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Development of Teaching and Learning Module for Basic Electrical and Electronic

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Abstract: Students taking the electrical and electronics course will typically take basic subjects that include sub-topic as well as Norton, Thevenin, Mesh, Nodal and Superposition. However, the content of this topic is difficult for students to understand because it involves complex calculations. Therefore, teaching and learning modules for Basic Electrical and Electronics have been developed. To conduct the study more systematically, this module was developed based on the module development process by Sharifah Alwiah Alsagoff (1981). As a result, the development of this module was successfully implemented. The modules produced meet the criteria that have been set and validated by experts according to the suitability of the design and content aspect.

Keywords: Electrical and Electronic Basic, module development, learning module, Flip Book Digital, Norton, Thevenin, Mesh, Nodal and Superposition

1. Introduction

Technical and Vocational Education (TVE) plays an important role in shaping the human workforce to meet the job market in the industry. According to Minghat et al. (2013), the Ministry of Education Malaysia (KPM) has identified the importance of TVE to ensure the country's aspirations to become a developed country by 2020 are achieved. Therefore, an active TVE transformation effort is being carried out by the Ministry of Education Malaysia should be supported by all stakeholder. Based on the data obtained, it is encouraging that more than 80% of students are offered employment by the industry and this demonstrates that courses in skills in public institutions have met the goal of setting up a skills institution that is to produce workforce skilled (Che Lah, 2018). To achieve such goals as developed countries, Malaysia needs to have knowledgeable and highly skilled human capital as it is an important factor for Malaysia to transform its economy towards achieving high-income and high-status countries (Ismail, 2012). In developing a skilled and quality workforce, quality and productive education is essential for students to achieve effective learning and to produce a skilled and trained workforce.

Learning modules are methods that have long been adopted by educators who are systematically structured and engaging. The methods or techniques used should be appropriate to the teaching objectives as they leave a lasting impact on students' understanding and motivation (Sidek and Mohd Ariffin, 2011). In addition, the use of modules in this era is still relevant as it is suitable for producing students with specific academic qualifications, trained skills and high quality leadership, responsibility and so forth to meet the needs of the country in accordance with the requirements of the National Education Philosophy (Sidek and Mohd Ariffin, 2011). This learning module also helps the lecturer facilitate the teaching and learning process. Success will be possible in the delivery of the teaching staff or lecturers when using the learning module.

One of the providers for human capital in Malaysia produced by Kolej Kemahiran Tinggi Mara (KKTM). There are many courses offered in KKTM and part of it is electrical engineering. Students who take electrical engineering are required to take basic electrical and electronic subject. This subject will cover subtopic as well as Norton, Thevenin, Mesh, Nodal and Superposition to meet the requirements set by the institution. However, based on the preliminary study that has been done, students have difficulty understanding the subtopics (Norton, Thevenin, Mesh, Nodal and Superposition) because it's consist of complex calculations. Pupils require additional reference to understand the topic. There is a need to develop a teaching and learning module so that it will help students and lecturers conduct teaching and learning sessions in a timely manner and will enable students to provide effective feedback during question and answer activities in the classroom. Therefore to overcome that problems two objectives have been set which is (i) to develop the learning modules for Norton, Thevenin, Mesh, Nodal and Superposition subtopics for Electrical and Electronics programs at KKTM and (ii) to evaluate the level of suitability of the content and design of the learning modules for Norton, Thevenin, Mesh, Nodal and Superposition subtopics for Electrical and Electronics programs at KKTM.

2. Methodology

This study focuses on the development of teaching and learning modules based on the model by Sharifah Alwiah Alsagoff (1981). It was motivated by several interesting and appropriate elements as follows (i) Define goals clearly such as taking into account age, intelligence, background and appropriate factors (ii) Includes selection of appropriate concepts, principles, skills and procedures (iii) Create the objectives that students want to achieve (iv) The content presented and the learning and teaching activities will follow by students and lecturers (v) Assessment method that measures how well the learning outcomes are being met (vi) Various learning strategies and mediums are selected to interest and enhance student understanding. Figure 1 shows the process of the module development suggested by Sharifah Alwiah Alsagoff (1981) followed by discussion of each process.

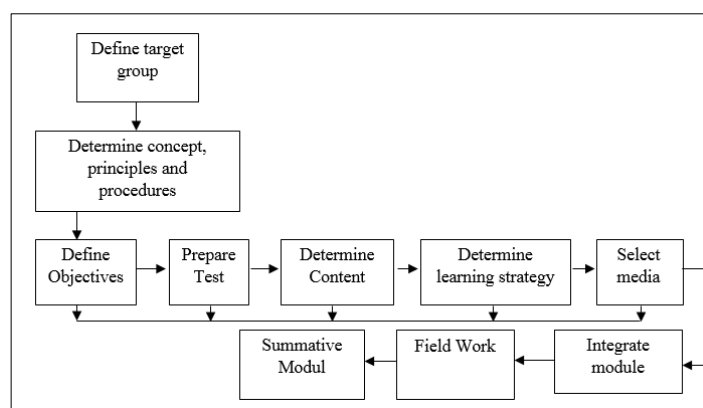


Figure 1: The Process of Sharifah Alwiah Alsagoff (1981) Module Development

(a) Define target group

To determine the student target, the researchers selected students from Kolej Kemahiran Tinggi Mara (KKTm). This is because KKTm is one of the institutions offering electrical and electronic courses.

(b) Choose concepts, principles, skills or procedures

In this research, constructivism learning theory was applied. Constructivism is a view that students need to build on their own knowledge (individual perception) or concepts actively based on knowledge and prior experience. In the process, students will adjust received knowledge with existing knowledge to build new knowledge. This concept was applied in the learning module where many exercises were provided in the module, so students develop their own knowledge by using step by step from the module to solve the problem given.

(c) Define Objectives

Each beginning of the topic has a list of learning outcomes that students need to achieve at the end of the course so that students can evaluate their own level of achievement based on their own understanding.

(d) Prepare the Test

Before the teaching and learning module developed, preliminary studies were done. There are 17 respondents of KKTm students who took electrical and electronic course answers to the google forms questionnaire. This preliminary study is to know the knowledge and understanding of certain question as well as (i) I was learned this topic (ii) I can solve the calculation problem given by the lecturer (iii) I understand the topic explained by the lecturer (iv) References book easy to get (v) Reference sources easy to get from the internet and (vi) I need additional references for the topic.

(e) Select Content

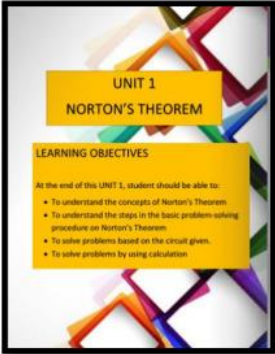
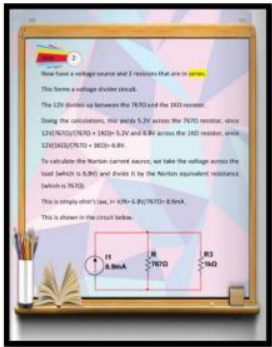
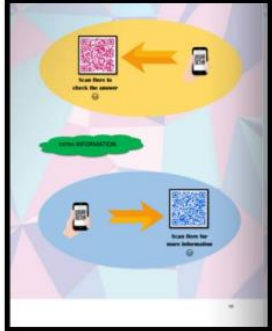
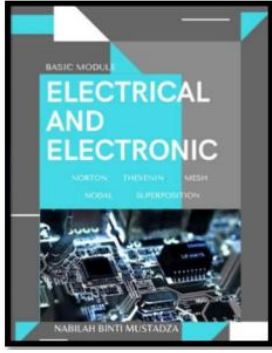
Researchers are not able to get the full syllabus from the KKTm because it is confidential. Based on preliminary research through interviews with KKTm lecturers, it has also been confirmed that the five subtopics chosen as the content of this module are compulsory topics for students in the following institutions. The topic covers are Norton, Thevenin, Mesh, Nodal and Superposition.

(f) Select a Learning Strategy

Some of the strategies implemented in this module are explain in Table 1:

- Design Lessons
- Teaching Implementation
- Student-centered
- Material-centered

Table 1: Strategy implemented in the teaching and learning module

Strategy	Example of the module
<p>Design lesson – There is a list of learning objectives for each subtopic at the beginning of the modules developed. The purpose of the objectives is to make sure that students achieved the learning objectives at the end of the subtopic.</p>	
<p>Teaching implementation – The use of attractive graphics and colors in the teaching and learning modules aims to engage students and stimulate students' memory of important things they have learned.</p>	
<p>Students-centered – Many exercises provided in this module encourage students to solve the problem given by themselves. Students can check their answer by using a QR code.</p>	
<p>Material-centered – This developed module is a material that can be used by lecturers and students. Inside this module also contains additional information that connects to YouTube platform. This teaching and learning module categorized as material-centered, because students can refer as additional reference.</p>	

(g) Select media and integrate module

All the design process was integrated in the module and finally the module was published in the form of Flip Book Digital that is accessible online. However, these modules can also be printed according to the needs and requirements of the users. Researchers use two platforms in this module which is QR code and Anyflip.

(h) Field Work

The final process is to validate the content module. The researchers then selected four experts from UTHM to evaluate the design and content of the completed module.

3. Results and Discussion

The develop module was validated by four experts in electrical and electronic discipline. The experts were asked to validate the module from the aspects of content and design by using checklist instrument type. The results of the study are described in the following sections. The questionnaire are divided into 4 sections namely section A (content aspect), section B (design aspect) section C (technical aspect) and section D for open ended questions. Open ended is to get the qualitative comments from the experts.

(a) Module Analysis of Content Aspects

There are seven items in section A but each is broken down into five different subtopics, namely Norton, Thevenin, Mesh, Nodal and Superposition using the same question items. By using checklist instrument type all the experts (100%) agree with the item as shown in table 2.

Table 2: Analyze part A items based on content aspects

Item
A1. The content of this subtopic is suitable for students taking Basic Electric and Electronic courses
A2. The content of this subtopic is appropriate to the level of study
A3. The description of this subtopic is accurate without any error
A4. The calculation steps related to this subtopic are correct without any error
A5. The circuit used for this subtopic question is clear without error
A6. The exercises provided for this subtopic are appropriate for measuring student comprehension
A7. The extra materials provided in relation to this subtopic are appropriate as they adding the student learning materials

(b) Module Analysis from Design Aspects

There are six items in this section B, all of which answer the questions raised by the researcher. By using check list instrument type all the experts (100%) agree with the item as shown in table 3.

Table 3: Analyze part B items based on design aspects

Item
B1. The colour tones used in the design of the Basic Electrical and Electronic Module are ideal
B2. The font size used in this Basic Module Electrical and Electronic design is perfect

B3. The background colours used in this Basic Module Electrical and Electronic design are ideal
B4. The diagram illustrated in this Basic Module Electrical and Electronic design is appropriate
B5. The graphics used in this Basic Module Electrical and Electronic design are ideal
B6. The arrangement set out in the Basic Module Electrical and Electronic design is organized

(c)Module Analysis from Technical Aspects

There are five items in this C section, all of which answer the questions raised by the researcher. By using checklist instrument type all the experts (100%) agree with the item as shown in Table 4.

Table 4: Analyze part C items based on technical aspects

Item
C1. QR codes work well when scanned and can be linked directly to the materials needed
C2. The QR Code Scanner phone app is easy for students to use
C3. Anyflip's online platform works well when the Basic Module Electrical and Electronic is accessible directly by clicking the link provided
C4. Basic Module Electrical and Electronic can be read fluently using Anyflip's online platform
C5. The buttons on the Anyflip's online platform help access the platform

Experts also comment on the module by open-ended questions. See Table 5 for feedback from experts.

Table 5: Comments from experts

BIL	Aspects	Reviews
1.	Contents	<p>Expert 1: The developed module has no interaction element with the student.</p> <p>Expert 2: The content of this module is in line with student learning in introducing circuit analysis methods. The use of QR codes in this module is very current in today's educational era by providing links to YouTube videos.</p> <p>Expert 3: There are punctuation errors such as 'dots' and 'commas' that need to be checked on each page. Corrections for subscript.</p> <p>Experts 4: Commented that the research should determine whether this study should be given a module name or just a study note.</p>
2.	Design	<p>Expert 1: Some of the errors in the module. Next, the QR code functionality is not working properly because the size of the QR code is too small.</p> <p>Expert 2: The graphics and layout concepts of this module are less attractive and do not reflect the modern design's professionalism during the development of this module.</p> <p>Expert 3: There is no colour contrast for the text and background for some parts.</p>

		Expert 4: Commented that there is a lot of free space in the module being developed.
3.	Extra / Other	<p>Expert 1: Implementing interactivity elements with students so that the module will be more interesting.</p> <p>Expert 2: Researchers need to master each learning style to make it easy to measure and evaluate the effectiveness of this module for students.</p> <p>Expert 3: Add the 'Example' section for each subtopic of at least three (3) examples with different levels. In addition, theoretical questions also need to be prepared to assess comprehension.</p> <p>Expert 4: Creating something interactive can fill that gap with either the question or the interactive picture of the circuit.</p>

Based on the finding in the aspect of content, all the experts agree that the module developed is suitable for student's taking basic electrical and electronic subject as additional references. However the module still lacks the concept of teaching and learning module that should be emphasized on constructivism learning theory. Other than that from the experts' comment, the module is similar to study notes and there is still typo error at certain important topics. Interestingly this developed module is in line with digital environment technology where the pupils easily can access the module everywhere and anytime by the QR code and any flip was provided used in this module.

In terms of design aspect all the experts agree with the background color, font size, diagram, graphics and arrangement used in the teaching and learning module. In contrast, there is still lacking in terms of graphics and layout which is less attractive and the colour use did not contrast for the text and background for some parts.

From the technical aspect the QR code and Anyflip online platform works well and accessible directly by clicking the link provided. However the suggestions from the experts to implementing interactivity elements with students so that the module will be more interesting. The teaching and learning module also needs more examples for each subtopic of at least three (3) examples with different levels. In addition, theoretical questions also need to be prepared to assess comprehension.

4. Conclusion

Overall, the development of teaching and learning modules of the basic electrical and electronic subject is successful and meets the requirement in terms of design, content and technical element as set in the objectives. By making additions from aspects suggested by the expert such as more interactive, and use of appropriate colors will make this module more meaningful. The use of QR code and anyflip will make this module helpful to students so that they can access the module everywhere and anytime they want. The model of Sharifah Alwiah (1981) helps researchers to make the process of making this module systematic.

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