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Effect of an Inquiry-Based Blended Learning Module on Electronics Technology Students' Academic Achievement

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Abstract: Technological advances have led to a change in teaching strategies applied in Technical and Vocational settings. An effective teaching strategy is needed to address issues encountered in the traditional learning process of Electronics Technology Students at Malaysian Vocational College. Blended learning is one of the best teaching strategies for Electronic Technology courses as it is in line with the 21st-century learning, especially in promoting student-centred and life-long learning. This study looks at the impact of an Inquiry-Based Blended Learning (IBBL) module on the students' achievement in the Industrial Electronics Equipment Problem Solving (IEEPS) Course, in an Electronic Technology Program. This study uses an experimental study design through the quasi-experimental method to evaluate the effectiveness of the module. The comparison of achievement between an experimental group and a control group was conducted based on the pre-test and post-test protocol. The findings of the evaluation phase through the t-test showed that there was a significant difference ($p<.05$) between the experimental group and the control group. This indicated that using an Inquiry-Based Blended Learning Module was effective to help the student to improve their achievement in Industrial Electronics Equipment Problem Solving Course. Therefore, the inquiry-based blended learning module has the potential to be applied by instructors and students in the Vocational College setting.

Keywords: Blended learning, inquiry-based learning, electronic technology, vocational college, quasi-experimental, TVET

1. Introduction

The Industrial Electronics Equipment Problem Solving (IEEPS) course is one of the courses introduced to students of the Electronic Technology program, Malaysia Vocational Certificates (SVM). This course was designed to expose students in carrying out problem-solving of industrial electronic equipment according to the manufacturer's specifications and manuals (DPSK, 2017). Competent students in the IEEPS course will be able to identify malfunctions of industrial electronic equipment, express the functionality of industrial electronic equipment, and check the operational specifications of industrial electronic equipment as well as make a malfunction report of industrial electronic equipment (KSKV, 2020).

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Technological advances led to the need for changes to the teaching strategy of instructors at the Vocational College. Therefore, a more effective teaching approach should be taken to overcome the problems encountered in implementing teaching methods for the IEEPS courses in KV. The pre-requisite for mastering a topic is based on a deep understanding of the basic concept and theories in the subject (Yadav & Barry, 2009). Normally, students who are unable to master basic concepts and theories in the early topics of their course will have difficulties and a lack of motivation as they proceed to advanced topics. (Marlini, 2017). A study on the topic of electronics by Faizah, Rafidah, Juliyana and Norashikin (2005), shows that it is uneasy for students as they have difficulties imagining the circuit operation, hence requiring extra time to fully understand it. The lack of theoretical learning time in vocational education also causes theory learning not to be emphasized to students, this causes most vocational students to have difficulty in reporting practical work according to the needs of evaluators and have problems connecting the relationship between theory and practice (Cochran-Smith, & Zeichner, 2005).

In addition, vocational education pedagogy is still less effective and does not meet the needs of the industry causing students to get bored quickly and not interested in mastering theoretical learning better (Khairul, Sukri, Yusri & Norazrena, 2015). According to Yadav, Lundeberg and Bunting (2011) there are still teachers or educators who do not understand learning needs, unable to apply the right teaching methods, and approaches to help students build their knowledge and skills. Vocational stream students are also more exposed to traditional methods of learning theory and less exposed to new and more advanced learning methods (Henson, Hull and Wili, 2010). Thus, students venturing into technical and vocational fields seem to be less interested in learning theory in depth (Cochran-Smith, & Zeichner, 2005). In addition, the lack of appropriate teaching aids causes vocational students to face serious problems in understanding the concept of learning (Azaman, 2012). The use of teaching aids can make students more focused during the lesson (Kamarul, Mohd Faeez, Ab. Halim & Mohd Izham, 2011). The results of a study conducted by Faeez, Kalthom, Amin, Zetty and Murihah (2016) have shown that the use of teaching aids can have a positive impact on the academic excellence of students and the teaching methods of the instructors themselves. However, the study found that the teaching aids that is widely used by Electronic Technology instructors in Vocational Colleges are still in the conventional category (Anesman, Mohd Azlan dan Rafeizah, 2020).

1.1 An Inquiry Based Blended Learning (IBBL)

Blended learning is one of the most suitable teaching strategies implemented for IEEPS courses in Vocational Colleges as this method is suitable for 21st-century learning. By implementing a blended learning approach, students can be instilled with lifelong learning through various active and exploratory learning activities (Hisham, Sobri & Hamzah, 2012). Through the blended learning approach, students' knowledge, skills and motivation in learning can be enhanced through the latest technology-based collaboration activities (Muhamad Azhar Stapa, Mohamad Ibrahim & Amri Yusoff, 2017). In addition, blended learning in engineering can provide an efficient and effective learning experience for students (Shambavi & Babu, 2015). Although blended learning has been well received by students and educators in educational institutions, the application of blended learning in TVET institutions is still at a minimal level (Yuk, Yee, Kwan & Ka, 2017). The use of ICT in schools also has not reached a satisfactory level, both in terms of quality and quantity, thus maximizing the use of ICT for distance learning and self-paced learning (KPM, 2013). However, to improve these shortcomings, the Malaysian government are transforming the national education system in the Malaysian Education Development Plan for 2013 to 2025 (KPM, 2013). The implementation of blended learning involving ICT users in Vocational Colleges for this IEEPS course is appropriate and coincides with the development of educational technology today.

Previous studies found that the use of inquiry learning methods can improve student interest and learning achievement. In general, inquiry-based learning is a student-centred strategy that enhances students learning by finding answers based on the questions outlined (Mohd Paris 2016). Siti Nur Kamariah, Norraliza, Norhasyimah, Arihasnida dan Tamil Selvan (2018) in their study found that inquiry-based learning increase students' interest in learning session because this approach enhances students a sense of curiosity and problem-solving skills, as well as provide them with opportunities to investigate questions through observation and experiment for better understand their lesson. Brooke (2018) also agrees that inquiry-based learning encourages students to learn from their curiosity and engages them in the process of knowledge discovery. In addition, inquiry-based learning allowed the student to realize the significant impact of lesson activities they have done and encourages in-depth learning (Brooke, 2018). These characteristics of inquiry-based learning above are in line with the learning activities in the IEEPS course which requires students to solve damage problems on industrial electronic equipment based on symptoms of damage. In addition, the characteristics of inquiry-based learning involving cognitive, affective and psychomotor processes are also appropriate for vocational student learning activities that involve these three learning domains in performing practical activities and assignments given by instructors. Therefore, the use of appropriate inquiry models will assist the researcher in developing a systematic and planned learning module in providing learning activities for IEEPS courses in helping to improve student achievement.

Inquiry skills are also one of the skills emphasized in the Malaysian Education Development Plan (PPPM) 2013-2025. These skills need to be built by students to master lifelong knowledge to enable them to connect various knowledge. Therefore, the action taken by the researcher in applying this inquiry-learning method to the Module is consistent and in line with the recommendations proposed in the PPPM. Inquiry activities require students to find sufficient information to solve a problem or assignment provided by the teacher. Student involvement in finding information online is highly needed and in line with the 21st-century learning concept proposed by KPM. Thus, the study's action to incorporate an inquiry-based integrated learning strategy is an innovation in the development of a learning module for vocational students, especially for Electronic Technology program students at Vocational College.

1.2 Theory and Model

In the development of a learning module, the use of appropriate theories and models is crucial to ensure the effectiveness of the module. In the context of this study, the IBBL module was developed based on the Theory of Learning Constructivism (Vygotsky, 1896). While the models involved are the Blended Learning activity model (Alex Koohang, 2009) and the 5E Inquiry Model (BSCS, 1989). Fig. 1 shows the conceptual framework of the study used by the researcher on the inquiry-based blended learning module used in the IEEPS courses.

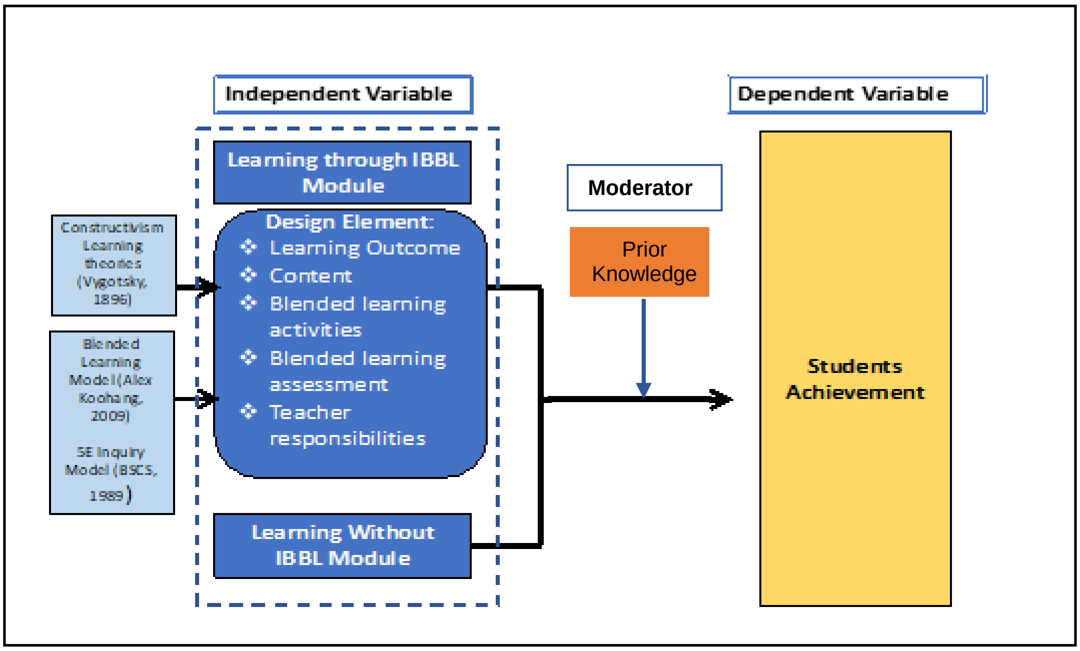

Fig. 1 - Conceptual framework

The Theory of Learning Constructivism is based on the principle that students will find solutions to problems through activities provided by educators where the educators act as a mentor by constantly giving questions to the students so that the students can discover the necessary concepts (Cooperstein & Weidinger, 2004). In this theory, students need to be active in developing their knowledge based on their own experiences. This theory of constructivism is applied to learning activities within the Inquiry-Based Blended Learning Module that has been developed by the researcher. Through this theory, the learning activities in the inquiry-based blended learning module are formed by using the same task execution method based on 5E inquiry learning but having different electronic equipment problems. Students will gain knowledge from their experience while performing the first activity assignment to help them perform the assignment on the next activity. This inquiry-based blended learning module was also developed with reference to seven principles in constructivist learning theory proposed by Lev Vygotsky (1896). Among them are:

a) Knowledge is built by students.
b) Learning activities combine three domains namely cognitive domain, affective domain, and psychomotor domain.
c) Students have a role in determining their own learning.
d) Learning outcomes are varied and difficult to expect.
e) Understanding is formed through analysis and synthesis of past experiences.
f) Reflection helps to form knowledge and understanding.
g) Reflection helps form knowledge and understanding.

The inquiry approach used by the researcher in developing this blended learning module is based on Inquiry Model 5E, which is used in implementing inquiry-based learning in Malaysia (BPK, 2016). The Biological Sciences Curriculum

Study has developed this model as an adaptation of the Science Curriculum Improvement Study (SCIS) Model introduced by Karplus and Their (1967). The 5E BSCS Teaching Model (Biological Sciences Curriculum Study) has five phases that refer to the 5E symbol, namely the Engagement phase, Exploration phase, Explanation phase, Elaboration phase, and Evaluation phase.

i) Engagement Phase

In the Engagement phase, the teacher's role is to access students 'prior knowledge and helping them engage in the new concepts using simple activities to generate students' curiosity. The engagement phase in this model is like the process of performing an induction set before the learning activity begins. Therefore, in this module the engagement phase is by preparing some questions to be asked to the students. The purpose is to identify the student's level of knowledge before starting a learning session for a new topic.

ii) Exploration Phase

In the Exploration phase, students will build an understanding of concepts based on hands-on activities based on prior knowledge and subsequently be able to generate new ideas, explore questions, and conduct preliminary investigations. Students can conduct investigations in a guided or open manner to answer the questions that have been given. In this second phase, students are encouraged to search for information or data using a variety of sources.

In the module at this phase, assignment questions in the form of theory are given to the students for them to complete. The assignment questions are related to the damage to industrial electronic equipment. Each question will be accompanied by a picture, real object or video as a reference for students in understanding the assignment questions given. In this phase, guidance is also provided to instructors and students to complete the task. In addition, this module also provides online learning notes as well as resource links that students can use as a reference in finding answers to assigned tasks.

iii) Explanation Phase

In the Explanation phase, students construct further descriptions and ideas through reflection on the investigations that have been carried out. At the same time, the teacher will provide input to check the understanding of the concepts that have been formed by the students. This phase also provides an opportunity for teachers to introduce concepts, processes, or skills directly. Explanations from teachers can also help them towards a deeper understanding.

In the module, this phase is the process of presenting information that students have obtained from various sources to answer the questions of the assignment that has been given. Students are encouraged to use existing skills to present the data obtained. Presentations can be done face-to-face or online. The purpose of this phase is to ensure that the information obtained by the student is accurate or can answer the questions given.

iv) Elaboration Phase

In the Development phase, students develop an understanding of concepts through application in new situations. Teachers will challenge and enhance students 'understanding and conceptual skills. Through new experiences, students develop a deeper and broader understanding, more information, and adequate skills. Group discussions can also provide opportunities for students to express their understanding and receive feedback from others.

In the module, the expansion phase takes place in hands-on or practical activities. In this phase, students will be exposed to the activity of detecting damage to industrial electronic equipment based on the given symptoms. Students will try to find the damage with the help of resources obtained during the exploration phase. In this phase, learning activities are encouraged to be done face-to-face in the workshop. However, this learning can also be conducted online, especially in the preparation of damage reports.

v) Evaluation Phase

In the Evaluation phase, teachers can assess students' understanding and abilities to ensure that learning objectives are achieved. In this phase as well, students can assess their skills and understanding. Informal assessment can take place at each phase and throughout the 5E phase sequence to assess student progress.

In the modules developed, the assessment phase is a process of evaluation or assessment of students' knowledge and understanding throughout the activity. Assessment in this module is done by giving quizzes or tests face-to-face or online. In addition, assessment is also considered on the results of assignments of the students given throughout the learning process in certain phases.

2. Methodology

This study used a quasi-experimental study design to see the effect of the use of the IBBL Module on student achievement. The purpose of a quasi-experimental study performed was to test or determine cause-to-effect or aimed to find cause-and-effect relationships involving group comparisons. A Quasi experiment is a quantitative design for testing comparative hypotheses or significant differences between an experimental group and a control group or between two independent variables (experimental group) and dependent variables (control group) guided by at least one or more hypotheses that state the cause and effect of correlation between two variables (Ghazali & Sufean, 2018).

Table 1 - Quasi experimental design

Group	Pre-test	Treatment	Post Test
Experimental Group	OA¹	X	OB²
Control Group	OA¹		OB²

Adapted from Cook & Campbell (1979)

2.1 Population and Sample

The population in this study consists of students of the Electronic Technology program who are in KV located in Peninsular Malaysia, while the study sample is students of the Electronic Technology program who are in semester two, year one SVM level taking IEEPS course in KV. The selection of the study sample was done using two methods, namely purposive sampling and simple random sampling. In the selection of Vocational Colleges, the researcher used purposive sampling aimed to obtain the equivalence of the study sample. First, the researcher selected eight KVs that offer Electronic Technology programs available in the Federal Territory of Kuala Lumpur, Selangor and Pahang. The purposive sampling that is carried out is to obtain the equivalence characteristics of the study sample to meet the prerequisites for conducting a quasi-experimental study. In the context of this study, to ensure that the selected Vocational College group has the same student characteristics, the researcher selected based on the student achievement results in semester one, year one SVM for the vocational field. The list of final examination results is obtained from the instructors (class teachers) who are responsible for the first-year students of SVM in the KV involved. In addition, the selection of KV is also done based on computer and internet facilities provided and has a minimum number of 30 students in the field of Electronic Technology. This internet facility must be easily accessible to students and instructors. This is very important to implement lessons using the PTBI Module. Next, the researcher used simple random sampling to obtain two KVs, one KV to serve as an experimental group and one KV as a control group. Simple random sampling was performed using online RANDOM.ORG software. Based on the selection of the sample, a KV was selected to be the experimental group (K1) and a KV was selected to be the control group (K2). The sample size used in this quasi-experimental study was a minimum of 30 people in each group.

2.2 Instrument

In this study, an achievement test instrument was used to see the effectiveness of the PTBI Module intervention on student achievement. Achievement tests in this phase consist of two types namely pre-achievement tests and post-achievement tests. Pre-achievement tests are tests given to students in the experimental group and the control group to see what equivalence exists among the study participants. Pre-achievement tests were given prior to the intervention process. While post -achievement tests were given to students of the experimental group and control group to see the effectiveness of the use of blended learning modules after the intervention process. The pre-achievement test and post-achievement test in this study used the same assessment questions, but with different dispersion methods. All questions constructed were in the form of objective questions. A total of 50 items of objective questions were suitable for this achievement test after the pilot study was conducted.

Items in the pre-achievement and post-achievement test instruments were constructed by the researcher based on document analysis of the Competency Standards Assessment Document (DPSK), Vocational College Standard Curriculum (KSKV) and collection of final examination question papers of IEEPS courses as well as Bloom's Taxonomy of Learning table (B. S. Bloom, 1956). The constructed items were tested for content validity and face validity by seven experts with over 10 years of experience. Experts in the validity of this achievement test were given an instrument evaluation form to provide an evaluation of 11 elements covering: 1) Use of font size, 2) clarity of each item, 3) clarity of use of graphics, 4) clarity of use of question instructions, 5) appropriateness of format questions, 6) use of easy -to - understand language, 7) appropriateness of a number of items, 8) appropriateness of student achievement assessment level, 9) use of correct Test Specification Table, 10) use of correct difficulty level, and 11) use of items complying to IEEPS course content. The Likert scale used in this evaluation form is a 'Yes' or 'No' option. As a result of the findings obtained, 100% of the experts agreed with the content of the achievement test instruments that have been developed. The results of the analysis of the validity and reliability of the pilot test on the achievement test found that Cronbach's Alpha value for the achievement test is 0.917. According to Cooper & Schindler (2006), alpha value index (α) scores of 0.6 to 0.95 have high reliability. Therefore, the pre- and post-achievement test instruments developed are suitable for use in actual studies.

2.3 Procedure

Fig-2 shows the implementation flow chart for conducting the evaluation phase using the quasi-experimental method. The experiment group will utilize IBBL Module in the student's learning process, while the control group applied the conventional learning process. Both control and experiment groups will undergo instructor briefing, pre-test, and post-test sessions.

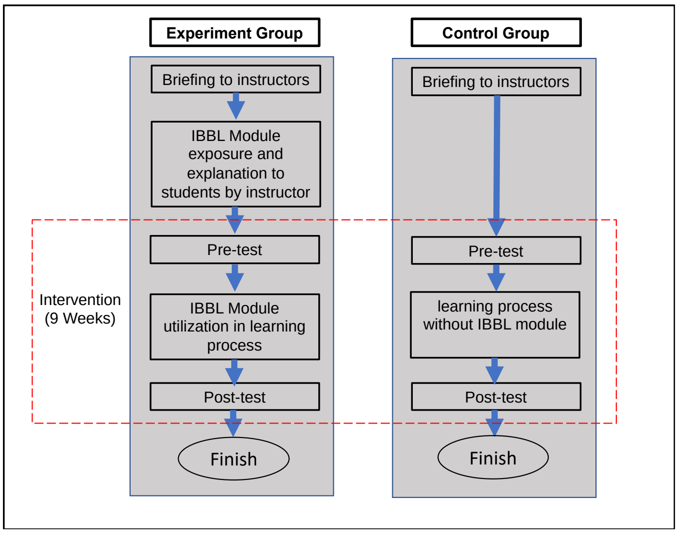

Fig. 2 - Conceptual framework
Adapted from Zanariah Binti Ahmad (2017)

3. Findings and Discussions

The findings of the effectiveness IBBL module, after implementation, were interpreted using both descriptive and inferential analysis. The descriptive analysis involved the mean and standard deviation of the IBBL module, whereas the inferential analysis involved the t-test. The following null hypothesis was formulated:

H_{o1}: There was no significant difference in the pre-test achievement of the Industrial Electronic Equipment Problem Solving Course between the experimental group and the control group.

Table 2 - Mean score and standard deviation of pre-test based on student groups

Group	No. of Students	Mean	Standard Deviation	Mean Difference
Experimental Group	30	50.73	14.71	2.87
Control Group	30	53.60	11.04	

Based on table 2 above, it is found that the mean score for the pre-test of the experimental group is 50.73 and the mean score of the pre-test for the control group is 53.60. These findings show that the pre-test between the experimental group and the control group is almost equivalent before the experimental treatment is implemented where the mean difference between the three groups is small which is 2.87. Table 3 below shows the results of the Independent Sample t-Test analysis for the pre-achievement test for IEEPS course tested in the group-based pre-achievement test.

Table 3 - Analysis of independent Sample T-test based on students group (Pre-test result)

		Independent Samples Test								
		Levene's Test for Equality of Variances		***t-test for Equality of Means***						
		F	**Sig.**	**t**	***df***	***Sig. (2-tailed)***	***Mean Difference***	***Std. Error Difference***	***95% Confidence Interval of the Difference*** ***Lower***	***Upper***
Pre-Achievement Test	*Equal variances assumed*	2.412	**0.126**	-.853	58	**0.397**	-2.867	3.359	-9.590	3.857
	Equal variances not assumed			-.853	53.816	0.397	-2.867	3.359	-9.601	3.868

Based on Table 3, Levene test is insignificant where the *p*-value> 0.05. Then the two groups are equal or homogeneous. Thus, the Independent Sample *t*-test for the pre-achievement test between the experimental group and the control group showed a *t* value (58, *p* = 0.397) = - 0.853, *p*> 0.05, and this indicates that there was no significant difference between the experimental group and the control group. Thus, the two groups were equivalent in terms of the initial achievement level of the IEEPS course before the experimental treatment was implemented. Therefore, the null hypothesis, H_{o1} is accepted.

H_{o2}: There is no significant difference in the post-achievement test of the Industrial Electronic Equipment Problem Solving course between the experimental group and the control group.

The findings of the post-test descriptive analysis for each group are as in Table 7.14. Table 7.14 shows the mean scores and standard deviations of the post-test for the experimental group and the control group.

Table 4 - Mean score and standard deviation of post-test based on student groups

Group	No. of Students	Mean	Standard Deviation
Experimental Group	30	71.07	9.989
Control Group	30	62.20	9.087

Based on Table 4, it is found that the post-test for the experimental group obtained a mean score of 71.07 and the mean score of the post-test for the control group was 62.20. These findings indicate that the experimental group had the highest mean score in the post-achievement test. Analysis using an Independent Sample *t*-Test was also performed to analyze the post-achievement test data. Table 5 shows the results of the Independent Sample *t*-Test analysis for the post-achievement test of the Industrial Electronic Equipment Problem Solving course which is tested based on the group.

Table 5 - Analysis of independent sample T-test based on students' group (Post-test result)

		Independent Samples Test								
		Levene's Test for Equality of Variances		***t-test for Equality of Means***						
		F	**Sig.**	**t**	***df***	***Sig. (2-tailed)***	***Mean Difference***	***Std. Error Difference***	***95% Confidence Interval of the Difference*** ***Lower***	***Upper***

Post-Achievement Test	*Equal variances assumed*	1.485	**0.228**	3.596	58	**.001**	8.867	2.466	3.931	13.802
	Equal variances not assumed			3.596	57.488	.001	8.867	2.466	3.930	13.803

Based on Table 5, the Levene test was insignificant where the *p*-value> 0.05. Then the two groups are equal or homogeneous. Thus, the Independent Sample *t*-Test for the post-achievement test between the experimental group and the control group showed a *t* value (58, p = 0.001) = 3.596, *p* <0.05, and this indicates that there was a significant difference in achievement between the experimental group and the control group. This indicates that the two groups have differences in terms of the level of final achievement of the Industrial Electronic Equipment Problem Solving course after the experimental treatment is carried out. Therefore, the null hypothesis, H_{o2} is rejected.

3.1 Analysis of the Impact of Students' Prior Knowledge on Student Achievement

H_{o3}: There is no influence of teaching methods on student achievement by controlling the factors of students' prior knowledge.

The analysis used to see the effect of students' prior knowledge on student achievement is by using the ANCOVA test. Therefore, the researcher used the result of the Electronic Technology subject grade in the first semester (existing knowledge) as a covariate. Table 6 shows the results obtained by using the Tests of Between-Subjects Effects analysis.

Table 6 - Analysis of Tests of Between-Subjects Effects of prior knowledge compared to teaching methods on student achievement

Tests of Between-Subjects Effects

Dependent Variable: Student achievement

Source	*Type III Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Corrected Model	1182.134[a]	2	591.067	6.374	.003
Intercept	934.644	1	934.644	10.079	.002
Prior knowledge	2.867	1	2.867	.031	**.861**
Teaching method (Experimental Group & Control Group)	1126.885	1	1126.885	12.152	**.001**
Error	5285.800	57	92.733		
Total	272868.000	60			
Corrected Total	6467.933	59			

a. R Squared = **.183** (Adjusted R Squared = **.154**)

Based on table 6, students' prior knowledge does not have a significant effect (p=0.861 >0.05) on student achievement, but there is a significant relationship between student achievement and teaching methods (p=0.001<0.05). This shows that when the variable of existing knowledge is controlled, then the variable of teaching method still affects the results of student achievement. Therefore, the null hypothesis, Ho3 is successfully rejected. This shows that the teaching method used by the instructor is the main contributor to determining the effectiveness of student learning in obtaining better academic achievement results. However, it was found that there was 15.4% of students' prior knowledge contributed to student achievement in this study. The results of the analysis that has been carried out on the variable of prior knowledge as a moderator variable because this variable does not have a great impact and influence on student achievement.

3.2 Comparison of Pre-Test and Post-Test in Control Group and Experimental Group

The analysis used to look at the mean score differences of the pre-and post-achievement test findings in the experimental group and the control group was by using Paired Sample *t*-Test. The purpose of the comparative analysis of pre-and post-achievement tests was to see the difference in mean scores of initial and final performances of students in each group. The following research hypotheses were formed:

H_{o3}: There were no significant differences in the pre-and post-achievement tests of the Industrial Electronic Equipment Problem Solving Course in the control group.

H_{o4}: There were no significant differences in the pre-and post-achievement tests of the Industrial Electronic Equipment Problem Solving Course in the experimental group.

Table 6 shows the results of the Paired Sample *t*-Test for the achievement of the pre and post-tests of the control group.

Table 7 - Paired sample *t*-test analysis result of pre and post-test (control group)

Sample	Test	Mean	Standard Deviation	*Paired T* Mean	SP	*t*	df	Sig. *(2-tailed)*
Control Group	Pre Post	53.60 62.20	11.047 9.087	**-8.600**	4.818	-9.777	29	**.000**

The Paired Sample *t*-test showed that the pre-achievement test (Mean = 53.60, Standard Deviation = 11.05) and the post-achievement test (Mean = 62.20, Standard Deviation = 9.09) had a *t*-value (29, $p = 0.000$) = -9.777, $p < 0.05$. Thus, there was a significant mean score difference between the pre-achievement test and the post-achievement test in the control group. Based on the above results, it was found that there was a slight increase in the mean score value on the post-test with a mean score difference of 8.60. This indicates that students in the control group have also shown a slight improvement in test achievement in the PMEPI course after the post-test was implemented. Therefore, the null hypothesis, H_{o3} is rejected.

3.3 Comparative Analysis of Pre-Test and Post-Test of Industrial Electronic Equipment Problem Solving Course in Experimental Group

Table 8 shows the results of the Paired Sample *t*-Test findings for pre- and post-test achievement for the experimental group.

Table 8 - Paired sample t-test analysis result of pre and post-test (experiment group)

Sample	Test	Mean	Standard Deviation	*Paired T* Min	SP	*t*	df	Sig. *(2-tailed)*
Experimental Group	Pre Post	50.73 71.07	14.711 9.989	**-20.333**	9.614	-11.584	29	**.000**

The Paired Sample *t*-test showed that the pre-achievement test (Mean = 50.73, Standard Deviation = 14.71) and the post-achievement test (Mean = 71.07, Standard Deviation = 9.99) had a *t*-value (29, $p = 0.000$) = -11.584, $p < 0.05$. Thus, there was a significant difference between the pre-achievement test and the post-achievement test in the experimental group. Based on the above results, it was found that there was an increase in the value of a high mean score on the post-test with a mean difference of 20.33. This indicates that students in the experimental group have shown a higher improvement in test achievement in the IEEPS course than the control group after the experimental treatment was implemented. Therefore, the null hypothesis, H_{o4} is rejected.

The findings of this study show that blended learning combined with inquiry learning can have a positive effect on student achievement. The findings of the study are in line with the findings of the study of the effectiveness of blended learning on the improvement of student academic achievement by Tajudeen et. al., (2017), Reza et. al., (2020), and Nurhafizah et. al., (2014). The improvement in the academic achievement of students in this experimental group is also one of the results of the application of the inquiry learning approach applied in the IBBL Module. Through inquiry learning, students' conceptual understanding of IEEPS courses can be enhanced. This is evidenced by studies that have been conducted by Nisa, Koestiari, Habibbulloh and Jatmiko (2017), and Annisa and Rohaeti (2018). Through their study, it was found that there was an improvement and positive changes in students' understanding of concepts in the subjects they studied. Therefore, the use of a blended learning approach that is complemented by inquiry learning based on constructivism theory can improve students' understanding of concepts and in turn, can improve vocational student achievement in IEEPS courses.

Previous study indicates that Electronic Technology students at Vocational College achievement in PMPEI courses at a low level due to students' difficulty in understanding the concept of a course taken (Faizah et al., 2005). Besides, time constraints during learning sessions become a barrier for students in understanding their lesson, reporting practical work according to the requirements, and making connections between theory and practice (Cochran-Smith, & Zeichner, 2005). In addition, there are some teachers who are still less competent in choosing the right teaching methods and strategies to help students develop their knowledge and skills (Yadav et al., 2011). This study has statistically proved that the PTBI module that conceptualizes inquiry-based learning can address those problems and can be one of the preferred teaching approaches for educators in Malaysian Vocational Colleges.

4. Implications and Conclusions

There are two main implications in this section which involve implications and recommendations on theoretical as well as implications on the field of education. Implications for the theory show that the findings of the study are parallel to the theory used in the study namely the theory of Constructivism (Vygotsky, 1896). Based on constructivism theory, students will build basic concepts before the concepts are developed and then apply them together with students 'existing knowledge to new situations. Through the learning of constructivism, students will find a solution to a problem through activities given by the teacher where the teacher acts as a guide to students so that students can find the necessary concepts (Cooperstein and Weidinger, 2003). The constructivist approach allows students to follow the lessons in a more organized, systematic and directed to enable the learning objectives to be well achieved by students. The implications of this study are to provide information to instructors so that when preparing learning activities for students when this is done, it is found that it is easier for students to complete other assignments given by the instructor.

The model used as the main basis in the development of this module is the 5E Inquiry model. This model has been used as the main backup in designing learning activities in the IBBL Module. It is found that this model is very in line with the theories used in this study. The use of this model has helped researchers design highly structured and effective learning activities in improving student achievement. The implications of using this model were found to be able to improve students' understanding better.

This study has successfully developed an online learning module with the concept of inquiry-based blended learning as a contribution to the field of education, especially in the field of vocational education. Researchers have been able to list the delivery methods of inquiry-based blended learning for Electronic Technology program for vocational students by stating the appropriate learning activities and assessment methods to be used as a guide when implementing inquiry-based blended learning based on consensus from experts. The assessment activities and methods used in this study are not only for online learning but they can also be used as a reference for face-to-face learning. In addition, based on this study, inquiry-based learning strategies applied in the IBBL module can also be used as a guide in designing learning activities for other courses for vocational students.

The IBBL module is a contribution to the teaching of the Industrial Electronic Equipment Problem Solving course for the Electronic Technology program at the Vocational College. Instructors of the Electronic Technology program can use this module by accessing the special WordPress platform for this module. Even students can upload apps for this module into their smartphones. Next, the development process used by the researcher is a contribution to the field of research. This study has successfully evaluated the effectiveness of the module through the quasi-experimental method and the comparison of achievement between an experimental group and a control group was conducted based on the pre-test and post-test protocol. The outcome of the study indicated that using an Inquiry-Based Blended Learning Module was effective to help the student to improve their achievement in Industrial Electronics Equipment Problem Solving Course.

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