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Innovative Distance Learning: Leveraging PBL and the Flipped Classroom to Improve Student Outcomes and Motivation

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***Abstract**: This research aims to improve learning outcomes of students' cognitive abilities and to learn motivation through developing a Problem-Based Learning learning design with a flipped class model. This research uses a quasi-experimental type with a one-group pretest-post Test Design. The instruments used were (1) multiple-choice tests to measure students' cognitive abilities and (2) observation sheets to assess learning motivation using a motivation rubric developed based on the ARCS rubric. Student learning outcomes (post-test) are calculated using the t-test, followed by concluding the learning hypothesis. Based on the results of the hypothesis test, it was obtained 0.003 < 0.005, so it was supposed that there was a significant difference between the pre-test and post-test learning results. These results show that applying this learning method can improve student learning outcomes. Furthermore, from testing learning motivation, it was found that there was an increase from the first meeting to the third meeting. However, this study suggests the need for further research using the same model on other subjects, using a larger sample size, and including measurements of affective and psychomotor aspects.*

***Keywords**: Learning Design, Flipped Classroom, Cognitive, PBL, Motivation*.

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INTRODUCTION

The development of education in technological prospects is increasingly expanding beyond the boundaries of physical space (Da Silva, 2016; Silva et al., 2020). This condition necessitates a revision of the traditional education paradigm to make it more flexible, effective, and engaging (Aulya et al., 2023; Chiu et al., 2021; Purwasih et al., 2022). Changes in the learning process like this demand a bold and transformative shift towards innovative learning combined with technology, advancements in pedagogy, and dynamic learning strategies (Endris & Suhartini, 2022; I. P. Sari et al., 2023). This progress is not merely a necessity but also a means to ensure that education remains inclusive, accessible, and truly impactful in the digital era (Cheng & Wang, 2023; Grybauskas et al., 2022)

The COVID-19 pandemic has become a litmus test for education worldwide. It has posed a significant challenge to active, imaginative, and innovative education, which traditionally relied heavily on in-person classroom instruction (McMahon et al., 2022; E. R. Sari et al., 2022;

Yorkovsky & Levenberg, 2022). Conventional educational practices must be discarded to adapt to education in pandemic conditions(Abuhammad, 2020). This situation has led to the development of numerous new regulations and strategies by the government to support distance-based(Abuhammad, 2020; Adi et al., 2021) and virtual learning (Onggirawan et al., 2023; Osman, 2020).

Learning during the pandemic has led to distance learning, which takes advantage of technological advances and time efficiency (Assunção Flores & Gago, 2020; Yorkovsky & Levenberg, 2022). It cannot be denied that the COVID-19 condition has accelerated the implementation of innovative and technology-based educational changes (Haulia et al., 2022). Distance learning provides the opportunity to learn simultaneously in different spaces and times, as recognized by researchers (Adi et al., 2021; Assunção Flores & Gago, 2020). Thus, it is hoped that innovative distance education can open new horizons in learning outcomes and student motivation.

However, currently, there are significant gaps in influencing learning in the field of distance education. The problem of educator unpreparedness has become a significant polemic in distance learning (Adi et al., 2021). Educators cannot be denied as the key to success in activating students in the learning process (Eom, 2013). Therefore, research and trials are needed to implement distance learning using innovative and integrated pedagogical approaches successfully.

An innovative solution from an integrated pedagogical approach to overcome this gap is by using the Flipped Classroom and Problem Based Learning (PBL) models. This approach consistently demonstrates their capacity to engage students in the learning process actively. This approach equips students with strong fundamental knowledge, fostering a deeper understanding of the upcoming lesson material, as emphasized in previous research (Nurdiansyah & Widodo, 2013). Specifically, PBL provides problem-based learning experiences. Then, the Flipped Classroom approach provides innovative learning experiences through activities inside and outside the classroom. This learning integration can increase learning activities (Da Silva, 2016) and produce increased cognitive (Bintang et al., 2020; Huang et al., 2023; Sinaga et al., 2022; Suri et al., 2022) and student learning motivation (Bredenkamp et al., 2023; Burt, 2010; Dion Bahrudin & Insjaf Yogihati, 2022; Huang et al., 2023).

Several relevant studies reveal that the Flipped Classroom approach yields positive results in enhancing learning (Aşıksoy & Özdamlı, 2016; Leo & Puzio, 2016), increasing motivation to learn (Huang et al., 2023), and enhancing creative thinking skills (Inayah et al., 2021; Riwayani et al., 2019). Furthermore, research conducted by Damayanti et al (2020) demonstrates that a PBL approach based on the Flipped Classroom can stimulate students' creative thinking abilities. Research by Hu et al (2019) asserts that combining the Flipped Classroom and PBL learning models may be a superior choice to traditional methods. Consequently, multiple relevant studies have showcased the successful application of this learning model. However, limited research is available on the concurrent enhancement of cognitive and motivational learning outcomes through Flipped Classrooms and PBL.

Based on the previous explanation, these two learning models have their respective advantages, which can complement each other in the learning context. These two models are considered elements of learning design that, when combined, create a learning approach that

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enables students to learn with enthusiasm, active involvement, and strong motivation. In the learning design that will be implemented, the Flipped Classroom model is the primary basis for the learning process. In contrast, the PBL model is used as a framework for giving assignments to students during the learning process. This situation presents opportunities and incentives for us to research distance learning design, integrating PBL and the Flipped Classroom. The objective of this research is to improve student learning outcomes and motivation Kerinci.

METHOD

Research Design

This research is quantitative research with a quasi-experimental method. The design used is One Group Pretest and Posttest Design. The research design image can be seen as follows in Figure 1.

Figure 1 Research Design One Group Pretest and Post-test Design

Research activities begin by pre-testing students' abilities towards the concept. Second, by providing treatment, and third, by providing a post-test to determine the condition of the dependent variable after being given treatment (Yusuf, 2013). The experiment given refers to the design in Figure 1. The innovative distance learning design by integrating PBL and Flipped Classroom was carried out in several stages.

1. 1. In pre-class activities, students are given videos about PBL-based learning topics. This activity provides an overview of problems that can be brought into the classroom.
2. In the in-class stage, students are given PBL learning activities according to the learning syntax in class.
3. Post-class stage, students are given test questions to measure the student's cognitive level and motivation from the learning outcomes.

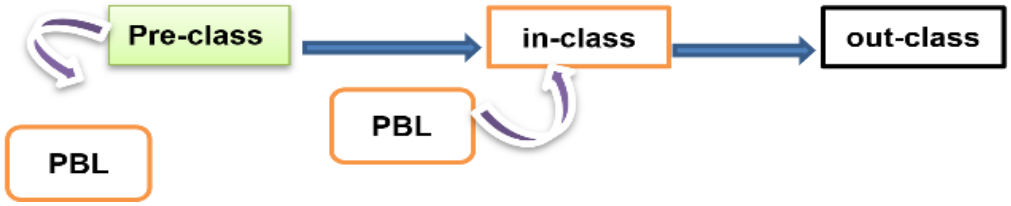

Figure 2 Combination Design of Flipped classroom and Problem-Based Learning model

Sample

Sampling used a technique uses purposive sampling. This technique was chosen because the research was conducted online and focused on improving specific learning outcomes. Apart from that, consideration of the difficulty of accessing the 5th-semester population during the pandemic was the reason for this special implementation. However, in this study the sample used was Class V B, totaling 24 people. The sample came from 16 women and 8 men in the class.

Instrument

The instruments used to collect data in this research were the results of students' cognitive tests in the form of questions and motivational observation sheets. Cognitive ability tests come from questions created based on material taught in class. While measuring motivation, it is carried out using four

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measurement indicators, namely attention, relevance, confidence and satisfaction (ARCS). This instrument has validity and reliability before being used in research. The measurement of learning motivation was carried out using the ARCS motivation instrument adopted from research (Setiawan & Anggraeni, 2019).

Data analysis technique

The data analysis technique used to examine the pretest and posttest results will then be analyzed using the normality test, homogeneity test, and hypothesis testing, specifically the t-test with independent samples test and the N-Gain test. The SPSS application version 26 was used to conduct this exam. This normality test was run to see if the data was normal. If the sig value > 0.05, then H0 is accepted, which means the data is normally distributed; if the sig value < 0.05, then H0 is rejected, meaning the data is not normally distributed. Then the N-Gain test was carried out to see the increase in pretest and post-test results.

Then, the motivation measurement is carried out three times after each learning process. Then, the results are analyzed by the following formula.

- Attention percentage $= \frac{SA}{N \,.\, XA \,.\, K} \times 100\%$
- Relevance percentage $= \frac{SR}{N \,.\, XR \,.\, K} \times 100\%$
- Confidence percentage $= \frac{SC}{N \,.\, XC \,.\, K} \times 100\%$
- Satisfaction percentage $= \frac{SS}{N \,.\, XS \,.\, K} \times 100\%$

Information:
SA : total average score on attention aspect statement
SR : number of average scores on relevance aspect statements
SC : number of average scores on the confidence aspect statement
SS : number of average scores on the satisfaction aspect statement
XA : number of attention aspect statements
XR : number of relevance aspect statements
XC : number of confidence aspect statements
XS : number of satisfaction aspect statements
N : number of protégés
K : maximum score of a statement

Based on the ARCS calculation formula, data is obtained in the form of achievement in the form of a percentage of achievement of each aspect classically. The data is categorized based on the following table 1.

Table 1 Percentage and quality of motivation

Success Percentage (%)	Motivational qualities
80-100	Very good
66-79	Good
56-65	Enough
40-55	Less
30-39	Fail

Source: Arikunto (2009)

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RESULT AND DISCUSSION

Observation of Learning Cognitive

At the beginning of learning (before the start of learning I) a Pretest (initial test) was carried out, the results of which were carried out a normality test using liliefors, so it was found that the distribution of data from the pretest results had a normal distribution of 0.18 > 0.05 and Post-test had normal distributioin of 0.011 > 0.05.

Table 2 Pre-test Normality Test

Pre-Test			**Post-Test**		
			Shapiro-Wilk		
Statistic	Statistic	**Sig.**	Statistic	df	**Sig.**
.897	.823	**.018**	.823	24	**.010**
Lilliefors Significance Correction					

Based on the research findings, we examined the mean scores for the pre-test, post-test, Gain, and N-Gain. The measurements revealed that out of the 24 students, the pre-test score averaged 54.75, while the post-test score averaged 83.50. Furthermore, the average N-Gain value was 0.63, suggesting a moderate impact. This Result indicates that the instructional model positively influences students' cognitive development. Additionally, with a Gain value of 63.19, the employed teaching model is adequate. For a more comprehensive dataset, please refer to Table 3, which displays the mean values for pre-test, post-test, Gain, and N-Gain.

Table 3: Mean values of pre-test, post-test, Gain, and N-Gain are presented below.

Data	**Pretest**	**Posttest**	**Gain**	**N-Gain**
N	24	24	-	-
Min. Value	40	80	-	-
Max.Value	70	90		
Average	54.75	83.50	63.19	0.63

Table 2 has shown that the use of a PBL and Flipped Classroom can affect improving student outcomes. Problem-solving learning can provide experience to meet the needs of students' thinking aspects in achieving scientific thinking skills (Widyastuti & Wuryanto, 2020). These results are supported by the findings of Damayanti et al. (2020) that the use of PBL and Flipped Classrooms can mutually improve students' thinking skills. In the learning process, we direct students through pre-learning activities to try to understand the problem and look for initial concepts and solutions to the material to be studied via Zoom. Students show very good activity. In line with that, Bintang et al. (2020) stated that a FIipped classroom can activate students to study independently before learning face to face

After establishing the normal distribution of the data, the analysis proceeds with further testing, specifically assessing students' cognitive learning outcomes. Based on the results of the hypothesis test, a significance level of 0.003 was obtained, which is less than 0.005. this result indicates a significant difference in learning outcomes. Consequently, distance learning

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innovation has a positive impact on students' learning outcomes. A detailed breakdown of these findings is in Table 3.

Table 3 Paired Samples Correlations (t-test)

		N	Correlation	**Sig.**
Pair 1	Pre-test – Post-test	24	.578	**.003**

Implementing this distance learning model has optimized all aspects of the learning process. We evaluate the progress made in the first session, aiming to enhance performance in subsequent sessions. This approach continues through Lesson , employing the Flipped Classroom method for learning preparation, implementation, and conclusion (Hu et al., 2019). During the preparation phase, researchers provide open materials for students to engage in independent thinking and learning before attending the classroom session. Students then document their questions and discoveries in video format, bringing them to the class as discussion topics for the lesson.

Furthermore, students are encouraged to revisit the material outside of class hours for enrichment purposes. Throughout the learning activities, instructors facilitate comprehensive preparation and discussion of all learning materials. The combination of the Flipped Classroom approach with PBL in distance education has shown excellent results, as evidenced by a marked improvement in students' cognitive learning outcomes.In learning activities, lecturers provide opportunities for students to discuss and prepare for learning properly. By using a *flipped classroom* approach and *problem-based learning*, students can be more mature in accepting learning because they already have sufficient initial knowledge. This is evidenced by the results of the post-test score, it can be seen that all students get very satisfactory scores.

Furthermore, according to Hu et al. (2019), the integration of the flipped classroom and PBL teaching approach may contribute to enhancing student performance and developing their various skills and abilities. These findings also validate that targeted learning methods have a solid potential to foster desired learning outcomes. Then, Using strategies in learning is prioritized to improve the quality of learning and help students grasp the material presented (Ananta et al., 2023; Dion Bahrudin & Insjaf Yogihati, 2022).

From the cognitive aspect, Flipped Classroom and PBL are learning designs that maximize student interaction. Flipped Learning is an innovative educational method that reverses the traditional learning process, moving activities usually carried out in the classroom outdoors, with class time provided to deepen understanding of complex concepts, which may have yet to be fully understood during outdoor activities. On the other hand, PBL encourages students to study according to the problems they find. This Learning encourages the creation of ideas, knowledge and experience in the learning process in the classroom (Bintang et al., 2020; Damayanti et al., 2020). Thus, from the research results, the problem-based learning model using the flipped classroom approach can maximize student learning outcomes and encourage students to be more active.

Observation of Learning Motivation

Learning motivation is observed through a motivation questionnaire filled out by students. Questionnaires are given at the end of the lesson. The analysis results from the questionnaire, which has been filled in 3 times, can be seen in Table 4 below.

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Table 4 Percentage of motivational observations on learning

Metting	Indicator	Average Percentage	Total Average	Categori
I	**Attention**	75,45	73,83	Good
	Relevance	63,23		
	Confidence	77,23		
	Satisfaction	79,2		
II	**Attention**	88,02	88	Very Good
	Relevance	90,63		
	Confidence	86,72		
	Satisfaction	88		
III	**Attention**	94,27	96	Veri Good
	Relevance	93,75		
	Confidence	96,88		
	Satisfaction	100		

Students' learning motivation increases with each learning cycle. Table 4 shows that learning I have increased student motivation but could be more optimal. Again, confidence scores 63.23 (enough), but the other three aspects already look good. Researchers improved by optimizing confidence aspects such as in discussions and question-and-answer processes regarding learning inside and outside the classroom. In the second and third lessons, there was a significant increase in student motivation. The average motivation score is 88 and 96 in the very good category. This value indicates that the student's learning motivation aligns with what is expected from applying innovative learning. We describe the increase in learning motivation in innovative distance learning with PBL and Flipped classrooms in Figure 2.

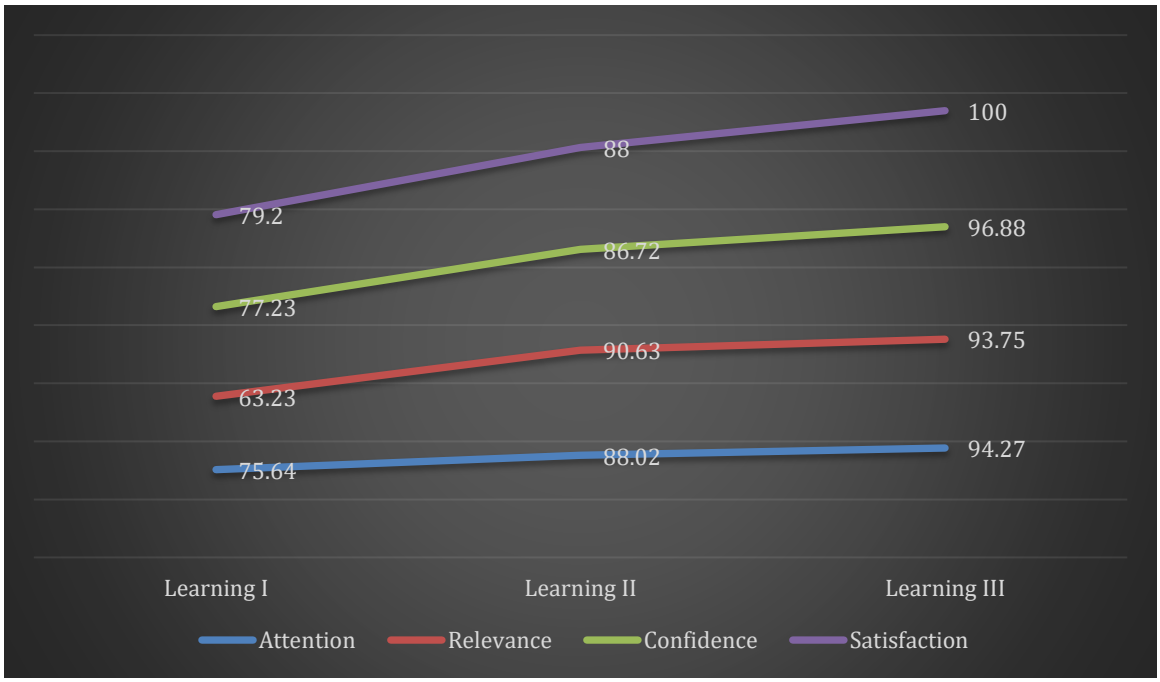

Figure 3. Increasing student learning motivation

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Motivation originates from internal processes that generate, guide, and sustain an individual's behavior over time (Dion Bahrudin & Insjaf Yogihati, 2022). Each student possesses varying levels of learning motivation (Setiawan & Anggraeni, 2019; Setiawan & Indriwati, 2018) Motivation is vital in motivating students to engage in the learning process. Many measures of motivation are drawn from Keller's ARCS approach, which was developed in 1984 (Keller, 2010). This approach encompasses four core elements: attention, relevance, confidence, and satisfaction (Keller, 2010; Leo & Puzio, 2016). These four components are the foundation for assessing the success of enhancing learning motivation.

During the implementation of the learning process in class, there was a visible increase in student motivation to learn. According to the results of the student questionnaire, there was an increase of 3% to 13% in motivation. This increase shows that the efforts made in the 2nd lesson learning, such as providing ice breakers in jargon and happy exercises, influence students' learning motivation. Giving Apperception by conveying learning objectives also greatly influences learning motivation because, at this stage, students can think about what they want to achieve after studying this material.

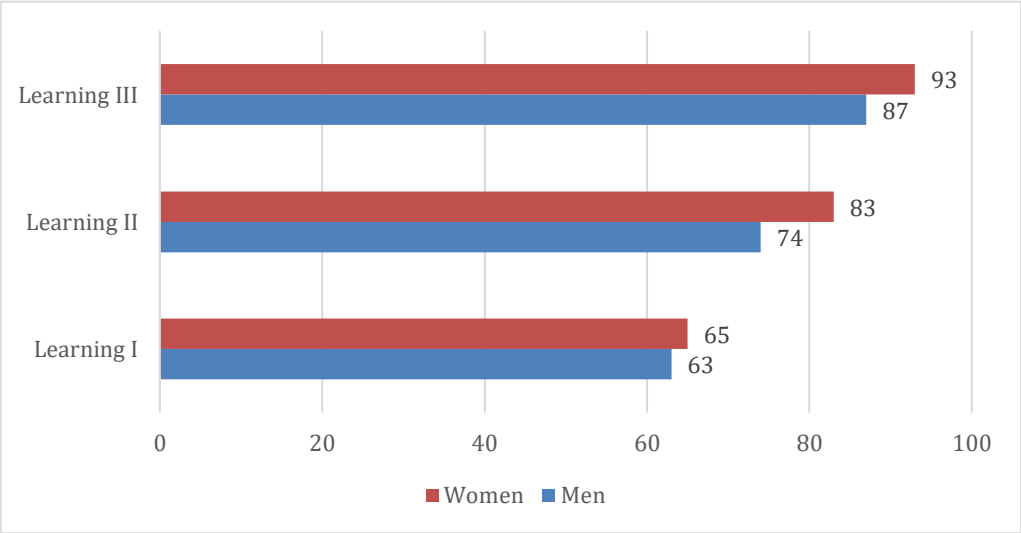

Figure 4 Motivation based on gender

We tried to differentiate the motivation index of students based on gender in each learning cycle in Figure 4. We found that women had a higher motivation index than men. However, both had a significant increase in learning motivation. The average motivation for men and women is enough category. In Study II, men had good abilities. In studies II and III, women have very good abilities.

In classroom learning, in general, learning motivation has increased. We tried to measure the gender aspect, namely between male and female students. We found interesting results that in lessons I and II, men had low motivation to learn when compared to women. We reviewed the learning process in that male students were less active than female students in the discussion and question and answer process in class. The level of self-confidence and attention of men in the learning process is lower than that of female students.

With the results obtained, we improved the second and third lessons. In the second lesson, we tried to focus more on male students' activeness in the learning process, so this led to an increase in male students' self-confidence in asking and answering questions during discussions. We conclude that gender is not the main problem here. However, activeness and focus in learning determine the success of learning. Based on the results obtained, the application of Flipped Classroom Model Learning Design and Problem-Based Learning in Open and Distance Learning (PTJJ) can be seen.

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CONCLUSION

Based on the research results, innovative distance learning through PBL and the Flipped classroom is known to have improved student learning outcomes and learning motivation. Learning has been carried out very well, and there has been improvement in each syntax prepared at the end of the learning phase. An increase in cognitive learning outcomes was obtained based on hypothesis test results of 0.003 < 0.005. Apart from that, the application of this innovative learning increases students' learning motivation from the first, second, and third lessons very good.

The results that have been obtained can illustrate how the innovative distance learning process can be carried out in a very narrow population, and the treatment is tailored to the needs of researchers. So, we realize there are still shortcomings that can be carried out in further research. Some research recommendations that can be carried out further include testing on more extensive samples. Apart from that, this research only has cognitive assessment aspects; it is hoped that future research observations can be made on affective and psychomotor aspects.

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