.3%

For assessing normal data distribution, the study used 58 pre-tests and 58 post-test data. The Shapiro-Wilk's test (p> .05) (Shapiro and Wilk, 1965; Razali and Wah, 2011) revealed in Table 6 and the visual inspection of their normal Q-Q plots (Figures: 2 and 3), showed that the experimental group and control group were approximately normally distributed.

Table 6. Normality test

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Group	Statistic	df	Sig.	Statistic	df	Sig.
Experimental Group	.112	29	.200*	.930	29	.055
Control Group	.141	29	.149	.951	29	.200

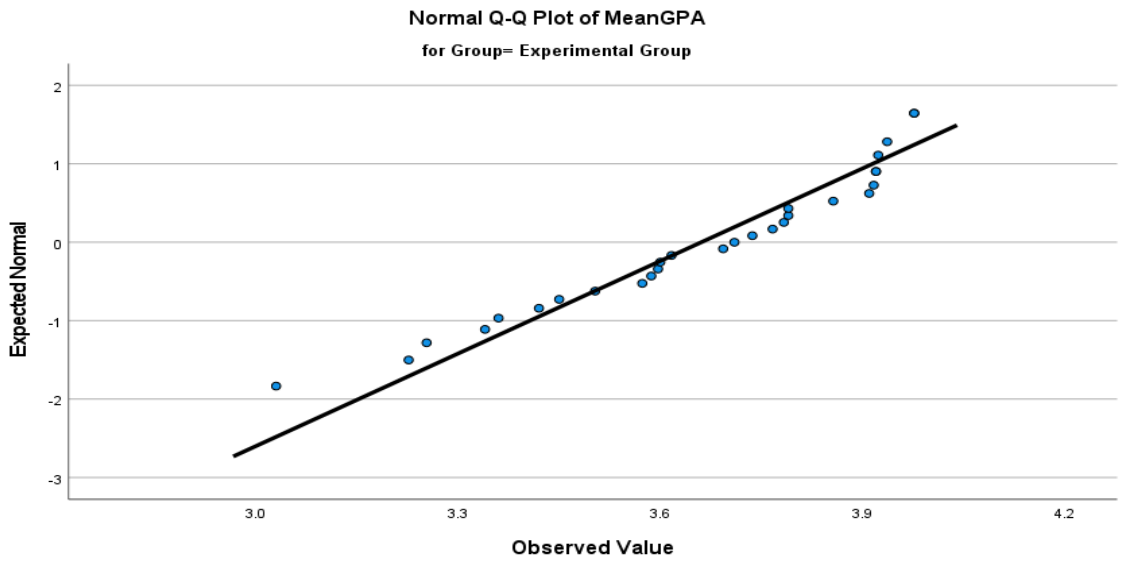


Figure 2. Normal Q-Q Plot (Experimental Group)

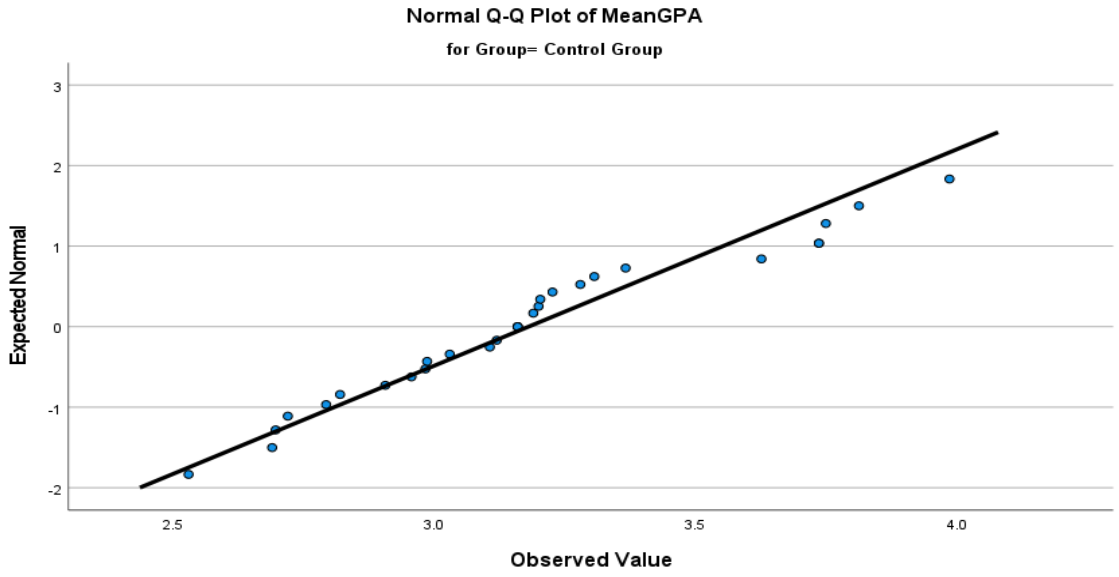


Figure 3. Normal Q-Q Plot (Control Group)

The acceptable range for skewness is ±3 with an acceptable range for kurtosis of ±10 (RB, Kline, 1998). The values of skewness and kurtosis fall within this range for both the experimental

and control groups, as shown in Table 7, indicating that the data is approximately normally distributed. These results also suggest that the demographic characteristics of the two groups were similar.

Table 7. Skewness and kurtosis for experimental and control group

Descriptives

	Group			Statistic	Std. Error	
MeanGPA	Experimental Group	Mean		3.6608	.04721	Z Value= Statistic/ Std. Error
		95% Confidence Interval for Mean	Lower Bound	3.5641		
			Upper Bound	3.7575		
		5% Trimmed Mean		3.6749		
		Median		3.7100		
		Variance		.065		
		Std. Deviation		.25422		
		Minimum		3.03		
		Maximum		3.98		
		Range		.95		
		Interquartile Range		.44		
		Skewness		-.712	.434	=-1.641
		Kurtosis		-.211	.845	=-0.253
	Control Group	Mean		3.1808	.06913	
		95% Confidence Interval for Mean	Lower Bound	3.0392		
			Upper Bound	3.3224		
		5% Trimmed Mean		3.1724		
		Median		3.1600		
		Variance		.139		
		Std. Deviation		.37227		
		Minimum		2.53		
		Maximum		3.99		
		Range		1.46		
		Interquartile Range		.41		
		Skewness		.477	.434	=1.102
		Kurtosis		-.337	.845	=-0.399

4.2 Measurement of central tendencies

Based on the provided information, the given data provides the mean and standard deviation of various variables for the experimental and control groups before and after the study. The central tendencies of the responses to four questions for each research question are also provided.

The mean of Q8, Q9, Q10, Q11, and Q14 is to be determined for RQ1, the mean of Q7, OCQ5, and OCQ6 is to be determined for RQ2, the mean of Q12 and OCQ9 is to be determined for RQ3, and the mean of Q13 and OCQ10 is to be determined for RQ4. For RQ5, the analysis is qualitative and is based on FGD, KII, and Q6.5 and Q6.6 of the questionnaire. (Table 8.)

Table 8. Research question, method, data source, data collection tools, and analysis data

RQ	Method	Data Source	Data Collection Tools	Analysis Data
RQ1	Quantitative	Students in the 4th semester, of electronics technology, at Barishal polytechnic institute.	Questionnaire	Q8, Q9, Q10, Q11 & Q14
RQ2	Quantitative	Students in 4th semester & teacher, of electronics technology at Barishal polytechnic institute.	Questionnaire, Observation checklist	Q7, OCQ5, OCQ6
RQ3	Quantitative	Students in 4th semester & teacher, of electronics technology at Barishal polytechnic institute.	Questionnaire, Observation checklist	Q12 & OCQ9
RQ4	Quantitative	Students in 4th semester & teacher, of electronics technology at Barishal polytechnic institute.	Questionnaire, Observation checklist	Q13 & OCQ10
RQ5	Qualitative	Students of 4th semester, teacher & head of the department, of electronics technology at Barishal polytechnic institute.	Questionnaire, FGD, KII	Q6.5, Q6.6, FGD & KII data

Table 9 shows the results for the experimental group on the pre-test the mean and standard deviation (SD) of the status of subject-based knowledge (SSB) are 2.600 and 0.484, mean and

standard deviation (SD) of Interest of learning (IOL) are 2.793 and 0.366, mean and standard deviation (SD) of student skills (SS) are 1.586 and 0.380, mean and standard deviation (SD) of Innovative Idea Generation (IIG) are 1.052 and 0.155. And for the control group on the pre-test, the mean and standard deviation (SD) of the status of subject-based knowledge (SSB) are 2.083 and 0.528, the mean and standard deviation (SD) of Interest of learning (IOL) are 2.664 and 0.380, mean and standard deviation (SD) of Student skills (SS) are 1.500 and 0.423, mean and standard deviation (SD) of Innovative Idea Generation (IIG) are 1.052 and 0.155.

Table 10 shows the results for the experimental group on the post-test, the mean and standard deviation of the status of subject-based knowledge are 3.766 and 0.421, the mean and standard deviation of Interest of learning are 4.069 and 0.513, the mean and standard deviation of Student skills are 3.448 and 0.488, mean and standard deviation of Innovative Idea Generation are 3.052 and 0.450. And for the control group on the post-test, the mean and standard deviation of the status of the subject-based knowledge are 2.014 and 0.421, the mean and standard deviation of Interest of learning are 2.716 and 0.352, the mean and standard deviation of Student skills are 1.569 and 0.438, mean and standard deviation of Innovative Idea Generation are 1.155 and 0.235.

Table 9. Measurement of central tendencies (Pre-Test)

Pre-Test					
Group Name		SSB	IOL	SS	IIG
Experimental Group	Mean	2.6000	2.7931	1.5862	1.0517
	Std. Deviation	.48403	.36638	.37959	.15497
Control Group	Mean	2.0828	2.6638	1.5000	1.0517
	Std. Deviation	.52785	.37959	.42258	.15497

Table 10. Measurement of central tendencies (Post-Test)

Post-Test					
Group Name		SSB	IOL	SS	IIG
Experimental Group	Mean	3.7655	4.0690	3.4483	3.0517
	Std. Deviation	.42112	.51277	.48816	.45010
Control Group	Mean	2.0138	2.7155	1.5690	1.1552
	Std. Deviation	.42065	.35181	.43761	.23541
Compare with the control group, the Experimental Group Increased in %		87%	50%	120%	164%

It has been observed that in the pre-tests conducted before the study, the central trends for the experimental and control groups are almost identical, although there are slight differences in SSB, it is so small that they can be ignored. (Figure 4.)

On the other hand, the results of the post-test, taken at the end of the study show that the central trends in the experimental group were much higher than in the control group. This indicates that problem-based learning (PBL) increases subject-based knowledge, learning interests, skills, and innovative ideas.

Overall, the provided information gives an insight into the results of the study and the effectiveness of PBL in improving various variables. This indicates that project-based learning increases knowledge, interest of learning, skills, and innovative idea generation. As a result of RQ1, RQ2, RQ3, and RQ4, SSB (87%), IOL (50%), SS (120%), and IIG (164%) increased significantly. After obtaining these results, it is clear that the subject-based knowledge and learning interests, skills, and innovative ideas in the experimental group are much higher than in the control

group. Especially in skills and innovative ideas, students in the experimental group increased too much compared to the control group. (Figure 5.)

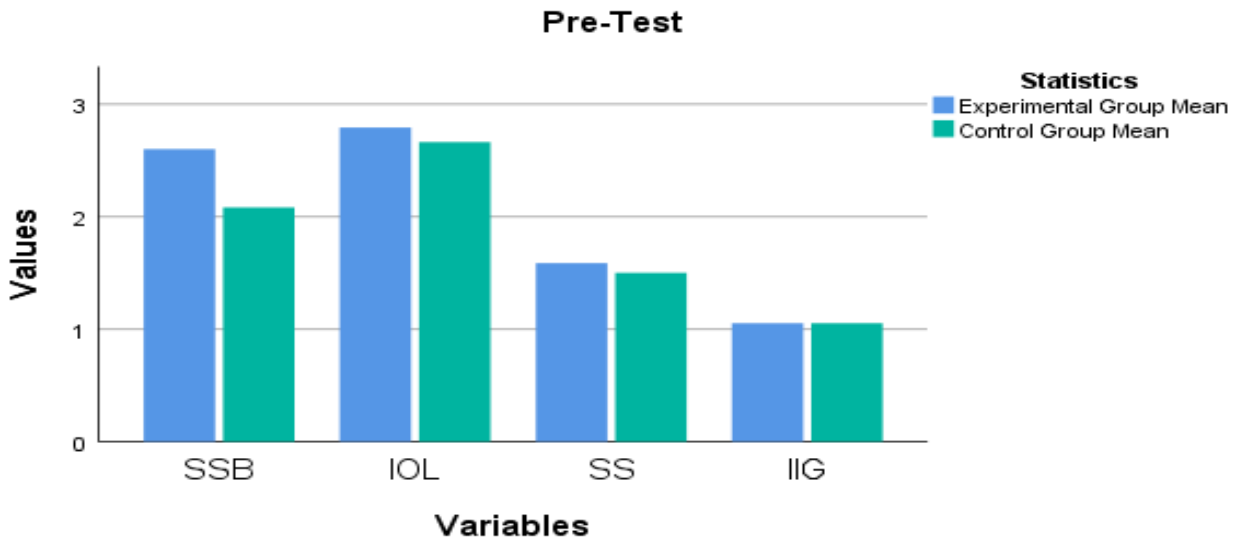


Figure 4. The mean value of the Pre-Test

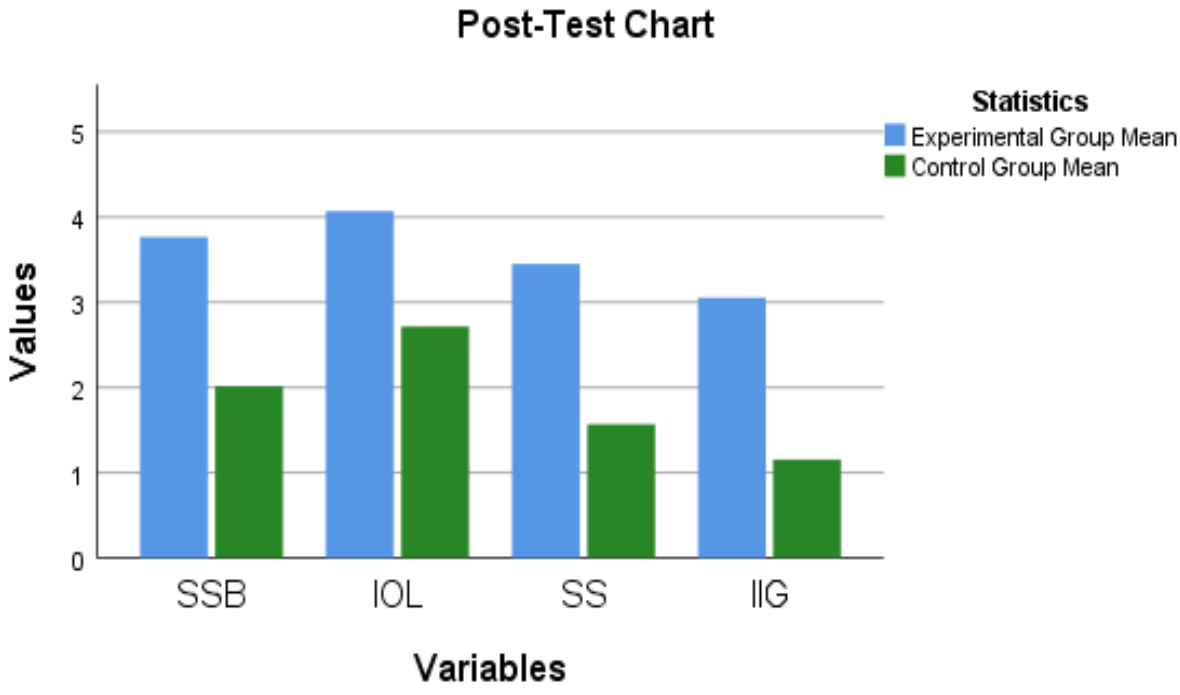


Figure 5. The mean value of the Post-Test

4.3 Measurement qualitative data are findings from the Questionnaire, FGD & KII

Based on the qualitative data, that were collected through the Questionnaire, FGD and KII, the following data were collected.

Most of them say,

1. PBL Increases the interest of learning.
2. PBL is easy to understand
3. PBL increases subject-based knowledge
4. Increase skills
5. Developed and increase innovative idea
6. Teachers should be properly trained on PBL.
7. Shortage of updated raw materials and machinery for PBL

Some of them say,

1. Not need to memorize a lot.
2. Developed and increase self-confidence
3. There is no detailed syllabus for PBL in the Board of Technical Education, Bangladesh.
4. PBL takes more time in class than in traditional classes.

Few of them say,

1. PBL classes are so much interesting and helpful for understanding so if any subject of a semester has PBL then it reduces interest in a subject that does not have a PBL.

Based on the data collection, the following qualitative thematic data analysis can be made:

Theme 1: Benefits of PBL

1. Most participants stated that PBL increases their interest in learning, as it is more engaging and interactive than traditional lectures.

2. Participants also stated that PBL is easy to understand and helps them develop subject-based knowledge and skills.
3. PBL was found to be effective in developing innovative ideas among students and boosting their self-confidence.

Theme 2: Teacher Training on PBL

1. Participants emphasized the importance of properly training teachers on PBL to ensure its effective implementation in the curriculum.
2. Participants highlighted the need for teachers to have a clear understanding of how to design, implement and assess PBL activities.

Theme 3: Shortage of Resources

1. Participants mentioned a shortage of updated raw materials and machinery for PBL, which can negatively impact the effectiveness of PBL activities.
2. Institutions were advised to buy some raw materials and machinery and also to partner with industry or other institutions to acquire necessary resources for PBL activities.

Theme 4: Time Management

1. Some participants stated that PBL activities take more time in class than traditional lectures, which can impact the overall schedule of the curriculum.
2. Teachers were advised to plan and structure PBL activities efficiently to optimize time management.

Theme 5: Lack of Syllabus

1. Some participants pointed out the lack of a detailed syllabus for PBL in the Board of

Technical Education, which can lead to inconsistency in PBL implementation across different institutions.

2. Participants suggested that a detailed syllabus should be provided to ensure that students and teachers have a clear understanding of the expectations and assessment criteria for PBL activities.

Theme 6: Impact on Other Subjects

1. Few participants noted that PBL classes are more interesting and helpful for understanding than traditional lectures, which can negatively impact their interest in other subjects that do not have PBL activities.
2. Institutions were advised to incorporate a mix of traditional lectures and PBL activities across all subjects to maintain students' interest in learning.

Finally, qualitative thematic data analysis reveals that PBL has significant benefits for students, including increased interest in learning, subject-based knowledge, skills, innovative ideas, and self-confidence.

Chapter 5: Conclusion

The purpose of this research was to examine the impact of project-based learning on students at polytechnic institutions in terms of their knowledge acquisition, interest in learning, skills development, innovative idea generation, and the advantages and disadvantages of this learning method. The study involved 63 students in their 4th semester, 7 teachers, and the head of the department of electronics technology at Barishal Polytechnic Institute. The data were collected using structured questionnaires with 27 closed-ended questions, evaluated on a 5-point Likert scale. The descriptive analysis of demographic information and measurements of central tendencies, including mean and standard deviation, were used to analyze the nature of the responses. A normality test analysis was carried out to examine the normality of the distribution groups.

The findings revealed that all the items on the questionnaire received positive responses from the participants, indicating that PBL increases knowledge acquisition, interest in learning, skills development, and innovative idea generation among polytechnic students. Although there are some disadvantages associated with PBL, this study suggests that they can be addressed by taking appropriate actions and researchers hope that based on the findings of this research; some recommendations will help PBL be more effective.

However, it's important to note that this research only focused on the 4th-semester students of electronics technology at Barishal polytechnic institute. Therefore, further research that collects data from a larger sample of students and institutions across the country can provide a more comprehensive understanding of the impact of PBL on polytechnic education. Such research can also help inform policymakers and educators on how to effectively integrate PBL into the curriculum and improve student outcomes. The results of this study have several implications for

educators and policymakers. Firstly, they highlight the importance of adopting PBL as an effective pedagogical approach in polytechnic institutions to improve student outcomes. Secondly, the findings suggest that PBL can promote active learning, critical thinking, and problem-solving skills. Finally, the study provides some practical recommendations to enhance the effectiveness of PBL in polytechnic institutions, such as providing training for educators and designing appropriate assessment strategies.

Chapter 6: Recommendation

Based on the quantitative and qualitative data analysis, the following recommendations can be made to improve the implementation of PBL in technical education:

1. Teacher training on PBL: To ensure effective implementation of PBL, it is essential to provide proper training to the teachers on how to design, implement, and assess PBL activities. Therefore, institutions should provide regular training to their teachers on PBL.
2. Develop a detailed syllabus for PBL: To ensure that students receive the necessary guidance on PBL, the Board of Technical Education should develop a detailed syllabus for PBL, including guidelines on the types of activities, assessment criteria, and expected learning outcomes.
3. Ensure availability of updated raw materials and machinery: To effectively implement PBL, institutions should ensure that updated raw materials and machinery are available to the students. Institutions can partner with industry or other institutions to acquire necessary resources.
4. Optimize time management during PBL: PBL activities may take more time in class than traditional lectures. To optimize time management, teachers should plan and structure PBL activities efficiently, so that students can complete the activities within a reasonable time frame.
5. Incorporate PBL in all subjects: To avoid the reduction of interest in subjects without PBL, institutions should incorporate PBL in all subjects to maintain students' interest in learning. This can be achieved by providing a mix of traditional lectures and PBL activities throughout the semester.

Researcher Recommendation some further research will make a clearer picture of PBL in the TVET sector of Bangladesh.

1. Investigate the effectiveness of project-based learning in other technology with different subjects and semesters. This study focused on 4th-semester electronics technology students, but it would be valuable to explore whether the findings are consistent across different subject areas and technology.
2. Conduct a longitudinal study to examine the long-term effects of project-based learning on student learning outcomes and career readiness. This would help to determine whether the benefits of PBL persist over time and prepare students for their future careers.
3. Investigate the factors that contribute to the successful implementation of project-based learning, including teacher training, resources, and institutional support. This would help to identify strategies for overcoming barriers and promoting the widespread adoption of this approach.
4. Explore the perspectives of students, parents, and employers on the value of project-based learning. This would provide insights into the perceptions and attitudes towards this approach and help to ensure that it meets the needs of all stakeholders.

Overall, implementing PBL in technical education can provide significant benefits to students and teachers. Therefore, institutions should take proactive measures to address the challenges and ensure the effective implementation of PBL.

References

Alkharusi and Al-Musawi. (2017). *Project-based learning and traditional instruction: A comparative study of academic achievement in a genetics course.* Journal of Biological Education, 51(3), 273-282.

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.* Longman.

Barron, B. J., Schwartz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., & Bransford, J. D. (1998). *Doing with understanding: Lessons from research on problem-and project-based learning.* Journal of the Learning Sciences, 7(3-4), 271-311.

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). *Effects of problem-based learning: A meta-analysis from the angle of assessment.* Review of Educational Research, 73(4), 123-157.

Duch, B. J., Groh, S. E., & Allen, D. E. (2001). *The power of problem-based learning.* Stylus Publishing.

Gallagher, S. A., & Stepien, W. J. (1996). *Content acquisition in problem-based learning: Depth versus breadth in American studies.* Journal of Educational Psychology, 88(2), 369-376.

Hmelo-Silver, C. E. (2004). *Problem-based learning: What and how do students learn?* Educational Psychology Review, 16(3), 235-266.

Hung. (2009). *The 9-step problem design process for problem-based learning: Application of the 3C3R model.* Educational Research Review, 4(2), 118-141.

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., & Ryan, M. (2003). *Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting proof in the pudding.* Journal of the Learning Sciences, 12(4), 495-548.

Larmer, J., Mergendoller, J. R., & Boss, S. (2015). *Setting the standard for project-based learning: A proven approach to rigorous classroom instruction.* ASCD.

O'Connor, A. (2012). *Project-based learning and adult English language learners.* Journal of Adolescent & Adult Literacy, 56(7), 577-586.

Razali, N. M., & Wah, Y. B. (2011). *Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors, and Anderson Darling tests.* Journal of Statistical Modeling and Analytics, 2(1), 21-23.

RB, K. (1998). *Principles and practice of structural equation modeling.* New York: Guilford Press.

Runco, M. A., & Jaeger, G. J. (2012). *The standard definition of creativity.* Creativity Research Journal, 24(1), 92-96.

Savery, J. R., & Duffy, T. M. (1995). *Problem-based learning: An instructional model and its constructivist framework.* Educational Technology, 35(5), 31-38.

Shapiro, S. S., & Wilk, M. B. (1965). *An analysis of variance test for normality (complete samples).* Biometrika, 52(3/4), 591-611.

Thomas, J. W. (2000). *A review of research on project-based learning.* Autodesk Foundation.

Torp, L. &. (2002). *Problems as possibilities: Problem-based learning for K-16. Alexandria: ASCD.*

Walker, A. &. Leary, H. (2009). *A problem based learning meta analysis: Differences across problem types, implementation types, disciplines, and assessment levels. Interdisciplinary journal of problem-based learning, 3(1), 6.*

APPENDIX A

A.1 Guideline of FGD

শিক্ষকদের ইন্টারভিউ এর জন্য আলোচনার গাইড লাইন

ব্যক্তিগত তথ্যঃ

- নাম।
- পদবী।

শিক্ষাগত যোগ্যতা ও প্রশিক্ষনঃ

- শিক্ষকতা।
- প্রশিক্ষন।

অভিজ্ঞতার সময়কালঃ

- শিক্ষকতার ক্ষেত্রে।
- প্রজেক্ট বেইসড লার্নি এর ক্ষেত্রে।

শিক্ষাদানের পদ্ধতিঃ

- তাত্ত্বিক শিক্ষাদানের পদ্ধতি।
- ব্যবহারিক শিক্ষাদানের পদ্ধতি।
- অ্যাসাইনমেন্ট নির্ধারনের পদ্ধতি।

মূল্যায়নের পদ্ধতিঃ

- তাত্ত্বিক মূল্যায়নের পদ্ধতি।
- ব্যবহারিক মূল্যায়নের পদ্ধতি।
- অ্যাসাইনমেন্ট মূল্যায়ন পদ্ধতি।

শিক্ষাদান ও মূল্যায়ন এর ক্ষেত্রে সমস্যা সমূহঃ

- তাত্ত্বিক শিক্ষাদানের ক্ষেত্রে সমস্যা।
- ব্যবহারিক শিক্ষাদানের ক্ষেত্রে সমস্যা।
- অ্যাসাইনমেন্ট নির্ধারনের ক্ষেত্রে সমস্যা।
- তাত্ত্বিক মূল্যায়নের ক্ষেত্রে সমস্যা।
- ব্যবহারিক মূল্যায়নের ক্ষেত্রে সমস্যা।
- অ্যাসাইনমেন্ট ক্ষেত্রে সমস্যা।

বর্তমানের শিক্ষা পদ্ধতি সংক্রান্তঃ

- ছাত্র-ছাত্রীদের আগ্রহ।
- ছাত্র-ছাত্রীদের বিষয় বুঝতে পারা।
- ছাত্র-ছাত্রীদের বিষয়ের উপর দক্ষতা।
- ছাত্র-ছাত্রীদের উদ্ভাবনী শক্তি।

প্রজেক্ট বেইসড লার্নি সংক্রান্তঃ

- ছাত্র-ছাত্রীদের আগ্রহ।
- ছাত্র-ছাত্রীদের বিষয় বুঝতে পারা।
- ছাত্র-ছাত্রীদের বিষয়ের উপর দক্ষতা।
- ছাত্র-ছাত্রীদের উদ্ভাবনী শক্তি।
- প্রজেক্ট বেইসড লার্নিং এর সুবিধা ও অসুবিধা।

A.2 Guideline of KII

বিভাগীয় প্রধানের ইন্টারভিউ ও প্রয়োজনীয় তথ্যের জন্য আলোচনার গাইড লাইন

বর্তমানের শিক্ষা পদ্ধতির তথ্যঃ

- তাত্ত্বিক ক্লাসে ছাত্র-ছাত্রীদের উপস্থিতি।
- ব্যবহারিক ক্লাসে ছাত্র-ছাত্রীদের উপস্থিতি।
- ক্লাস টেস্টের ফলাফল।
- ক্লাসের সময়ের পরিমান।
- ছাত্র-ছাত্রীদের বিষয়ের উপর দক্ষতা।
- ছাত্র-ছাত্রীদের উদ্ভাবনী শক্তি।

প্রজেক্ট বেইসড লার্নি এর তথ্যঃ

- প্রজেক্ট বেইসড লার্নিং ক্লাসে ছাত্র-ছাত্রীদের উপস্থিতি।
- ক্লাস টেস্টের ফলাফল।
- ক্লাসের সময়ের পরিমান।
- ছাত্র-ছাত্রীদের বিষয়ের উপর দক্ষতা।
- ছাত্র-ছাত্রীদের উদ্ভাবনী শক্তি।
- প্রজেক্ট বেইসড লার্নিং এর সুবিধা ও অসুবিধা।

শিক্ষার্থী ও শিক্ষার্থীদের তথ্যঃ

- শিক্ষার্থীদের সংখ্যা।
- মেয়ে শিক্ষার্থীদের সংখ্যা।
- প্রতিবন্ধী শিক্ষার্থীদের সংখ্যা।

যন্ত্রপাতি ও কাচামাল সংক্রান্তঃ

- বর্তমান শিক্ষা পদ্ধতির জন্য প্রয়োজনীয় যন্ত্রপাতি ও কাচামাল ।
- বর্তমান শিক্ষা পদ্ধতির জন্য প্রয়োজনীয় যন্ত্রপাতি ও কাচামালের প্রাপ্যতা।
- প্রজেক্ট বেইসড লার্নিং এর জন্য প্রয়োজনীয় যন্ত্রপাতি ও কাচামাল ।
- প্রজেক্ট বেইসড লার্নিং এর জন্য প্রয়োজনীয় যন্ত্রপাতি ও কাচামালের প্রাপ্যতা।

APPENDIX B

B.1 Questionnaries for Polytechnic Students

Effect on the quality and interest of students in learning through Project Based Learning: a case study of 4th-semester electronics technology at Barishal Polytechnic Institute.

৪র্থ পর্বের ইলেকট্রনিক্স টেকনোলজির শিক্ষার্থীদের জন্য প্রশ্নমালা

প্রিয় পলিটেকনিক শিক্ষার্থী,

কারিগরি শিক্ষা অধিদপ্তর ২০২২-২৩ অর্থবছরে অধিদপ্তরের রিসার্স উইং এর মাধ্যমে " Effect on the quality and interest of students in learning through Project Based Learning: a case study of 4th-semester electronics technology at Barishal Polytechnic Institute." শীর্ষক গবেষণা পরিচালনা করছে। এই গবেষণায় বাস্তব অভিজ্ঞতা ভিত্তিক তথ্য ও উপাত্ত সংগ্রহের জন্য এই প্রশ্নমালাটি তৈরি করা হয়েছে। কারিগরি শিক্ষার একজন শিক্ষার্থী হিসেবে বাস্তবভিত্তিক তথ্য সরবরাহের জন্য আপনাকে একজন গুরুত্বপূর্ণ তথ্যদাতা হিসেবে নির্বাচন করা হয়েছে।

প্রশ্নগুলোর কোন কোনটিতে তথ্য প্রদানের জন্য নির্দিষ্ট খালি জায়গা রয়েছে, আবার কোন কোন প্রশ্নের একাধিক বিকল্প তথ্য সরবরাহ করা হয়েছে। অনুগ্রহ করে খালি জায়গায় আপনার জানা তথ্য লিখুন এবং সরবরাহকৃত বিকল্প তথ্যের ক্ষেত্রে প্রযোজ্য বাম পাশের খালি বক্সে টিক দিন।

প্রিয় শিক্ষার্থী, এক্ষেত্রে আপনার সরবরাহকৃত তথ্য শুধুমাত্র গবেষণার কাজেই ব্যবহার করা হবে। আপনার নাম ও পরিচয় সম্পূর্ন গোপন রাখা হবে।

প্রশ্নমালাটি পূরণ করতে আনুমানিক ৩০ মিনিট সময় লাগতে পারে। অনুগ্রহপূর্বক প্রশ্নমালার নির্দেশনা অনুযায়ী যথাযথ ভাবে তা পূরণ করে গবেষণা কাজে সহায়তা করার জন্য বিনীত অনুরোধ করছি।

Effect on the quality and interest of students in learning through Project Based Learning: a case study of 4th-semester electronics technology at Barishal Polytechnic Institute.

৪র্থ পর্বের ইলেকট্রনিক্স টেকনোলজির শিক্ষার্থীদের জন্য প্রশ্নমালা

১। আপনার নামঃ _____

২। আপনার রোল নম্বরঃ _____

৩। পলিটেকনিক ইন্সটিটিউটে ইতিমধ্যে সমাপ্ত সেমিষ্টারগুলোতে অধ্যয়ন আপনার কাছে কেমন লেগেছে?

☐ খুব ভালো ☐ ভালো ☐ মোটামুটি ☐খারাপ ☐ খুবই খারাপ

৪। পলিটেকনিক ইন্সটিটিউটে ইতিমধ্যে সমাপ্ত সেমিষ্টারগুলোতে অধ্যয়নে পঠিত বিষয় গুলো কি রকম বুঝতে পেরেছেন?

☐ খুব ভালো বুঝতে পেরেছি ☐ ভালো বুঝেছি ☐ মোটামুটি বুঝেছি ☐তেমন একটা বুঝতে পারি নাই ☐ বুঝতে পারি নাই

৫। পূর্বের কোনো সেমিষ্টারে আপনি কি কোনো বিষয়ে প্রজেক্ট ভিত্তিক শিক্ষা গ্রহণ করেছেন?

☐ হ্যাঁ ☐ না

৫.১। ০৫ নং প্রশ্নের উত্তর হ্যাঁ হলে সেমিস্টার ও বিষয়ের নাম লিখুনঃ

_____

৫.২। ঐ বিষয়ে অধ্যয়ন আপনার কাছে কেমন লেগেছে?

☐ খুব ভালো ☐ ভালো ☐ মোটামুটি ☐খারাপ ☐ খুবই খারাপ

৫.৩। ঐ বিষয়ে আপনি কি রকম বুঝতে পেরেছেন?

☐ খুব ভালো বুঝতে পেরেছি ☐ ভালো বুঝেছি ☐ মোটামুটি বুঝেছি ☐তেমন একটা বুঝতে পারি নাই ☐ বুঝতে পারি নাই

৬। বর্তমান সেমিষ্টারে প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়ে আপনি কি প্রজেক্ট ভিত্তিক পাঠ গ্রহণ করেছেন?

☐ হ্যাঁ ☐ না

০৬ নং প্রশ্নের উত্তর হ্যাঁ হলে ৬.১ নং প্রশ্ন থেকে ৬.৬ নং প্রশ্নের উত্তর দিয়ে ০৭নং প্রশ্ন থেকে উত্তর শুরু করুন।

০৬ নং প্রশ্নের উত্তর না হলে নং ০৭ নং প্রশ্নের থেকে উত্তর শুরু করুন।

৬.১। আপনি প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয় সংশ্লিষ্ঠ কয়টি প্রজেক্ট করেছেন?

☐ ০১ টি ☐ ০২ টি ☐ ০৩ টি ☐ ০৪ টি ☐ ০৪ টির অধিক

৬.২। প্রজেক্ট এর কাজ কি আপনি কিভাবে করেছেন?

☐ আপনি নিজে করেছেন ☐ শিক্ষকের কিছু সহযোগিতা ছিল ☐ বেশীর ভাগ শিক্ষক করেছেন ☐ সম্পূর্ন প্রজেক্ট শিক্ষক ই করেছেন আপনি দেখেছেন ☐ আপনার গ্রুপের অন্য সহপাঠী করেছেন, আপনি বা শিক্ষক কেউ করেননি।

৬.৩। কোনো প্রজেক্ট কি নিজের চিন্তায় করেছেন?

☐ হ্যাঁ ☐ না

৬.৪। কোনো প্রজেক্ট কি নিজের চিন্তায় পরিবর্তন/পরিমার্জন করেছেন?

☐ হ্যাঁ ☐ না

৬.৫। নতুন এই পদ্ধতিতে পুর্বের পদ্ধতির তুলনায় কী কী সুবিধা আছে বলে আপনি মনে করেন তা লিখুন?

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৬.৬। নতুন এই পদ্ধতিতে পুর্বের পদ্ধতির তুলনায় কী কী অসুবিধা আছে বলে আপনি মনে করেন তা লিখুন?

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৭। প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়ে আপনার অধ্যয়নে আগ্রহের অবস্থা কী?

☐ যথেষ্ট আগ্রহ আছে ☐ অনেকটাই আগ্রহ আছে ☐ মোটামুটি আগ্রহ আছে ☐ সামান্য আগ্রহ আছে ☐ কোনো আগ্রহ নাই

৮। প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়ের তাত্ত্বিক ক্লাশে আপনার হাজিরা কেমন?

☐ ১০০% ☐ ৯০%-৯৯% ☐ ৮০%-৮৯% ☐ ৭০%-৭৯% ☐ ৭০% এর কম

৯। প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়ের ব্যবহারিক ক্লাশে আপনার হাজিরা কেমন?

☐ ১০০% ☐ ৯০%-৯৯% ☐ ৮০%-৮৯% ☐ ৭০%-৭৯% ☐ ৭০% এর কম

১০। প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়ে অধ্যয়ন আপনার কাছে কেমন লেগেছে?

☐ খুব ভালো ☐ ভালো ☐ মোটামুটি ☐খারাপ ☐ খুবই খারাপ

১১। প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়টি আপনি কি রকম বুঝতে পারছেন?

☐ খুব ভালো বুঝতে পেরেছি ☐ ভালো বুঝেছি ☐ মোটামুটি বুঝেছি ☐তেমন একটা বুঝতে পারি নাই ☐ বুঝতে পারি নাই

১২। প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়ের ব্যবহারিক ক্লাশের মাধ্যমে আপনার দক্ষতা বৃদ্ধির পরিমান

☐ যথেষ্ট বৃদ্ধি পেয়েছে ☐ অনেকটাই বৃদ্ধি পেয়েছে ☐ মোটামুটি বৃদ্ধি পেয়েছে ☐ সামান্য বৃদ্ধি পেয়েছে ☐ বৃদ্ধি পায় নাই

১৩। প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়ে আপনার উদ্ভাবনী চিন্তার অবস্থা কী?

☐ যথেষ্ট বৃদ্ধি পেয়েছে ☐ অনেকটাই বৃদ্ধি পেয়েছে ☐ মোটামুটি বৃদ্ধি পেয়েছে ☐ সামান্য বৃদ্ধি পেয়েছে ☐ বৃদ্ধি পায় নাই

১৪। প্রিন্সিপাল অফ ডিজিটাল ইলেকট্রনিক্স বিষয়টি সম্পর্কে নিম্নের প্রশ্নগুলোর উত্তর দিন

১৪.১। 2A5(16) সংখ্যাটিকে বাইনারী ও অক্টালে রুপান্তর করে দেখান।

১৪.২। ট্রুথ টেবিলের মাধ্যমে EX-OR গেট এর আউটপুট সমীকরনটি তৈরী করুন।

১৪.৩। P-MOS ও N-MOS এর মাধ্যমে NAND গেটের চিত্র ব্যাখ্যা করুন।

১৪.৪। BCD to 7-Segment ডিসপ্লের IC এর পিন ডায়াগ্রাম সহ 7-Segment ডিসপ্লের আউটপুট দেখান।

১৪.৫। 4-Bit Comparator IC এর পিন ডায়াগ্রাম সহ কম্পারেটর এর কাজ দেখান।

ধন্যবাদান্তে

গাজী সাইফুল ইসলাম

চিফ ইন্সট্রাকটর (ইলেকট্রনিক্স) ও

দলনেতা (গবেষণা কার্যক্রম)

বরিশাল পলিটেকনিক ইন্সটিটিউট, বরিশাল।

মোবাইলঃ ০১৭১২-৫৭৮৯৭৯

Email: gazisaifulislam@gmail.com

B.2 Observation Checklist

ছাত্র-ছাত্রীদের জন্য পর্যবেক্ষন চেকলিস্ট

১। ছাত্রের নামঃ _____

২। ছাত্রের রোল নম্বরঃ _____

৩। তাত্ত্বিক ক্লাসে উপস্থিতির শতকরা অনুপাতঃ

☐ ১০০% ☐ ৯০%-৯৯% ☐ ৮০%-৮৯% ☐ ৭০%-৭৯% ☐ ৭০% এর কম

৪। ব্যবহারিক ক্লাসে উপস্থিতির শতকরা অনুপাতঃ

☐ ১০০% ☐ ৯০%-৯৯% ☐ ৮০%-৮৯% ☐ ৭০%-৭৯% ☐ ৭০% এর কম

৫। তাত্ত্বিক ক্লাসে মনোযোগঃ

☐ যথেষ্ট মনোযোগ ☐ অনেক মনোযোগ ☐ মোটামুটি মনোযোগ ☐ সামান্য মনোযোগ ☐ মনোযোগ নাই

৬। ব্যবহারিক ক্লাসে মনোযোগঃ

☐ যথেষ্ট মনোযোগ ☐ অনেক মনোযোগ ☐ মোটামুটি মনোযোগ ☐ সামান্য মনোযোগ ☐ মনোযোগ নাই

৭। ব্যবহারিক ক্লাসে অংশগ্রহণের মনোভাবঃ

☐ সম্পূর্ণ নিজে করতে চায় ☐ শিক্ষকের কিছু সহযোগিতা চায় ☐ নিজে কম করে শিক্ষকের বেশি সহযোগিতা চায় ☐ নিজে কিছুই করতে চায়না শিক্ষকের করা দেখতে চায় ☐ অন্য সহপাঠীর মাধ্যমে করাতে চায়।

৮। ক্লাসে বোঝার ক্ষমতাঃ

☐ যথেষ্ট পরিমাণ আছে ☐ অনেকটাই আছে ☐ মোটামুটি আছে ☐ সামান্য আছে ☐ নাই

৯। দক্ষতার পরিমানঃ

☐ যথেষ্ট দক্ষ ☐ অনেকটাই দক্ষ ☐ মোটামুটি দক্ষ ☐ সামান্য দক্ষ ☐ দক্ষতা নাই

১০। উদ্ভাবনী চিন্তা শক্তির পরিমাণঃ

☐ যথেষ্ট পরিমাণ আছে ☐ অনেকটাই আছে ☐ মোটামুটি আছে ☐ সামান্য আছে ☐ নাই

(শিক্ষকের স্বাক্ষর)

APPENDIX C

C.1 Question from the questionnaire for data analysis

Q6.5: Advantage of PBL

Q6.6: Disadvantage of PBL

Q7: Interest of learning

Q8: Status of attendance in theoretical class

Q9: Status of attendance in practical class

Q10: Status of study in terms of liking

Q11: Understanding of the subject

Q12: Improvement of skills

Q13: Improvement of innovative idea generation

Q14: Rapid assessment for basic knowledge of the subject

C.2 Acronyms and Abbreviation

DTE	Directorate of Technical Education
TVET	Technical and Vocational Education & Training
FGD	Focus Group Discussion
KII	Key Informative Interview
SD	Standard Deviation
PBL	Project-Based Learning
SSB	Status of Subject-Based Knowledge
IOL	Interest of Learning
SS	Student Skills
IIG	Innovative Idea Generation
RQ1	Research Question 1

RQ2	Research Question 2
RQ3	Research Question 3
RQ4	Research Question 4
RQ5	Research Question 5
Q6.5	Question 6.5 of the Questionnaire
Q6.6	Question 6.6 of the Questionnaire
Q7	Question 7 of the Questionnaire
Q8	Question 8 of the Questionnaire
Q9	Question 9 of the Questionnaire
Q10	Question 10 of the Questionnaire
Q11	Question 11 of the Questionnaire
Q12	Question 12 of the Questionnaire
Q13	Question 13 of the Questionnaire
Q14	Question 14 of the Questionnaire
OCQ5	Observation Checklist Question 5
OCQ6	Observation Checklist Question 6
OCQ9	Observation Checklist Question 9
OCQ10	Observation Checklist Question 10