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The Effects of Flipped Learning on Student Achievement and Interest Across Different Learning Styles in Polytechnic Education

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Abstract

Flipped learning is designed to encourage students to be more active and be able to give more accurate answers. In addition, students will face fewer problems with their learning if they control their learning patterns. Hence, this study aims to identify the difference in the level of score achievement and interest of polytechnic students based on their learning styles. This research instrument consists of a questionnaire about interests and Index Learning Styles (ILS), ii) an e-learning guidebook, and iii) pre-test and post-test questions. MANCOVA analysis was used to answer the question to determine whether there was an increase in the level of student achievement and interest. The results of the MANCOVA analysis for the four breakdowns of student categories, PA-IV, PA-IA, PR-IV, and PR-IA, show no significant difference for the treatment and control groups. The use of the flipped learning method for the treatment group did not show an optimal effect, especially for their academic achievement and interest. This is because using the flipped learning method only takes eight (8) weeks. After looking into more details, if this method's flipped learning application for an extended period, the possibility of changes in academic achievement and student interest can be seen more significantly. However, to some extent, using this flipped learning method in the teaching and learning activity can improve academic achievement and student interest to be more outstanding and positive, especially for Electrical Technology courses.

1. Introduction

Education in Malaysia has changed and is getting stronger, especially in the 4.0 era. This change is in line with economic development. Learning in higher learning institutions is formal learning oriented to the achievement theory evaluated and confirmed by certain parties in addition to recognition through the degree awarded. The learning process is related to cognitive, affective, and psychomotor domains and occurs via training, interaction, and environmental experiences, leading to changes in behavior, thinking, and skills (Abdullah et al., 2020). The transformation process in education requires a drastic change from a conventional teaching and learning style to a modern one based on information and communication technology (ICT). Technology in education makes teaching materials interesting for students (Santi et al., 2023; Abdullah et al., 2023). Similarly, blended learning is

a process that allows students to learn anywhere and not necessarily in class or during lectures, discuss with anyone, and not be tired of pieces of information being learned. Hence, the flipped learning method is one of the blended learning methods.

A study conducted by Lai & Hwang (2016) for students who took an information systems management course in the United States of America found that the percentage of scores for quizzes (79%) and final exams (88%) increased among students who received the flipped learning method. The learning method applied to these students is discussion in small groups, group activities, quizzes, and exams. In addition, Lai and Hwang have discussed that the percentage of students in the control group (flipped learning) increased to allocate time for three to six hours a week to learn the content and materials prepared. This group also felt happy and had fun while learning the material. In addition, from the instructor's point of view, this method has given the instructor the space to approach students experiencing problems and can help students early overcome their problems. In the flipped learning method, the instructor becomes a facilitator and helps students not to fall behind in the learning process (Sun et al., 2023).

The findings of Lelinge (2023) show that students will not face problems if they control their learning patterns. In addition, the findings of Sun et al. (2023) show that the flipped learning method improved self-confidence or intrinsic motivation levels. A good learning atmosphere can give happiness to students and indirectly increase their interest in learning. Active processing is a dimension where students learn actively about the learning material by trying and applying it directly, and students tend to be more active in communicating and working in groups to discuss a topic (Birgili, Seggie & Oğuz, 2021). In this study, the active processing dimension refers to students who like to experiment with learning something and prefer group learning. Hu et al. (2021) stated that the dimension of reflective processing is students who tend to think and review lessons where they like to learn independently. In this study, reflective processing is the dimension where students prefer to think about solving problems. In addition, these students prefer to learn to think first and then explain to their friends. Research by Masegosa et al. (2024) showed that students with an active processing learning style can manipulate objects and experiment with existing materials and like to learn through trying methods. Students in the reflective category prefer to think about things first, evaluate the options available, and learn through the obtained analysis. In addition, students in the active category like to participate when the group discussion process takes place (Aflah & Rahmani, 2022), while students in the reflective category need space to understand what is being delivered by the instructor (Lyle et al., 2023).

Visual input is the dimension where students like to learn by looking at the information they learn in diagrams, writing, chart displays, computer displays, and video (Harisman et al., 2024). In this study, the visual input dimension refers to students who like to see visual presentations such as diagrams, flowcharts, and video presentations. In addition, these students also find it easier to remember things through vision. According to Yotta (2023), the auditory input dimension refers to students who like to learn by listening, discussions, and recordings that involve the sense of hearing. In this study, the auditory input is a dimension where students receive or give explanations in writing or orally. In addition, this student's characteristic is that it is easier to remember things through listening.

Findings from a preliminary study conducted by researchers at Mersing Polytechnic, Johor, Sultan Azlan Shah Polytechnic, Perak, Merlimau Polytechnic, Melaka, and Port Dickson Polytechnic, Negeri Sembilan found that the subject of Electrical Technology 1 (DET 1013) is a subject that always gets the percentage of passing with excellence is very low while the percentage of students who fail is high. The finding proven by data obtained by researchers from the examination unit of Sultan Azlan Shah Polytechnic shows that the number of students who got grade A was five people, grade B was seven people, grade C was 50 people, and several students who failed the subject this is a total of nine people. These are the students for the December 2019 session. In addition, the results of the researcher's interview with the students found that the teaching method applied by the instructor still used the "chalk and talk" method, where this method is no longer relevant. Most students cannot analyze the circuit diagram correctly and use inaccurate theories when solving exam questions because they need help understanding the concepts taught by the lecturer.

In addition, the researchers in this preliminary study interviewed several lecturers on this subject, and they stated that some topics are challenging for them to explain to students. Among those topics are Star-Delta Transformations, Kirchoff's Law, Thevenin's Theorem, Norton's Theorem, and Maximum Power Transfer Theorem. The difficulty experienced by these lecturers is because the students need help understanding the basic concepts in these theories; they cannot understand the circuit and need to be more creative in solving the questions given. Meanwhile, students need help in imagining the learning content. The difficulties experienced by these students learning. Based on this problem, the learning production based on blended learning can help students and lecturers to improve the learning achievement quality and their interest in the topic.

When viewed in more detail, the data shows that these technical students still need to perform satisfactorily. The consequences of this failure impacted the country because the graduates needed the creativity level and talent to get new and thoughtful ideas to create something highly innovative. Creativity and innovation generated by skilled workers are crucial to improving the country's technological development. In addition, applying science and

mathematics learning is one of the main components of creating new pioneers with excellence. The teaching techniques are also crucial during the learning process. Even so, some lecturers need to diversify teaching techniques in class. This teaching technique can help students adapt to their respective learning styles. For example, students have a visual learning style, although the lecturer applies an audio learning style. If the lecturer can identify the student's learning style, it will be easier for him to use the appropriate teaching strategy. This study identifies the difference in the improvement in score achievement level and the interest of polytechnic students based on their learning style. The objective of this study is to identify the difference in the level of score achievement and interest of polytechnic students based on their learning style:

i. To identify combinations of students who have active processing (PA) with visual input (IV) and active processing (PA) with auditory input (IA).
ii. To identify student combinations who have Reflective Processing (PR) with Visual Input (IV) and Reflective Processing (PR) with Auditory Input (IA).

2. Methodology

The research for this study used a quasi-experimental method with a non-equivalent control group post-test design (Pre Test-Post Test, Non-equivalent Control Group Design). The study design used is a quasi-experimental study using a quantitative approach. In this study, the researcher uses a quantitative approach to obtain facts using objective measurement and statistical analysis of numerical data as a guide to the researcher. The selection of polytechnics in Malaysia uses a purposive sampling method. Based on Polytechnic and the Ministry of Education Malaysia rules, the treatment and control groups cannot be selected using a random process. Next, the researchers used a pair of control and treatment respondent groups that had almost the same. However, the sample selection for the treatment and control groups uses a random method by the researcher.

UTHM's Faculty of Technical and Vocational Education granted the researcher permission. In addition, the researcher sent a letter to the Malaysian Ministry of Education to obtain permission to carry out the study at polytechnics. The researcher sent a permission letter from the Dean of UTHM's Faculty of Technical and Vocational Education and the Ministry of Education of the Polytechnic Division to the Polytechnic director and the Head of the Department of Electrical Engineering. The researcher chose 38 students from Merlimau Polytechnic in Malacca (Treatment Group) and 35 from Port Dickson Polytechnic in Negeri Sembilan (Control Group). The sample selection method to avoid the transfer of information during the teaching and learning process causes the study findings to be invalid or inaccurate. The reason for comparison is that only one class for the Electronic Engineering Diploma program is available at both polytechnics. The two lecturers involved in this study were selected based on their experience teaching this subject. Therefore, the researcher thinks these students are homogeneous based on the eligibility requirements to enter the polytechnic to avoid any issues. Before conducting the study, the researcher made sure that the respondents volunteered to be the respondents of this study. The research instrument consists of a questionnaire about interests and the Index Learning Style (ILS), ii) an e-learning guidebook, and iii) pre-test and post-test questions. Controlling all variables in a study is not possible. The response of the study object is affected by covariates, which are not controlled variables. MANCOVA is a covariance analysis with more than one dependent variable, and there are covariate variables as independent variables and must have a ratio or interval scale. In this study, two dimensions and four subscales of Felder & Silverman's Learning Style are the dependent variables, academic achievement and interest as covariates, and the group is the independent variable. MANCOVA analysis was used to answer questions to determine if there was an increase in student achievement and interest.

2.1 Pre-test

The pre-test is used to find students' prior knowledge of the topics that students studied. The researcher organized a pre-test to ensure that polytechnic students answered the questions smoothly. Accordingly, the students answered pre-test questions in one hour and thirty minutes. The questions involved are from the title Introduction to Electric Circuit, DC Equivalent Circuit, and Network Theorems.

2.1.1 Student Interest Measurement

A questionnaire was given to students to determine their interests and preconceptions towards Electrical Technology 1. This questionnaire consists of 30 items. The items are to identify the student's interest in the subject and implement the teaching and learning approach. The time allocated for students to answer these questions was fifteen minutes.

2.1.2 Learning Style Dimension Measurement

Students were given the Index of Learning Styles (ILS) test to find out the learning style dimensions of students. This ILS test was developed by Felder and Silverman in 1980. This ILS test contains a processing dimension

consisting of active and reflective, while the input dimension consists of visual and auditory. This test was conducted simultaneously for all students. The time allocated for students to answer this test is thirty minutes.

2.2 Treatment Implementation

The lecturer implemented the flipped learning method in the second week. The lecturers were given a flipped learning guidebook for Electrical Technology 1 and e-learning notes. In addition, before the lecturer started this treatment, the lecturer was given a briefing and training to handle the flipped learning method. The briefing and training given to the lecturers before the first week started again. The elements of flipped learning have been compiled and applied in the development process of the flipped learning method to understand and know the suitability of the learning style in terms of processing and student input. The learning process using the flipped learning method takes seven weeks. In addition, the treatment implementation at Merlimau Polytechnic, Melaka.

2.3 Control Implementation

The control group used conventional methods without using the flipped learning method, and control research implementation for the control group at the Port Dickson Polytechnic, Negeri Sembilan. Lecturers use lecturer-centered methods for the control group. The topics presented by the lecturer for the control group are the same as those studied by the treatment group. The research period for a control and treatment group is seven weeks.

2.4 Post-test

This research conducts treatment and control in the polytechnic for seven weeks. The evaluation of student performance and the student interest measurement in Electrical Technology 1 subject was tested using a post-test. The allotted time for students to answer this post-test is one hour and thirty minutes. As a result of the question, the effectiveness of the flipped learning method was obtained through the change in the performance of treatment students after using the flipped learning method. The student interest measurement in this third phase aims to find the increased student interest level in the teaching and learning process implemented by their lecturers based on their respective groups. The difference between the two teaching and learning approaches for these different groups can show the tendency of students' interest in the subject. The time allocated for students to answer the questionnaire is fifteen minutes.

3. Findings

This study aims to identify the difference in the level of score achievement and interest of polytechnic students based on their learning styles. This research instrument consists of a questionnaire about interests and Index Learning Styles (ILS), ii) an e-learning guidebook, and iii) pre-test and post-test questions. MANCOVA analysis was used to answer the question to determine whether there was an increase in the level of student achievement and interest.

3.1 The Difference in Achievement Level and for Students' Combinations with Active Processing (PA) with Input Visual (IV) and Active Processing (PA) with Auditory (IA) Input

Based on the results, the achievement value for both categories of students is significant $F(2, 37) = 6.165$, $p \leq 0.05$. This value shows a difference in the value of academic achievement before and after students attend the teaching and learning session. In addition, interest also indicates a difference between before and after teaching and learning. The value obtained is significant $F(2,37) = 6.418$, $p \leq 0.05$. The variables for the treatment and control groups indicate a significant $F(2, 37) = 669.016$, $p \leq 0.05$. This finding indirectly also shows that there is a difference between academic achievement and student interest in the treatment and control groups. The variable value for processing in Table 1 shows no significant difference with the value of $F(2, 37) = 0.412$, $p > 0.05$. The interaction variable Group*Processing refers to the combination of students processing actively with visual input and auditory input. The reading value obtained for this interaction in Table 1 shows that the value is not significant $F(2, 37) = 0.187$, $p > 0.05$. This result shows no difference between the group variables with combined students of PA-IV and PA-IA.

Table 1 *MANCOVA summary of differences in achievement scores (pre and post) and student interest by variable for PA-IV and PA-IA students*

Effect	Value	F	Hypothesis df	Error df	P
Academic achievement	0.250	6.165	2.000	37.000	0.005
Interest	0.258	6.418	2.000	37.000	0.004
Group	0.973	669.016	2.000	37.000	0.000
Processing	0.022	0.412	2.000	37.000	0.665
Group*Processing	0.010	0.187	2.000	37.000	0.830

$p \leq 0.05$

However, data analysis indicates differences between the variables. Table 2 shows the achievement score and interest of PA-IV and PA-IA combined students. The value of interest for Pré against post-interest is significant F (1, 38) = 4.405, $p \leq 0.05$. Pre-interest refers to the student's interest before participating in the learning activity, while post-interest refers to interest after participating in the learning activity. The value obtained shows a difference in the interest of students before and after following the learning. Even so, the variable pre-interest against a score of post-achievement shows a non-significant value F (1, 38) = 5.136, p >0 .05. The variable score for pre-achievement refers to the student's score achievement before and after attending the learning activity. The variable score for the pre-achievement against the score for the post-achievement is significant F (1, 38)

= 10.343, $p \leq 0.05$. This result proves an increase in student achievement scores after the learning activity. The pre-achievement score to post-interest results shows that the value obtained is not significant F (1, 38) = 0.330, p >0 .05.

The group variable refers to the treatment and control group against post-achievement scores and post-interest. The values obtained by these two variables are significant, namely F (1, 38) = 17.575, $p \leq 0.05$, and F (1, 38) = 1171.991, $p \leq 0.05$. Next, the interaction between the variable processing with post-achievement and post-interest scores shows that the value is not significant F (1, 38) = 0.198, p>0.05 and F (1, 38) = 0.424, p>0.05. The interaction between the variable Group*Processing with the variable score post-achievement and post-interest indicates significant values. The values are F (1, 38) = 0.022, p>0.05, and F (1, 38) = 0.288, p>0.05. The analysis results show no difference between the interaction of Group*Processing and the variable score for post-achievement and post-interest. However, the mean analysis before and after indicates a clear difference between the variables.

Table 2 *Comparison of achievement scores (pre and post) and interest for students with different processing of visual and auditory input*

Source	Dependent variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Pre-interest	Post-Achievement Score	57.544	1	57.544	4.405	0.043
	Post-Interest	23.166	1	23.166	5.136	0.290
Pre-achievement	Post-Achievement Score	135.104	1	135.104	10.343	0.003
	Post-Interest	1.486	1	1.486	0.330	0.569
Group	Post-Achievement Score	229.568	1	229.568	17.575	0.000
	Post-Interest	5286.212	1	5286.212	1171.991	0.000
Processing	Post-Achievement Score	2.585	1	2.585	0.198	0.659
	Post-Interest	1.299	1	1.299	0.424	0.519
Group*Processing	Post-Achievement Score	0.293	1	0.293	0.022	0.882
	Post-Interest	1.299	1	1.299	0.288	0.595
Error	Post-Achievement Score	496.375	38	13.063		
	Post-Interest	171.397	38	4.510		
Total	Post-Achievement Score	55641.500	44			
	Post-Interest	330878.000	44			

$p \leq 0.05$

Table 3 shows that the achievement and interest scores of combined PA-IV and PA-IA students for the treatment compared to the control group show a significantly higher mean score after the learning activity. The score values for group treatment are 40.000 and 40.571, while the score values obtained by group control are

29.281 and 30.083. For the post-interest variable, the scores obtained by the treatment group were 3.480 and 3.471, while the mean scores obtained by the control group were 2.144 and 2.156.

Table 3 *Comparison of mean scores on score achievement (pre and post) and student interest according to variables for PA-IV and PA-IA students*

Dependent Variable	Independent Variable	Group	N	Mean (Before)	Mean (After)	SD
Post-Achievement Score	PA-IV	Treatment	15	27.000	40.000	5.219
		Control	16	27.063	29.281	2.695
	PA-IA	Treatment	7	27.357	40.571	5.968
		Control	6	28.083	30.083	2.289
Post-Interest	PA-IV	Treatment	15	2.169	3.480	0.775
		Control	16	1.996	2.144	0.075
	PA-IA	Treatment	7	2.224	3.471	0.052
		Control	6	2.033	2.156	0.086

$p \leq 0.05$

3.2 The Difference in Achievement Level and for Students' Combinations with Reflective Processing (RA) with Visual Input (IV) and Reflective Processing (PA) with Auditory (IA) Input

Based on the results in Table 4, the achievement value for both categories of students is significant F (2, 22) = 2.162, $p \leq 0.05$. This value shows a difference in the value of the achievement score before and after the students follow the teaching and learning activity. In addition, interest also indicates a difference between before teaching and learning and after teaching and learning. The value obtained is significant F (2,22) = 0.393, $p \leq 0.05$. The variables for the treatment and control groups are significant F (2, 22) = 768.839, $p \leq 0.05$. This finding indirectly shows a difference between the achievement score and student interest in the treatment and control groups. The variable value for processing in Table 4 shows no significant difference with the value of F (2, 22) = 0.738, $p > 0.05$. After the researcher analyzed the data using the meaning before and after scores shown in Table 4, this result proved that there was a difference in the achievement score and interest of the combined PR-IV and PR-IA students. The interaction variable Group*Input indicates the combination of students' reflective processing with input visual (IV) and input auditory (IA). The value obtained for this interaction in Table 4 shows that the value is not significant F (2, 22) = 1.100, $p > 0.05$. This finding shows no difference between the variables of the Group with PR-IV and PR-IA combined students.

Table 4 *Summary of MANCOVA on score achievement comparison (pre and post) and student interest according to variables for PR-IV and PR-IA students*

Effect	Value	F	Hypothesis df	Error df	Sig
Achievement Score	0.164	2.162	2.000	22.000	0.001
Interest	0.355	0.393	2.000	22.000	0.004
Group	0.986	768.839	2.000	22.000	0.000
Input	0.078	0.738	2.000	22.000	0.410
Group*Processing	0.091	1.100	2.000	22.000	0.351

$p \leq 0.05$

However, after analyzing more carefully, it was found that there is a difference between the variables. Table 5 shows the readings for achievement scores and students' interest combined with PR-IV and PR-IA. After considering the value of the pre-interest against the post-interest, the result was significant F (1, 23) = 0.058, $p \leq 0.05$. Pre-interest refers to the student's interest before participating in the learning session, while post-interest refers to the interest after participating in the learning session. The value obtained shows that there is a difference in student Interest before and after following the learning. Even so, the pre-interest variable against the post-achievement score shows a non-significant value F (1,23) = 5.870, $p>0.05$. The variable score pre-achievement refers to the student's achievement score before and after participating in the learning activity. The pre-achievement score variable against the post-achievement score is significant F (1, 23) = 72.602, $p \leq 0.05$.

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This result proves an increase in achievement scores after students attend the learning session. For the variable score, pre-achievement to post-interest shows that the value obtained is not significant F (1, 23) = 0.003, p>0.05. The group variable refers to the treatment and control group for post-achievement and post-interest scores. The values obtained by these two variables are significant, namely F (1, 23) = 672.844, p ≤ 0.05, and F (1, 23) = 7.097, p ≤ 0.05. Next, the interaction between the processing variable with the score post-achievement and post-interest shows that the value is not significant F (1, 23) = 12.235, p>0.05 and F (1, 23) = 0.004, p>0.05. The interaction between the variable Group*Processing and the variable score post-achievement and post-interest each shows a non-significant value. The values are F (1,23) = 8.261, p>0.05, and F (1,23) = 0.006, p>0.05. Although the analysis results show no difference between the interaction of Group*Processing with the variable score post-achievement and post-interest after being analyzed using the mean score before and after, it shows a clear difference between the variables.

Table 5 *Comparison of scores achievement (pre and post) and interest for processing students with different visual and auditory input*

Source	Dependent variable	Type III Sum of Squares	df	Mean Square	F	Sig
Pre-interest	Post-achievement Score	5.870	1	5.870	0.348	0.561
	Post-interest	0.058	1	0.058	13.177	0.01
Pre-achievement score	Post-achievement Score	72.602	1	72.602	4.300	0.004
	Post-interest	0.003	1	0.003	0.734	0.401
Group	Post-achievement Score	672.844	1	672.844	39.853	0.000
	Post-interest	7.097	1	7.097	1605.743	0.000
Processing	Post-achievement Score	12.235	1	12.235	0.725	0.404
	Post-interest	0.004	1	0.04	0.849	0.366
Group* Processing	Post-achievement Score	8.261	1	8.261	0.489	0.491
	Post-interest	0.006	1	0.006	1.410	0.247
Error	Post-achievement Score	385.074	23	16.883		
	Post-interest	90.304	23	0.004		
Total	Post-achievement Score	1358.741	28			
	Post-interest	10876.679	28			

p ≤ 0.05

Table 6 shows that the achievement score and interest of combined PR-IV and PR-IA students for the treatment group compared to the control group showed a significantly higher mean score after the learning activity. The score values for group treatment are 43.500 and 41.500, while the score values obtained by group control are 31.857 and 36.300. For the post-interest variable, the scores obtained by the treatment group were 3.458 and 3.493, while the mean scores obtained by the control group were 2.157 and 2.161.

Table 6 *Comparison of the mean score of student achievement and interest score according to variables for PR-IV and PR-IA students*

Dependent Variable	Independent Variable	Group	N	Mean (Before)	Mean (After)	SD
Post-achievement Score	PR-IV	Treatment	11	27.136	43.500	6.012
		Control	7	29.071	31.857	1.248
	PR-IA	Treatment	5	27.700	41.500	4.077
		Control	6	28.250	31.083	2.245
Post-Interest	PR-IV	Treatment	11	2.158	3.458	0.790
		Control	7	2.019	2.157	0.896
	PR-IA	Treatment	5	2.120	3.493	0.435
		Control	6	2.044	2.161	0.998

4. Discussions

Learning styles influence students' academic achievement (Oliveir et al., 2023). An individual's learning style is independent according to the individual's ability and must satisfy the individual's needs until reaching the desired level of understanding. The learning style has provided a learning process that can challenge students and respond to their academic achievement (Nguyen, 2021). Learning style is an important concept and needs to be focused on in education because it is the main factor in shaping individual quality. The active and reflective dimensions are processing stages for students. It means that the student tends to process information actively or reflectively. Students quickly understand when discussing in groups, and they also prefer working in groups and doing activities such as carrying out projects. Meanwhile, reflective students tend to process information before understanding it deeply. This group also likes to work alone.

These visual and auditory dimensions differentiate students based on the medium of information delivery that students prefer. As already mentioned, there are many ways for students to receive input. According to Cavite and Gonzaga (2023), students with a visual learning style like demonstrations and help with explanations. Students have this learning method to give high focus when there is movement or action, even if the environment is noisy. Students with a visual learning method type are more likely to illustrate information when the instructor uses diagrams, shapes, and symbols for tools such as graphs, flow charts, hierarchical models, and arrows. According to Ribosa and Duran (2022), the construction of teaching materials for students in the visual category focuses more on elements such as pictures, writing, and videos. Students in this category use the help of diagrams during the explanation process, and they have a high imagination to describe something and are more creative in solving something. In addition, the use of animation elements and interactive buttons also helps in this learning process. For students in the auditory category, the voice elements used are very appropriate. Besides, the use of text can support conveying information. In the auditory category, students focus more when the instructor starts their lecture (Roark et al., 2023; Munna & Kalam, 2021). These students, too, tend to listen rather than write notes given by their lecturers. In addition, students of this group discussed with each other after the lesson session to understand their lecturer's explanation more clearly. These students will also be easily distracted from their learning focus when there is noise.

According to Birgili, Seggie, and Oğuz (2021), there are several advantages to this flip learning process. Among them is the time required for the learning and teaching process to increase. The teaching and learning goal set by the lecturer to complete the course syllabus. Next, this two-way or student-centered learning process will make students active during the learning process. Students can ask questions and discuss them directly with lecturers and friends. The results that have been analyzed prove that students from the treatment group who use the flipped learning method can improve their academic achievement and interest in the subject of Electrical Technology 1. The flipped learning method is learning that uses an active learning style. Active learning encourages students to use their minds to study ideas and solve problems (Rossi et al., 2021). Active learning refers to students not only as listeners and taking notes but students also need to participate in learning in the classroom. In this context, teaching and learning are student-centered, while the teacher only acts as a facilitator. Therefore, in the context of active learning, teachers play a crucial role in designing practical lessons to improve the achievement level of their students. MANCOVA analysis was used to answer questions to determine if there was an increase in student achievement and interest.

5. Conclusions

The research finding proved that students from the treatment group who used the flipped learning method could improve their academic achievement and interest in the Electrical Technology 1 subject. However, the flipped learning method for the treatment group did not show such an optimal effect, especially on their academic achievement and interest. The usage period allocated to use this method needs to be increased. The duration of using this method is only eight weeks. This study concluded that with the long-lasting duration of using this method in learning activities, the possibility of changes in academic achievement and student interest is more significant. However, this flipped learning method in teaching and learning activities can increase academic achievement and student interest to be more outstanding and positive, especially for Electrical Technology 1. This result indicates that the flipped learning method can improve student performance and achievement by encouraging engagement, student interaction, and cooperation in learning. The findings of the treatment and control groups in this study were different. Their interest control group does not increase after the learning process. These results show that the academic achievement of the control group students is only at the passing grade. Everyone has a different learning style. The learning process of students is practiced directly through their learning style. Therefore, using correct learning methods can contribute to different learning outcomes.

The researcher hopes this study can provide benefit and insight into the improvement process to the Ministry of Higher Education Malaysia, especially in the field of Technical and Vocational Education, and help lecturers and students at polytechnics improve academic achievement and student interest, especially in Electrical Technology courses 1. The findings of this study can provide information to the Malaysian Ministry of Higher Education,

especially in the field of Technical and Vocational Education, and help lecturers and students in polytechnics need to implement teaching and learning methods with the help of active activities for engineering courses, especially for subjects Electrical Technology lesson 1. This reason is because identifying the student's learning style and the instructor's teaching style plays a crucial role in meeting the needs of students to improve their academic performance and interests. Based on the result, the flipped learning method can help the technical education department improve and further teaching techniques compatible with the student learning style. In this study, we only focus on five active activities compatible with the teaching and learning of Electrical Technology 1. The syllabus involved is only for chapters 1 to 2. For future studies, researchers can use other active activities. Based on the title or measure of teaching and learning of the subject.

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Conflict of Interest

There is no conflict of interest regarding the publication of the paper.

Author Contribution

The contribution to the paper is as follows: ***Study conception and design:*** *Ahmad Rizal Madar, Hashima Hamid, Noor Azyani A.Jalil;* ***Data collection:*** *Noor Azyani A.Jalil, Ahmad Rizal Madar;* ***Analysis and interpretation of results:*** *Ahmad Rizal Madar, Hashima Hamid, Noor Azyani A.Jalil, Mohd Hasril Amiruddin, Nurhanim Saadah Abdullah, Setiyani;* ***Draft manuscript preparation:*** *Ahmad Rizal Madar, Hashima Hamid*

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