



ADDIE Model Application for Development of Teaching Material Based on Flipped Learning for Lecturer's in Polytechnic

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Abstract: The process of teaching and learning is an important element of ensuring that students are able to keep up with the content of the subject being presented. In order to attract student's interest and improve the student's academic achievement, the process of learning should be a fun and challenging process for students' thinking. The main issue of this study is that science and mathematics learning for some students is abstract and difficult to understand. This study aims at the development of teaching material based on flipped learning in Polytechnic. The findings of this study show that the development of teaching materials based on flipped learning involves all phases of ADDIE model namely analysis, design, development, implementation and evaluation. In this study, the teaching of flipped learning materials produced has gained the content of five experts in teaching and learning. The results show that the researcher has successfully produced teaching material that emphasizes the five main components of the active learning method, namely Jigsaw Puzzle, video presentation, Bingo Balls of Doom, Group Presentation, and Assignment Assessment. It is hoped that the development of teaching materials based on these flipped learning methods will enhance students' academic achievement and achievement and enable students to work together to make the learning process more meaningful.

Keywords: Teaching, flipped learning, application development, ADDIE model

1. Introduction

Education in Malaysia has changed dramatically and is now steadily increasing especially in the early 21st century. These changes are in line with the country's economic growth from time to time. Learning at institutions of higher learning is formal learning that is based on the theory of achievement that is evaluated and validated by a particular party as well as recognition through the awarding of degrees. The goal of an institution of higher learning is to produce graduates who are successful in academic and personal achievement. Learning is a process related to cognitive, affective and psychomotor learning that occurs after student's experience training, interaction and experience of the environment resulting in changes in behavior, thinking and skills.

Teachers play an important role in controlling the teaching and learning process. This is because teachers are individuals responsible for student development and achievement (Yunos et al., 2019). Learning is generated when stimuli are processed and stored in memory to become experience and knowledge (Mok, 2000). Learning is a mental, physical or spiritual activity to the student. It is a process by which activities can change their attitudes and behaviors for continuous and lasting growth and the ability to use the knowledge and skills acquired for personal and social development and society or nation in general.

Student-centered learning is a teaching approach in which students influence content, activities, materials and learning rates (Froyd & Simpson, 2010). According to Abdullah (2015) when student-centered learning is practiced, the

burden of communication rests with the students and this is one of the broader learning approaches such as actively transforming the student's experience into learning, solving problems using creative and critical thinking, which also plays their role. - learning during the learning process, self-regulation techniques are also used and cooperative learning. Student-centered learning also provides students with independent learning opportunities and this enhances students' motivation, understanding and interest in the subject (O'neil & McMahon, 2005).

Learning Science and Mathematics is often considered a difficult and boring subject for students. This problem is due to the traditional learning environment, poor answering skills among students, teacher-centered teaching and emphasis on memorizing theories or concepts as well as engaging in activities that do not attract students (Tahar et al., 2011). In addition, the attitude of students who do not want to ask makes the learning process unattractive (Ismaon, Iksan & Othman, 2013). In the process of selecting a teacher's method, media and materials should be based on the three levels of student ability and learning objectives, namely selecting the appropriate method so that the teacher can attract and interest the student during the teaching and learning process. Next, a teacher should choose the learning and teaching medium so that the message or information he or she wants to convey can be understood by the student.

The problem is that Electrical Engineering subject 1 (DET1013) is one of the mandatory requirements for graduating students to take the Electric Circuit course (DET2033). The ministry has lowered its graduation rate to allow students to continue their study sessions next semester. As an example the score for graduating students who qualify for the next subject is 40- 43. This clearly indicates that the standards or quality of students to be born are lower and this indirectly contributes to the unemployment rate among Malaysian graduates. If a student who graduates in semester 1 has a low score, then he or she has no solid knowledge base. If this problem is not resolved quickly, it will cause TVET graduates produced by the polytechnic to not be compared to other graduates from other institutions. Therefore, it is important to use a variety of methods to enhance student interest so that students are actively involved throughout the teaching and learning process. Therefore, the objective of this study is for the development of teaching material based on flipped learning in Polytechnic.

2. Flipped Learning

Perez and Dong (2012) suggest that Flipped learning is a method by which students learn a subject outside the classroom while in the classroom students are exposed to active learning. Flipped learning means that the teacher-led teaching process has been implemented at home or outside the classroom while in the classroom teachers only discuss learning-related topics (Gerald, 2014). During the learning process in the classroom students only engage in discussion with the teacher. In this process the teacher acts only as a facilitator where the teacher will explain the lesson as needed by the student. The learning environment will also be student-centered.

Through the flipped learning method, students are able to self-administer all the necessary materials before they attend college (Johnson & Renner, 2012). In addition, teamwork skills can be enhanced in the students, because in the classroom, students will be divided into groups and teachers will assign group assignments. This will indirectly allow teachers to approach students who have the problems. The next improvement is that teachers can make this flipped learning a teaching tool where teachers can use it for as long as there is no major change such as syllabus change and addition notes and exercises. Teachers will then receive quick feedback through this learning method as the teacher will identify students who have poor understanding without having to wait for the student to sit for the examination. Indirectly this will help the student to improve their academic achievement and interests.

3. Methodology

Generally, the ADDIE model has 5 phases whose first phase is Analysis, Design, Development, Implementation and Evaluation. The ADDIE model is a systematic approach to the process of designing instruction and helping designers to carry out the process with an organized framework to ensure their products are effective and efficient (Sanjaya, Suwatra & Suartama, 2015). Therefore, in this study the development of teaching material based on flipped learning involved all phases of the ADDIE model. This is to ensure that the teaching materials developed are effective in increasing the interest of polytechnic students in Electrical Technology 1 (DET1013) lessons and working together to make the learning process more meaningful.

4. Research Findings

In this study, researchers have applied five phases of ADDIE model, namely, analysis, design, development, implementation and evaluation to develop teaching materials based on flipped learning and phase-based findings are as follows:

4.1. Analysis Phase

The Analysis Phase was conducted to obtain detailed research related information. The planned teaching and learning activities should be in line with the learning objectives. If a teacher focuses on the use of appropriate methods and media, new knowledge, skills and attitudes that students need to master. In a nutshell, in the context of designing

material based on flipped learning, the process of analysis needs to involve three main aspects: student, teacher and teaching objectives. In seeking information related to these three aspects of the system, there are several key questions that can be asked during the analysis process:

- What is the background of students' knowledge of Electric Technology 1 (DET1013)?
- How far their mastery in Science and Mathematics the basis of Electrical Technology 1 (DET1013) lessons?
- What are the appropriate notes in Electrical Technology lesson 1 (DET1013) required?
- What activities are needed to further enhance student knowledge through active learning?
- What forms of effective teaching methodology are needed in delivering Electric Technology 1 (DET1013) lessons?
- What other disturbing and impactful issues can impede the teaching and learning process of Electric Technology 1 (DET1013)?

These questions are important for an early overview of the development of this teaching material.

4.2. Design Phase

The design covers system communication in general and process specifications and facilitates relevant stakeholders to understand the system's journey and evaluate its suitability and potential for developer development. Active learning encourages students to use their minds to study ideas, and to solve problems (Khatib, 2006). Active learning refers to students not only as listeners and take notes but students also need to participate in classroom learning. In this context, teaching and learning are student-centered while teachers act as facilitators only. Therefore, in the context of active learning, teachers play an important role in formulating effective teaching to enhance the achievement of their students. This teaching material emphasizes the five main components of the active learning method which are:

4.2.1. Jigsaw Group Experts

Jigsaw Group Experts are adapted from the Jigsaw Group learning method. Jigsaw Group Experts is a lecturer that divides students into groups and each group has different topic titles. Students are asked to have a discussion between them before they are re-divided into new groups. In this new group students have to explain and explain to their peers about the topic of the topic being discussed (Sugianti, 2016; Watson, 2009). In this way, students are trained to become experts in a particular topic. This is because the student must understand the topic in depth before explaining it to other peers (Kordaki & Siempos, 2011). Through this kind of learning, lecturers can indirectly assist and train students to develop self-confidence when speaking in public and students can recognize their own learning styles (Darnon, Buchs & Desbar, 2012 & Mengduo & Xiaoling, 2010).

According to Shume, Stander & Grier, 2015, learning to use this jigsaw concept is able to build teamwork skills and create positive competition among students to achieve learning and teaching objectives. In addition, according to Darnon, Buchs & Desbar (2012), students are also treated with a sense of responsibility within themselves. This is because students need to pass on the right information to their peers and to stimulate positive spirit in the classroom. According to Maden, 2010 & Walker & Crogan, 1998, students' academic achievement can be improved and students' prejudice toward their peers can also be reduced. This is because students are trained to be self-sufficient for additional information.

4.2.2 Video Shows

With the rise of multimedia in education, video has become one of the most popular mediums for educators. The combination of several multimedia elements such as text, graphics and audio has proven to interest students and can stimulate visual and auditory perception (Ab Rahman, Zainal & Ab Karim, 2015). This is also in line with the 21st Century learning of which one of the characteristics is to implement student-centered learning whereby the meaning of the teaching and learning role of the student is more important than the teacher whose role at the time was only as facilitator (Abdullah & Ahmad, 2017)

The method of learning to use video as the primary medium enables teachers to present teaching easily, interestingly and positively (Sidek & Hashim, 2016). In addition, it helps students to easily understand the learning process even when they are studying alone and without the presence of teachers. In addition, Mohd Nor & Sharif (2014), teaching and learning using media aids such as structured teaching modules, workbooks, videos, visuals and so on can change students' positive behavior as students enjoy and enhance student understanding. According to Abdul Razak & Abdul Rahman, 2013, students need to have a high level of reasoning as they have to overcome obstacles in achieving their learning objectives.

4.2.3 Bingo Balls of Doom

Learning to use the Bingo Balls of Doom method is one of the interesting learning methods. This is because through this method there are elements of the game among the students. The games applied in mathematics can address students' negative attitudes and perceptions of mathematics where many students say that math is a difficult subject (Samsudin et al, 2017). According to Mak Din et al, (2014), the application of the educational system using digital games techniques is very flexible and in fact has the advantage of applying the principles of learning that are the core of education such as the application of various elements as noted in behavioral theory, cognitive theory and constructive theory. Even through the elements of entertainment and fun present in the game package can actually stimulate the player's mind to realize that they have applied some of the concepts and skills they have learned before.

Further through this method also group learning can be applied. Each member of the group is fully responsible for ensuring that they are committed to sharing tasks to achieve their learning objectives (Yusri et al, 2012). According to Md Ibrahim et al (2015), the elements of group learning can make students more motivated to conduct R&D sessions. In addition, cognitive development can also be enhanced, through discussion and exchange of ideas within the student group to help students master learning concepts and to help students improve their thinking process.

Students are more responsible for ensuring the success of the group, they will be more interested in participating in the learning process and end up taking more responsibility (Jamaluddin et al, 2016 & Yusri et al, 2012). This not only creates a positive attitude towards learning but also builds positive relationships among group members where each group member has different cultural and socio-economic backgrounds.

4.2.4 Group Presentation

Learning to use group presentations also captures students' interest and enhances student confidence. Lecturers who use this presentation during the PdP session are more likely to be favored by students than the PdP who use the "talk and chalk" method (Bartsch & Cobern, 2003). According to Somasundram & Mahamod (2017) & Susskind (2004), learning through this method is a new and indirect method that enhances students' understanding, encourages students to think creatively and critically, enhances student achievement and motivation and even improves knowledge students constantly. In addition, Xingeng & Jianxing (2012) & Sidal (2003), inter-group collaboration enables productivity and quality to be enhanced in terms of combining the expertise, knowledge and commitment of all members and energies to produce a work that is minimized.

In addition to instilling interest and confidence among students, through this learning method students can apply values of respect and respect to each other (Mohamed Hussain, 2014 & Village & Keny, 2014) This is because other members of the group will remain silent and listen to their opinions or input their friends without questioning it. Respect can also be inculcated through the act of waiting for their turn to form opinions, views without interruption. In addition, Katip, Abu Bakr & Malia, 2005, when students are given a responsibility to ensure the success of their group will be more interested in engaging directly in the activity and the good relationship between the group members. Active learners are also involved in developing an understanding of the material they are learning (Tarmuji, Abdullah & Ahmad, 2015 & Thomas, 2014).

In addition, Gambari, Joseph & Balogun, 2015, stated that learning using this method can save time, as students will work together in groups to complete assigned tasks and in the short term allocate time. In addition, the cognitive achievement of technical students in engineering drawing subjects also improves when using slide point presentation methods. According to Brock & Joglekar, 2011, students who are used to presenting in front of their peers have a bright potential in their field of work as they have instilled in them a sense of self-confidence and the ability to answer any questions they ask thoughtfully.

4.2.5 Assignment Assessment

Assignment assessments have been evaluated with various definitions. Assignment assessment is a process of obtaining information that is used to make judgments that are subsequently used in decision making (Ahmad & Jingga, 2015). Moreover, evaluation is the process of obtaining quantitative information. The assessment is divided into two formative and sumative evaluations. In addition, according to Veloo (2011) & Prince (2004), defining is defined as a process undertaken to determine the effectiveness of teacher teaching and student mastery in a school-level course. Assessments also play an important role in the process of improving teacher teaching and learning in the classroom.

Group evaluation of tasks can improve the quality of the discussion (Rand, 2017 & Spiller, 2009). This is because students will talk to each other to get the job done and get excellent marks. Indirectly, assessments in this way can increase students' understanding of the topics they want to solve. Therefore, Gibson & Shaw (2011), assessing this assignment can also enhance students' internal motivation when teachers use this method. This is because, when students clearly understand the topic, their motivation and student confidence can also be increased. Assessment is not just about making decisions about a student's achievement, but on providing positive support and mechanisms to help students improve or improve their learning, improve lecturer teaching and contribute to the effectiveness of the program (Khalid, Ahmad & Hamdan, 2015 & Fitzsimons, 2014).

4.3 Development Phase

The next phase is the system design phase to be developed. It covers the process of determining how learning works. Designers or developers of teaching materials will focus more on how a topic will be presented to students, system specifications and system storyboards. In this phase, a general overview of the teaching materials will be presented using visual methods. This is done by setting the system content, interface design, storyboards and flow charts for the system being developed. The design covers system communication in general and process specifications and facilitates relevant stakeholders to understand the system's journey and evaluate its suitability and potential for developer development.

Table 1 - Proposed development of teaching material based on flipped learning

No.	Activity	Objective	Topic	Assignment	Activity
1	Jigsaw Puzzle	<ul style="list-style-type: none"> - Students understand the basic symbols of electrical components as well as the differences between cells and batteries. - Students learn the differences for circuit assembly (Series, Parallel and Combination) - Students understand the terms of electric current and quantity of electric current (current, Charge, Potential Difference and Resistance) - Students explain the main effects of electrical current (Thermal Effects, Magnetic Effects and Chemical Effects) - Students distinguish the concepts of resistors and resistance in electrical currents. 	<ul style="list-style-type: none"> -Standard symbols for electrical components and the difference between cells and batteries. -The effects of different cell connections (Series, Parallel and Series-Parallel). -Electric current and quantity of electricity (Current, Charge, Potential Difference and Resistance). -Main effects of electric current (Heat effect, Magnetic effect and Chemical effect). -Resistance and Resistivity 		<ul style="list-style-type: none"> -Discussions and descriptions in groups. - Discussions with lecturers
2	Video Shows	<ul style="list-style-type: none"> - Students compare between Ohm's Law, Series Circuit, Parallel Circuit and Combined Circuit. - Students use Ohm's Law, Series Circuit, Parallel Circuit and Combined Circuit to solve questions posed by lecturers. 	<ul style="list-style-type: none"> -Ohm's Law. -Series Circuit (Equivalent Series Resistance and Voltage Divider). -Parallel Circuit (Equivalent Parallel Resistance and Current Divider). -Combination of Series and Parallel Circuit. 		<ul style="list-style-type: none"> - Discussions with lecturers
3	Bingo Balls of Doom	<ul style="list-style-type: none"> - Students understand the concepts of Delta-star transformation, Star-Delta Transformation and Power and Electric Power. -Students apply existing formulas to solve problems given by lecturers. 	<ul style="list-style-type: none"> -Delta –Star Transformation -Star – Delta Transformation -Electrical Power and Energy 	<ul style="list-style-type: none"> -Electrical Technology Book (Polytechnic Series) - E-Learning Books (Yanz Book) 	<ul style="list-style-type: none"> -Games.

4	Group Presentation	- Students understand the Kirchoff Current Law, Kirchoff Voltage Law, Thevenin Theorem, Norton Theorem and Superposition Theorem. - Students apply these laws in solving problems given.	-Kirchoff's Current Law -Kirchoff's Voltage Law -Thevenin's Theorem -Norton's Theorem -Superposition Theorem	- Discussions in groups - Presentation
5	Assignment Assessment	- Students understand the concept of maximum power transfer within the circuit. -The student applies the formula contained in the title of the maximum power transfer when solving the problem given by the lecturer.	-Maximum Power Transfer	-Exercises - Discussions

4.4 Implementation Phase

Upon completion of the development phase, the implementation phase will be implemented. At the beginning level, the teaching material will be tested by operating on the part of the student. This phase is intended to determine the strengths and weaknesses of the teaching materials developed. According to Aaron, Aris and Tasir (2003), this phase is to test the effectiveness of teaching materials and also to evaluate the suitability of ready-made teaching materials. In addition, this phase is needed to support students' understanding of the topic and to master the topic well. In order to carry out this process, a group of students and teachers who have the criteria set before the study is required for the implementation process. The proceeds from this phase will be used for the purpose of improvement or recovery before the actual handbook is used.

Implementation of this handbook using the ADDIE model is because it solves the problems encountered during the design process. This is also because this model has a systematic process in designing teaching materials. The implementation stages in this manual are intended for improvement after they have been measured, tested and implemented. The elements tested at this level are:

- The state of the teaching staff during the teaching and learning process in achieving the teaching and learning objectives, the learning outcomes obtained by the students, the presentation skills used by the teachers, the activities and assignments of the teachers and students.
- Preparing for students with different learning styles such as active, reflective, visual and auditory. In addition, it includes soft skills such as communication skills, critical thinking skills and so on.
- Environmental conditions that include teaching aids, equipment for carrying out activities and assignments as well as years of teaching.



Figure 1 - Handbook of flipped learning methods implemented by researchers



Fig. 2 - Activities which was conducted

4.5 Evaluation Phase

This evaluation phase is the final phase and in this phase it will evaluate the feasibility and effectiveness of the teaching materials based on the objective success stated in the analysis stage. In addition, it can measure and obtain student feedback on this teaching material. The evaluation phase consists of two assessments, namely formative evaluation and summative evaluation. Formative assessment refers to the assessment of the effectiveness of the design of the teaching materials as well as the development of the teaching materials. While summative assessment refers to the effectiveness of teaching by the teaching staff, achievement of learning objectives and learning outcomes. The resulting information will be used for the purpose of improving the teaching process for the same or different topics as well as for other relevant courses. Also, assessment from the point of view of student feedback is also required. It is assessed using a set of questionnaires as well as a set of pre and post questions related to the subject title. The data obtained as a result of the summative assessment are used to further the teaching and learning process. The use of the ADDIE Model in the construction of this teaching material is intended to create a good teaching material because the phases involved in this model make problems that arise and can be identified over time as they are designed and developed.

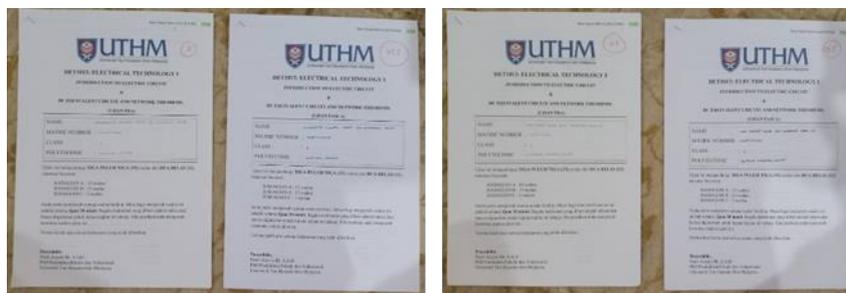


Fig. 3 - A set of pre and post questions that students have answered

5. Conclusion

Based on the discussions that have been presented, this shows that the ADDIE model covers five main phases of analysis, design, development, implementation and evaluation, which is a model of teaching material design that can be used to enhance student interest and academic achievement. This is proven because the phases contained in the ADDIE model have a comprehensive and systematic nature. The results show that the researcher has successfully produced teaching material that emphasizes the five main components of the active learning method, namely (i) Jigsaw Puzzle, (ii) Video shows, (iii) Bingo Balls of Doom, (iv) Group Presentation, (v) Assignment Assessment. It is hoped that the development of teaching materials based on flipped learning will enhance students' interest and academic achievements in learning and work together to make the learning process more meaningful.

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