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The Effectiveness of the Flipped Learning Method on the Subject of Electrical Technology 1 among Polytechnic Students with Different Learning Styles

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KEYWORDS

FLipped Learning, Technology in Education, TVET, Electrical Technology, Learning Style.

The preliminary study findings found that Electrical Technology 1 (DET 1013) is a subject that always has a meager percentage of students who pass with distinction, while the percentage of students who fail is high. Students face problems in imagining the learning content delivered by the lecturer. Blended learning is a combination of traditional and technological methods. Among the blended learning methods that are usually used is flipped learning. The research aim is to identify the effectiveness of the flipped learning method on electrical technology 1 among students with different learning styles. This study uses a quasi-experimental method with a non-equivalent group pre-post test design. The research sample selected uses the purposive sampling method. Before and after flipped learning was implemented, questionnaires about interest contained 30 items about interest in Electrical Technology 1 subject, given to students in the treatment and control group. The analysis used is MANCOVA, using the SPSS software version 25. The analysis results show that there is a difference between before the start of the learning session and after the learning session. Therefore, the flipped learning method can help students who have different learning styles. Indirectly increases their academic achievement and interest in Electrical Technology 1. Besides, can instill elements of active student involvement in self-development and motivation to build the strengthening basis of their thinking and memory systems.

1. Introduction

Technical and vocational education and training (TVET) is a field that has existed for a long time in the Malaysian education system. Various efforts have been implemented by the government, including establishing polytechnics around Malaysia and providing courses that can help the community improve their respective skills. Polytechnic institutions are among the many institutions that offer engineering fields such as electrical, civil, and mechanical engineering. This is because one of the missions of polytechnics is to produce highly skilled and knowledgeable students in various fields and show interest in improving their skills [1,2]. One of the reasons polytechnic graduate students drop out is that students fail to understand and master what they learn [3]. Various approaches have been taken to improve students' understanding of what they learn, one of which is the delivery of learning using the blended learning method. Blended learning is a combination of traditional and technology methods with methods such as multimedia, CD ROM, video streaming, virtual classes, voice mail, email, and telephone conferences [4, 5, 6].

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Among the blended learning methods that are usually used is the flipped learning method [7]. The flipped method is one of the learning methods that use an interesting approach [8], because the information delivery process uses active activities that can stimulate interest and increase students' academic achievement [9, 10]. According to [11], there are several benefits to this flip learning process. Among them is the time required for the learning and teaching process to increase. The goal set by the lecturer to complete the course syllabus is achieved. Next, this two-way or student-centered learning process makes students active during the learning process. This is because students can ask questions and discuss directly with lecturers and friends. The use of technological materials will also increase among students if they apply this learning method [12]. Especially in the field of engineering, how to process information and how to receive information is very important. To fulfill both of these, students must know their respective learning styles. According to [13], when students recognize their learning style it can help and increase students' confidence in managing their learning activities. The objective of this study is to identify the difference between the level of improvement in score achievement (pre and post) and the interest of polytechnic technical students between the treatment group and the control group based on learning style:

i. Active processing (AP)?
ii. Reflective processing (RP)?
iii. Visual input (VI)?
iv. Auditory input (AI)?

2. Methodology

This study uses a quasi-experimental method with a non-equivalent group pre-post test design (Pre Test-Post Test, Non-equivalent Control Group Design). The population in this study is all Diploma in Electronic Engineering (Communications) students at Polytechnic in Malaysia. There are 32 polytechnics in Malaysia, but only 15 polytechnics offer Diploma in Electronic Engineering (Communications) courses. To the selection of polytechnics in Malaysia use the purposive sampling method. The cluster represents the class of Diploma in Electronic Engineering (Communications) program students. Purposive sampling was used in selecting the study sample: the Treatment Group (Diploma Students of Merlimau Polytechnic, Melaka) and the Control Group (Diploma Students of Polytechnic Port Dickson, Negeri Sembilan).

Table 1 Research Sample

	Politechnic	Sample
1	Politeknik Merlimau, Melaka (PMM)	38
2	Politeknik Port Dickson, Negeri Sembilan (PPDNS)	35
	Total	73

Pilot study

A total of 38 Diploma in Electronic Engineering (Communication) Semester 1 students from Mersing Polytechnic in Johor were used as the treatment group, and 36 Diploma in Electronic Engineering (Communication) Semester 1 students from Sultan Azlan Shah Polytechnic, were used as the control group. Accordingly, to identify the reliability of the questionnaire that covers questions about interest. In this study, the data obtained was analyzed using the Statistical Package for Social Science (SPSS) version 25.0. The reliability value obtained is over 80%, and all instruments can be used in this study. The reliability values for this research instrument are shown in Table 2.

Table 2 Research Sample

No	Instruments	Tendencies (%)
1	Flipped Learning Guidebook	92
2	E-Notes	90

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3	Interest Questionnaire	83.5
4	Pre/post test	92.5

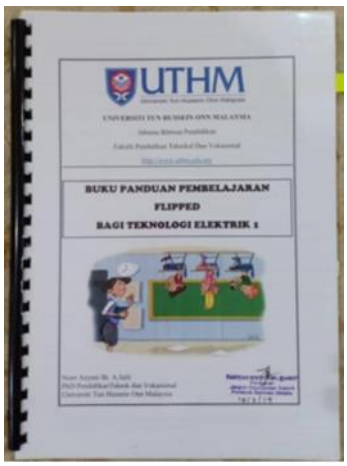

Fig. 1. Flipped Learning Guidebook for Electrical Technology 1

Measurement of Student Interest

A questionnaire was given to students to find out the student's interests and preconceptions towards the subject of Electrical Technology 1. The questionnaire about interest contains 30 items about interest in Electrical Technology 1, which uses a Likert 4 scale. The answer scale is based on a Likert Scale that has four answer score values, namely Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). A set of questionnaires about interest contains 30 items about interest in Electrical Technology 1, given to students in the treatment and control group before and after flipped learning was implemented. The items that are built are aimed at the student's interest in the subject and also the teaching and learning approach implemented. The time allocated for students to answer these items is fifteen minutes.

The implementation period is seven weeks, from the second to the eighth week. The method of implementation of this phase is as follows:

i. Treatment Implementation

The use of the flipped learning method by the lecturer since the second week. Lecturers have been provided with 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 appropriateness 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 implementation of this treatment was carried out at Merlimau Polytechnic, Melaka.

Fig 2. Treatment activities that have been carried out

Controls Implementation

The control implementation takes place in the second phase. The control implementation is carried out on students using conventional methods. The method used by lecturers for the control group is through lectures from lecturers or lecturer-centred. The topics presented by the lecturer for the control group are the same as those studied by the treatment group. The duration of the implementation of this control method is also equivalent to the duration of the treatment which is for seven weeks. The implementation of this control method is carried out at Polytechnic Port Dickson, Negeri Sembilan.

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After the completion of the treatment and control methods for seven weeks, the evaluation of student performance and the measurement of student interest in the subject of Electrical Technology 1 has been carried out. Measurement of student improvement and understanding was tested using a post-test. Both groups sat the same post-test. The time allocated 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 can be obtained through the change in the performance of treatment students after using the flipped learning method.

Pre-test

The pre-test that has been implemented on students is aimed at finding out their prior knowledge of the topics that have been studied. This test was administered by the researcher and the time allocated for students to answer these questions was one hour and thirty minutes. The questions involved are from the Introduction To Electric Circuit and DC Equivalent Circuit And Network Theorems.

The pre-test is a test given to all students in the treatment and control groups before the flipped learning method is used in learning. The pre-test aims to identify the knowledge level of students in the treatment group and the control group about the subject of Electrical Technology 1. The pre-test questions contain 33 questions related to the subject matter of Electrical Technology 1, where 15 questions (1-15) are multiple-choice questions consisting of 4 answer choices: A, B, C, and D. Meanwhile, 18 questions (16-33) are open questions that require students to give detailed The researcher used Statistical Package For Social Sciences (SPSS) version 25.0 to analyze the data in this study. The analysis used is the statistical method Multivariate analysis of covariance (MANCOVA).

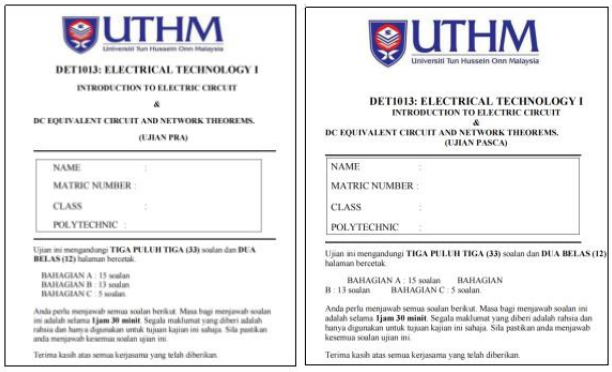
3. Results

The research objective is to identify the difference between the level of improvement in score achievement (pre and post) and the interest of polytechnic technical students between the answers related to questions about the Electrical Technology 1.

Post-test

The post-test is the same test in terms of format and structure as the pre-test. This test was conducted on all students whether students from the treatment group or the control group. The post-test aims to identify the knowledge level of students in the treatment group and the control group after applying the flipped learning method to the treatment group and the conventional method to the control group. Question

The post-test is the same as the pre-test questions. However, the order or position of the questions has been modified. This is intended to prevent students from remembering the following questions. The post-test questions also contain 33 questions related to Electrical Technology 1, and 18 questions are open questions that require students to give detailed answers related to questions about Electrical Technology 1.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DET1013: ELECTRICAL TECHNOLOGY 1
INTRODUCTION TO ELECTRIC CIRCUIT
&
DC EQUIVALENT CIRCUIT AND NETWORK THEOREMS.
(UJIAN PRA)
NAME :
MATRIC NUMBER :
CLASS :
POLYTECHNIC :
Ujian ini mengandungi TIGA PULUH TIGA (33) soalan dan DUA BELAS (12) halaman bercetak.
BAHAGIAN A : 15 soalan
BAHAGIAN B : 13 soalan
BAHAGIAN C : 5 soalan.
Anda perlu menjawab semua soalan berikut. Masa bagi menjawab soalan ini adalah selama 1jam 30 minit. Segala maklumat yang diberi adalah rahsia dan hanya digunakan untuk tujuan kajian ini sahaja. Sila pastikan anda menjawab kesemua soalan ujian ini.
Terima kasih atas semua kerjasama yang telah diberikan.
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&
DC EQUIVALENT CIRCUIT AND NETWORK THEOREMS.
(UJIAN PASCA)
NAME :
MATRIC NUMBER :
CLASS :
POLYTECHNIC :
Ujian ini mengandungi TIGA PULUH TIGA (33) soalan dan DUA BELAS (12) halaman bercetak.
BAHAGIAN A : 15 soalan BAHAGIAN B : 13 soalan BAHAGIAN C : 5 soalan
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Terima kasih atas semua kerjasama yang telah diberikan.

Fig. 3. Pre and post question sets

treatment group and the control group based on learning style:

i. Active processing (AP)?
ii. Reflective processing (RP)?
iii. Visual
iv. input (VI)?
v. Auditory input (AI)?

Multivariate analysis of covariance (MANCOVA) were used to determine if there was an increase in academic achievement and interest between the four categories, namely active processing (AP),

Journal of Chemical Health Risks
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JCHR (2024) 14 (02), 00-00 | ISSN: 2251-6727

reflective processing (RP), visual input (VI), and auditory input (AI).

Table 3 MANCOVA Summary of the Differential Interaction of Achievement and Interest Increases by Variable Category

Effect	Value	F	Hypothesis df	Error df	P
Academic achievement	0.231	9.441	2.000	67.000	0.000
Interest	0.252	10.635	2.000	67.000	0.000
Group	0.988	2721.457	2.000	67.000	0.000
Processing	0.053	1.858	2.000	67.000	0.164
Input	0.008	0.258	2.000	67.000	0.773
Group*Processing	0.005	0.153	2.000	67.000	0.858
Group*Input	0.002	0.066	2.000	67.000	0.937
Processing*Input	0.016	0.554	2.000	67.000	0.577
Group*Processing*Input	0.009	0.270	2.000	63.000	0.764

$p \leq 0.05$

Based on the MANCOVA test that has been stated in Table 5.3, the comparison between the group categories representing the treatment group, the control group, the processing dimension which is divided into active and reflective, and the input dimension is represented by visual and auditory. Findings for Academic achievement show a significant value when $F (2, 67) = 9.441$, $p \leq .05$. For interest, a significant value was obtained when $F (2,67) = 10.635$, $p \leq .05$, and for the group, it was also significant, which is $F (2, 67) = 2721.457$, $p \leq .05$. Even so, processing does not show a significant result which is $F (2, 67) = 1.858$, $p > .05$ and so does the input which shows a non-significant is $F (2, 67) = 0.258$, $p > .05$.

The interaction value shown for Group* Processing shows a non-significant result which is $F (2,67) = 0.153$, $p > .05$. This is also shown by the interaction between Group*Input which shows a non-significant value which is $F (2, 67) = 0.066$, $p > .05$. The interaction between Processing*Input also got a non-significant result which is $F (2, 67) = 0.554$, $p > .05$. A non-significant finding was also obtained between the interaction of Group*Processing*Input which is $F (2,63) = 0.270$, $p > .05$.

Table 4 Differences in Score Achievement (pre and post) and Student Interest in Active Processing, Reflective Processing, Visual Input, and Auditory Input.

Effect	Dependent Variable	df	MS	F	P
Academic_Pre	Academic_post	1	242.674	16.334	0.000
	Interest_post	1	11.273	2.127	0.150
Interest_Pre	Academic_post	1	38.343	2.124	0.150
	Interest_post	1	79.000	18.625	0.000
Group	Academic_post	1	2140.724	121.551	0.000
	Interest_post	1	28339.746	5443.658	0.000
Processing	Academic_post	1	66.154	3.756	0.057
	Interest_post	1	0.161	0.031	0.861
Input	Academic_post	1	2.400	0.136	0.713
	Interest_post	1	1.949	0.374	0.543
Group*Processing	Academic_post	1	0.817	0.046	0.831
	Interest_post	1	1.356	0.260	0.611
Group*Input	Academic_post	1	2.369	0.133	0.716
	Interest_post	1	0.001	0.000	0.991

Journal of Chemical Health Risks
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JCHR (2024) 14 (02), 00-00 | ISSN: 2251-6727

Processing*Input	Academic_post	1	14.359	0.815	0.370
	Interest_post	1	1.464	0.281	0.598
Group*Processing*Input	Academic_post	1	3.745	0.252	0.617
	Interest_post	1	1.737	0.328	0.569
Error	Academic_post	68	17.788		
	Interest_post	68	5.228		

$p \leq 0.05$

Based on Table 5, there is an interaction effect between Group, Processing, and Input variables. The analysis results show that the Academic_Pre value refers to the student's academic achievement before the start of the learning session. Post-academic refers to the student's academic achievement after the learning session. The interaction value obtained between pre-academic and post-academic shows a significant value which is F (1, 68) = 16.334, $p \leq 0.05$. This proves that there is a difference between before the start of the learning session and after the learning session. Even so, the variable Akademik_pre against Minat_pasca which represents students' interest after learning ends shows a non-significant reading value which is F (1, 68) = 2.127, $p > .05$. Next, the variable Interest_pre to Academic_pasca shows a non-significant reading when the value is F (1, 68) = 2.124, $p > .05$. Even so, the reading value obtained between the pre-Interest and post-Interest variables shows a significant reading which is F (1, 68) = 18.625, $p \leq 0.05$. This shows that there is a difference in interest before and after students learn the subject. For the Group variable against the variables Akademik_pasca and Minat_pasca show significant reading values when F (1, 68) = 121.551, $p \leq 0.05$ and F (1, 68) = 5443.658, $p \leq 0.05$. This shows that there is a difference in the improvement in academic achievement and students' interest in learning for the treatment group and the control group. Additionally, non-significant readings were shown by the Processing variable against the Academic_post and Interest_post variables. The findings are F (1,68) = 3.756, $p > .05$ and F (1,68) = 0.031, $p > .05$. For the Input variable against the Academic_pasca and Interest_pasca variables, the reading values found also show non-significant values which are F (1,68) = 0.136, $p > .05$ and F (1,68) = 0.374, $p > .05$.

For the interaction between Group*Processing with Akademik_pasca and Minat_pasca the findings are F (1,68) = 0.046, $p > .05$ and F (1,68) = 0.260, $p > .05$. The result of this finding shows that the value is not significant. Meanwhile, the interaction between Group*Input with Academic_pasca and Interest_pasca also showed non-significant values which are F (1,68) = 0.133, $p > .05$ and F (1,68) = 0.000, $p > .05$. The interaction between Processing*Input also got a non-significant value which is F (1,68) = 0.815, $p > .05$ and F (1,68) = 0.281, $p > .05$. Non-significant analysis results also occurred between the interaction of Group*Processing*Input with F (1,68) = 0.252, $p > .05$ and F (1,68) = 0.328, $p > .05$.

Table 5 Mean Score Difference for Academic Achievement (pre and post), and Student Interest in Active, Reflective, Visual Input, and Auditory Input Processing

Dependent Variable	Independent Variable	Group	N	Mean (Pre)	Mean (Post)	SD
Academic_post	Active	Treatment	22	27.114	40.318	5.326
		Control	22	27.341	29.500	2.563
	Reflective	Treatment	16	27.313	42.875	5.427
		Control	13	28.808	31.577	1.742
	Visual	Treatment	26	27.058	41.596	5.699
		Control	23	27.674	30.065	2.617
	Auditory	Treatment	12	27.500	40.958	5.069

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		Control	12	28.292	30.667	2.259
Interest_post	Active	Treatment	22	2.186	3.477	0.693
		Control	22	2.006	2.147	0.761
	Reflective	Treatment	16	2.146	3.469	0.704
		Control	13	2.031	2.159	0.904
	Visual	Treatment	26	2.164	3.471	0.774
		Control	23	2.003	2.148	0.777
	Auditory	Treatment	12	2.181	3.481	0.481
		Control	12	2.039	2.158	0.889

Although analysis results shown in Table 4, that there is no difference in the improvement of academic achievement and interest of students but after analyzing using the mean score before and after the learning session which can be seen in Table 5, there is a difference for both variables namely Academic_post and Interest_post.

4. Conclusions

Referring to the analysis results, both Hyphotesis cannot be fully accepted because there is a clear difference when the mean score is used to see the difference in academic achievement and student interest for both dimensions of active and reflective processing as well as both treatment and control groups. Although the analysis finding using MANCOVA analysis obtained a non-significant value, there are still differences for both student categories and learning method groups. The results show that the value is not significant because the difference between academic achievement and interest between the treatment and control groups is not very significant. In addition, the findings show that the advantages of using the flipped learning method cannot have an optimal effect in improving academic achievement and interest, and the duration of using the flipped learning method is limited and short, which is only eight weeks. Besides, the study results show that the flipped learning method is better than the conventional method.

When looking at the effects of flipped learning, it leads to positive changes and can increase academic achievement and student interest. The research results also found that the group of students who had been given treatment had better academic achievement and interest compared to before receiving treatment. When looking at the results of the analysis obtained, academic achievement and interest for both dimensions of processing, namely Active and Reflective, show changes that are not very significant before and after the teaching and learning process begins and ends. The difference in academic achievement and interest is closely related to the level of understanding of these two processing styles and has an impact on student performance. The academic achievement and interest of both Active and Reflective processing style categories of the control group can be increased if the teaching and learning methods applied are appropriate to their level of acceptance. The learning method applied by the control group is lecturer-centered, and this causes students to become quickly bored and passive. Therefore, it can be concluded that although there is no significant difference in both dimensions, those who apply the flipped learning method are found to have provided excellent achievements, and the learning also helps to increase their interest in exploring topics learning compared to students who follow conventional learning.

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