



The Development of a Hypothesis Testing Learning Module Through 5E's Model for Technical and Vocational Education Students

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Abstract. The teaching and learning of statistics can be seen as something very different from other subjects. Apart from cultivating counting skills that involve high thinking and creativity, statistics also requires an understanding in terms of a concept that is accurate and more comprehensive. However, various misconceptions of students in studying inferential statistics were the most troubling things in the study especially for Hypothesis Testing topic. Thus, this study aims to develop a teaching and learning modules of hypothesis testing topics based on the 5E's model as a learning module for students from Technical and Vocational Education background. The 5E model is used to develop teaching and learning activities through five phases, namely engagement, exploration, explanation, elaboration and evaluation. This teaching and learning module used an ADDIE model as a development design by implementing the 5E's model teaching design for the content of the module. Next, this study also evaluates the feedback on the level of effectiveness of the teaching and learning modules that have been constructed. This study was conducted using a quantitative method through questionnaires. A total of 2 experts and 8 students have been selected as respondents in order to provide their feedback on the evaluation of teaching and learning modules that have been developed. The analysis of the questionnaires has been translated in the form of percentage. The results of the study state that the development of this teaching and learning module were pleasing and have achieved its development goals. In addition, the teaching and learning modules that have been developed shows that the teaching design used is in line with students' expectation. In conclusion, the topic of hypothesis testing is said to be difficult to understand by students if the instructional design is used properly and student-centered so that students can move actively in the classroom.

Keywords: 5E Model · Teaching and Learning Module · ADDIE Model

1 Introduction

Nowadays, the use of statistics is becoming more widespread in various fields such as business, medicine, education and even psychology. Statistics is a field of knowledge centered on key concepts such as quantity, structure, space besides change and the discipline of scientific research related to it. According to Johnson & Bhattacharyya, [1] statistics is a subject that provides a principle and way to plan the process of data collection, summarize and interpret data as well as draw conclusions. However, the teaching and learning of statistics can be seen as something very different from other subjects. Apart from cultivating counting skills that involve high thinking and creativity, statistics also requires an understanding in terms of a concept that is accurate and more comprehensive. Statistics is a field of knowledge that cultivates the mind to be able to think in an orderly and systematic manner to solve a problem and make a decision. If seen at first, statistics are indeed in the nature of encouraging meaningful learning and challenging thinking as knowledge of statistics is an important factor in decision making in business and management [2].

Furthermore, statistics is also the investigation of statements that explain abstract structures using logic and mathematical symbols. In order to explain and make descriptions as well as better understand physical relationships and concepts, statistics are seen as a simple way to interpret conversational and written language using very clear vocabulary and grammar. Ribeiro et al. [3] state that statistics is important in data mining process and have the potential in creating competitiveness in various parties. Besides, the right basic statistics can reduce errors in reporting study results and interpreting conclusion [4].

However, learning based on abstract concepts or principles found in statistics especially on the topic of hypothesis testing seems to be difficult for students to understand. Most students who are at the intermediate level were likely to have difficulty understanding the purpose of the problem in question and have difficulty determining how to solve it [5]. Moreover, students experience some difficulty in understanding statistics topics that related to the concept as; (1) difficult to identify the concepts used; (2) difficult to use symbols to represent concepts; (3) it is difficult to identify the properties for a concept and identify the conditions determined by a concept; (4) weak in abstract thinking; (5) difficult in comparing and validating concepts [6].

As we know, learning style refers to how a person can process and observe information obtained in various ways according to the strength of his perception and sensory. Thus, students misunderstanding of certain concepts in statistics affect them when they cannot solve the problem in the allotted time and also making calculation errors [7]. Various students' misconceptions on inferential statistics topics were the most troubling things because this topic is one of the most important areas in statistics. This has led to exploration by researchers as well as educators on various aspects of student learning for the topic of inferential statistics. The negative perception that the Technical and Vocational Training (TVET) field is the second choice for weaker students compared to the conventional academic field causes many of these students to be less confident especially in cognitively shaped subjects [8]. This field needs to instill students' self-confidence because this field can produce the local workforce needed by the industry and the country to weather the industrial revolution.

In many different topics of inferential statistics, hypothesis testing is a topic that been taught in almost all courses covering various levels and majors because hypothesis testing is often used in statistical analysis of populations or proportions. Hypothesis testing topic is a key concept found in statistics especially in considerate inferential statistics [9]. Students lack understanding on the concept of hypothesis testing and they have problems with most symbols that been used. According to Rohana & Ningsih [10], understanding the concept of statistics is not an easy matter especially related to two-sample hypothesis testing. In other words, students are still too difficult to relate concepts or theories they have learned in learning while answering exam questions. Additionally, they still do not have full understanding on the concept of hypothesis testing even though through keywords that have been found in a given question [11].

Difficulties in hypothesis testing can be divided into several categories such as students' mistakes in carrying out hypothesis testing procedures, misunderstanding of hypothesis testing concepts and incomplete understanding of hypothesis testing and related concepts. As such, Nicholson & Ridgway [12]; White & Gorard [13], have suggested that students be better taught about inferential statistics that are more focused on null hypotheses, sampling design, p-values and interpretations of answers that have been found. Learning difficulties were common barriers that affect students' success in learning particularly in higher education, especially in calculation [14]. The learning difficulties experienced by students must not run away from the ability of understanding possessed by students because the understanding of the concept of Mathematics greatly affects the ability of students to solve problems.

Therefore, due to the awareness of the importance of Statistics in the development of current technology, various teaching aids have been introduced such as an online application, reference book besides teaching and learning modules. The development of teaching and learning modules for specific topics is the best alternative for educators as well as students because these modules can be used as a reference that can help students comprehend statistics knowledge and skills effectively [15]. Based on the issues that have been discussed, a module development is needed plus should be done specifically and in detail on the topic of hypothesis testing in statistics. In the context of this module, ideas on learning techniques will be given and the needs and work steps will be arranged according to students' requirements. Thus, this study aims to develop a teaching and learning modules of hypothesis testing topics based on the 5E's model as a learning module for students from Technical and Vocational Education background.

1.1 5E's Model

One of the alternative learning models that is often used is the 5E's learning cycle model adapted from Bybee [17]. This model was developed to create effective and efficient learning activities to enhance students' critical thinking ability. The 5E's learning cycle model used has five stages, namely engage, explore, explain, elaboration, and evaluate as in Fig. 1. The engage phase aims to prepare students to enter the next phase by exploring their initial knowledge and ideas. For the explore level, students are given the opportunity to work in small groups to do activities such as research highlights. Explain is the phase where the teacher encourages students to explain concepts in their own words. At the elaboration level, students can develop concepts and understandings in new situations.



Fig. 1. 5E Model of Instruction adapted from [17].

The last phase is to evaluate where the teacher assesses whether the student has achieved the learning objectives.

One of the advantages of the 5E's learning cycle model is that it can develop individual potential because of the students' conceptual changes that required them to perform analysis during explore phase, application of concepts to new situations in the elaboration phase, and evaluation for each learning that was done [16]. By doing so, their ability to think critically on some indicators can be increased. Research on the ability to think critically is considered important because it is a capital for students to be able to develop their knowledge widely. Handriani, et al. [18] stated that the ability to think critically is a process of deep cognition of students applied in learning activities that meet several indicators. A person's ability to think also determines success in life.

According to Ting et al. [19], the five phases of the learning cycle using 5E's model have succeeded in gaining the interest of the readers by using the strategies that have been suggested in each of the specified phases. Research involving children's verbal and cognitive development has had a positive impact by planning how to activate knowledge of teaching backgrounds, monitor children's understanding as well as place learning outcomes to be achieved [20]. The results of previous studies have proven that although originally the 5E learning cycle model started from Biological Science but the application of this model in teaching and learning is impossible.

In developing competent students and experts in Science, Technology, Engineering and Mathematics (STEM), the objectives of STEM education are not only focused on students' ability to master certain basic knowledge and concepts, but STEM education looks at 21st century skills such as collaborative skills, communication, critical thinking, creativity, and computational thinking need to be emphasized in learning. Students can be directly and actively involved in the process of knowledge exploration so that the pleasure of learning can arise. The most effective teaching and learning strategies are when students can interpret and connect existing knowledge with newly acquired knowledge.

Table 1. Implementation of DDR Phase.

Phase	Type of Development
Phase 1: Requirement Analysis	Literature Review
Phase 2: Design and Development	Development of AR Application
Phase 3: Functionality	Quantitative Method (Questionnaire)

2 Methodology

This study uses a design and development research (DDR) in which the researcher has focused on the development of teaching and learning module and uses a quantitative approach by providing a questionnaire to obtain feedback from experts and students. For the development of this teaching and learning module, the researcher has chosen the ADDIE model as the main reference. This model was selected because each phase in this model is compatible with the development process of this module. This model includes five phases: analysis, design, development, implementation and evaluation. All of the five 5E's Model have been structure as instructional design at the design phase to create activities for students. According to the DDR approach, there are three main phases, as illustrated in Table 1.

2.1 Sampling

The researcher used purposive random sampling in this study because generalization can only be done to populations that have been defined by sample selection criteria and cannot be generalized to other population groups [21]. The researcher has selected a total of 2 lecturer and 8 students who have TVET education background that is suitable for the purpose of the study. These lecturers were teaching statistics class for TVET student while the students were still studying hypothesis testing topic for their statistic classes in their respective TVET institution. The selected lecturers and students will use the built-in teaching and learning modules during their statistics teaching and learning process. Thus, their thoughts and opinions were based on their experience and knowledge on the topic of hypothesis testing during that period.

2.2 Data Analysis

The teaching and learning modules for the hypothesis testing topics that been constructed have been evaluated by two experts who have skilled in terms of content and instructional design before it being used by the respondent. Then, the respondent was given a questionnaire to analyze and provide feedback on the teaching and learning modules of the hypothesis test topics that has been developed. The data obtained from the questionnaire will be processed and translated in the form of diagrams and tables to facilitate analysis. The data have been analyzed according to the research questions that have been set at the initial stage of the study. The results of this analysis will prove the extent to which the objectives of the study conducted by the researcher can be achieved. The assessment

Table 2. Level of Determinant Table

Assessment	Percentage (%)
High	80–100
Medium	40–79
Low	0–39

process being done through a questionnaire that use “YES” or “NO” and have five sections that need to be answered. All sections will be analyzed using percentages. Item analysis for this questionnaire refers to the level determinant table as in Table 2.

2.3 Product Design

To achieve high quality research results, the process must be systematically planned and implemented in order to meet the objectives of the study. Planning phase will minimize or eliminate any unforeseen errors. As part of the product development process, this module was developed based on ADDIE model instructional design. The ADDIE model presented users with an approach to instructional design that incorporated an iterative process complete with essential steps for the development of an effective course or program. In this process, five main phases of the ADDIE model method were intended as a guideline for the development of the module:

Analysis Phase

In this phase, researchers have used two analytical processes, namely reading the literature review and conducting brief interviews with students. The following is a description of each analysis process:

Literature Review

Through the readings process that been done, the researcher found that most of the students has difficulty in hypothesis testing topics. The main problem experienced by these students were difficulty in understanding the concept and confusion about the idea on the topic of hypothesis testing. This issue has made it difficult for them to relate their knowledge of topics to its use. This information was obtained through journals, theses, and internet. The components that have been analyzed were on the research methodology, research objectives and research results.

Interview

Through a brief interview conducted by researchers with TVET students, most of them state that the difficulties they face while studying the hypothesis testing topic were the multi-step procedure and they do not understand on how to apply concepts that been learned into problem solving questions. Students also expect that the teaching and

Introduction

In research, sometimes the researcher must determine whether a statement or hypothesis should be accepted or rejected. In hypothesis testing, normally, we will take more precise approach based on the population parameter and start to develop the workflow. We will begin our discussion with confidence interval approach and continue with two other approach which is critical value approach and p-value approach. Hypothesis testing is really a systematic way to test claims or ideas about a group or population. Can you guys recall, on average, what we should expect the sample mean to be? Is it accurate that researchers take a sample of a population to learn more about its characteristics?

Fig. 2. Introduction part

Okay now, let say, you as a researcher is assigned the following research:

The average age of a population is of interest to researchers. The mean of a random sample of ten people taken from the demographic of interest is 27. Assume the population is approximately normally distributed with a variance of 20.

Can you guys give one research question based on the situation?

Fig. 3. Creating research questions process

learning methods used were more student-centered so that they will be able to contribute their ideas on the topics.

Design Phase

In this phase, researchers have applied the 5E's model into of the teaching and learning activities through this module. This 5E's model is the implementation of constructivism theory that allows students to build new ideas based on their existing knowledge.

Engagement

This phase is a very important phase in the teaching design of the 5E model where in this phase the educator can attract the interest and attention of students on the topics taught. This phase is developed in the topic introduction section through questions that been develop. The researcher deliberately posed the question at the introduction part in order to draw the students' attention to think about the topics. The researcher also gave instructions for students to make a research question based on the given situation. The instructions can make students recall on how to make research questions as they have learned before. Figure 2 and Fig. 3 show the questions involving the engagement phase.

Exploration

Exploration phase gives students a basic experience of the knowledge they have previously acquired. In this phase, the researcher has allowed the students to explore the basic concepts of hypothesis testing. This phase provides an opportunity for students to develop basic concepts and skills for hypothesis testing topic. The researcher has asked the students to change the research question in two different ideas or been simplified as

Next, let's recall back with research about animal behavior above. How can you turn the research topic into a clash of two opposing concepts using the first step of hypothesis testing?

Idea 1:

Idea 2:

Fig. 4. Instruction in generating hypotheses

Let's recall back to research before. Now, you already have your two opposite ideas which is:

Idea 1: The mean is same from 30 years.

Idea 2: The mean is different from 30 years.

Based on these two ideas, we want to design a study in order to be able to make a decision about the two statistical hypotheses. In hypothesis testing, we must choose between H_0 and H_1 . We all want to make the best decision possible, yet we all make mistakes from time to time. How would you explain each of these scenarios in language?

- 1) We choose H_1 , however this is the wrong choice because H_0 is correct.
- 2) We choose H_0 , however this is the wrong choice because H_0 is false.

Fig. 5. Instructions on idea restructuring

null and alternative hypothesis. This activity needed for students to differentiate ways to construct hypotheses. Figure 4 shows the instructions containing the exploration phase.

Explanation

This descriptive phase is where students can restructure their ideas that has been acquired. Students can explain the concepts that they have learned very well. In previous exploration phase, students can generate new ideas, thus, the description phase is where these students can restructure the ideas and knowledge that they have to re-explain the content of learning as shown in Fig. 5.

Elaboration

Next, the elaboration phase allows students to identify new ideas and able to apply those ideas with the right concepts. The concepts that have been constructed will be linked to real-world situations. Having obtained explanations for all the approaches used in hypothesis testing, the researcher has instructed the students to expand their knowledge that they have acquired by selecting new research questions and using various hypothesis testing approaches to get answers. In this phase, students were allowed to work with peers to discuss the instructions of a given question as shown in Fig. 6.

After learning, all the approach to test one sample means and two sample means, we would like to elaborate more on how we want to gather evidence to make decision and do conclusion based on the evidence.

We will use the same experiment about mean age before. Can you give another research question that suitable with the experiment? Then, elaborate the steps using any approach that we learned before to conclude your research question. State the data, assumptions, hypotheses, test statistic, decision rule and the decision made.

Fig. 6. Instruction on idea development

END-OF-CHAPTER PROBLEMS

1. A researcher performs a hypothesis test and finds his theory to be correct. Explain why coming to this conclusion is never a good idea in hypothesis testing.

2. Employees of a large corporation are concerned about the declining quality of medical services provided by their group health insurance. A random sample of 100 office visits by employees of this corporation to primary care physicians during 2004 found that the doctors spent an average of 19 minutes with each patient. This year, a random sample of 108 such visits showed that doctors spent an average of 15.5 minutes with each patient. Assume that the standard deviations for the two populations are 2.7 and 2.1 minutes, respectively.
 - (a) Construct a 95% confidence interval for the difference between the two population means for these two years.
 - (b) Using the 2.5% significance, can we conclude that the mean time spent by doctors with each patient is lower for this year than that for 2004?
 - (c) What would the decision for (b) be if the probability of making a Type I error were zero? Explain.

Fig. 7. Questions at the End-Of-Chapter-Problem

Evaluation

For this last phase, educators can assess the students' comprehension by using the questions provided at the end of the module. Questions that been provided were relatively purpose to assess students' comprehension according to their teaching and learning activities that have been developed. Figure 7 shows some of the questions provided in the End-Of Chapter-Problem.

Development Phase

Development stage refers towards the provision of learning for students in order to achieve the research objectives that have been set in the design stage. In this phase, researchers have developed a teaching and learning modules exactly based on the design phase. At this phase, module development process that includes all the content based on the syllabus need to be consistent with student's necessities. It is hoped that this

developed module will attract the interest, motivation and understanding of these TVET students and further help their success in considerate this topic.

Implementation Phase

The implementation stage refers to the actual delivery of the use of this module whether used in the classroom, laboratory or through online learning effectively and efficiently. The implementation phase in this study is where the researcher has produced a teaching and development module and it has been used during data collection process. Lecturer and students use the provided modules during their statistics teaching and learning classes as their thoughts and opinions were based on their experience and knowledge on the topic of hypothesis testing during that period.

Evaluation Phase

The evaluation phase was the last phase that need to be analyzed. This stage measures the effectiveness of this module which is carried out comprehensively in a given stage, between one stage to another, and after the implementation process. In this phase, it involves the validation process from 2 lecturer and 8 students who have TVET education background as they were using this module during their statistic classes in their respective TVET institution.

3 Results

The research instrument was used in evaluating the usability feedback of the teaching and learning module of hypothesis testing topic based on 5E's model. There were 4 sections that been analyzed namely Section A (Demographic Information), Section B (Content Quality), Section C (Potential Effectiveness) and Section D (Overall Satisfaction). Based on Fig. 8, the number of female respondents is 80% ($n = 8$) while the male respondents were 20% ($n = 2$) as the study was conducted randomly without specializing in gender.

The results of a closed-ended questionnaire given to the respondents' perception on hypothesis testing topic stated that as many as 80% of them were agreed that the topic of hypothesis testing was difficult to learn as shown in Fig. 9.

Next, section B contains 6 questions that need to be evaluated by the respondents on the content quality of the module based on the objectives and content as in Table 3.

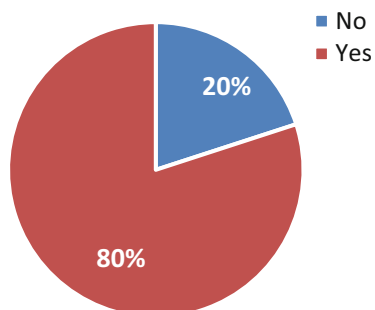


Fig. 8. Respondent gender

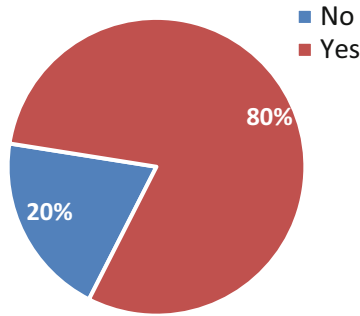


Fig. 9. Respondents’ perception on hypothesis testing topic

Table 3. Content quality analysis

No.	Items	Percentage (%)	
		Yes	No
1.	I think the teaching objectives achieve the goals of the module.	80	20
2.	I think the teaching objectives lead to the achievement of learning outcomes.	100	-
Content			
3.	I think the content of the module meets the teaching objectives.	80	20
4.	I think the content of the module is complete in terms of teaching steps.	100	-
5.	I think the content of the module is complete in terms of reinforcement exercises.	80	20
6.	I think the content of the module is complete in terms of assessment.	90	10

The result of the analysis shows that only 20% of the respondents disagreed with items 1, 3 and 5 of which 80% of the respondents agreed that the teaching objectives can achieve the module goals and the module content meets the teaching objectives. While 90% agreed with item 4 that the module content is complete in terms of assessment and all experts and students (100%) agree with items 2 and 4. This shows that all respondents agree that teaching objectives can lead to the achievement of learning outcomes and able to help students understanding.

Then, section C contains 17 questions on potential effectiveness of the module which been separate into 4 parts on usefulness, flexibility, presentation and evaluation. All these aspects need to be evaluated to ensure that this teaching and learning modules can provide maximum effectiveness as in Table 4.

The results of the analysis as in Table 4 show that only 70% of the respondents agreed with items 8 and 12 in which they acknowledged that module content uses appropriate techniques to engage students in learning and the contents of the module are suitable for students' self-use. While 80% agreed with items 7, 9, 10, 14, 15, 16, 17, 18, 21 and 23 that they agreed that the techniques used in the module can be applied effectively, the content of the module have been customized according to the student's need, the activities in the module can attract students' active participation, the level of difficulty in the module content is suitable with students' cognitive ability and the scope of the title and the order of the topics in the module is compatible with the students' developmental

Table 4. Potential effectiveness analysis

No.	Items	Percentage (%)	
		Yes	No
7.	I think the techniques used in the module can be applied effectively.	80	20
8.	I think the module content uses appropriate techniques to engage students in learning.	70	30
9.	I think the content of the module have been customized according to the student's need.	80	20
10.	I think the activities in the module can attract students' active participation.	80	20
11.	I think the activities in the module enable students to understand the content well.	100	-
Flexibility			
12.	I think the contents of the module are suitable for students' self-use.	70	30
13.	I think the content of the module is suitable to be use during teaching and learning sessions in the classroom.	100	-
14.	I think the level of difficulty in the module content is suitable with students' cognitive ability.	80	20
Presentation			
15.	I think the scope of the title in the module is compatible with the students' developmental needs.	80	20
16.	I think the order of the topics in the module is compatible with the students' developmental needs.	80	20
17.	I think the topic in the module is arranged logically according to the order of learning.	80	20
18.	I think the terms used in the module are easy to understand.	80	20

(continued)

Table 4. (continued)

No.	Items	Percentage (%)	
		Usefulness	Yes
Assessment			
19.	I think the reinforcement status is clearly stated in each lesson.	100	-
20.	I think the assessment provided accordance with the teaching objectives.	100	-
21.	I think the assessment provided can measure the achievement of teaching objectives.	80	20
22.	I think the assessment component is in line with the content of the module.	100	-
23.	I think the assessment can be carried out using worksheets in modules.	80	20

needs. They also agreed that the topic in the module is arranged logically according to the order of learning, the terms used in the module are easy to understand and the assessment provided can measure the achievement of teaching objectives and can be carried out using worksheets in modules.

Afterward, all experts and students (100%) agreed with items 11, 13, 19, 20 and 22. This shows that all respondent agreed that the activities in the module enable students to understand the content well, the content of the module is suitable to be use during teaching and learning sessions in the classroom, the reinforcement status is clearly stated in each lesson and the assessment component is in line with the content of the module.

Next, section D contains 16 questions on overall satisfaction as the respondent give their opinion on the usefulness of the module in their teaching and learning process as in Table 5.

The results of the analysis from Table 5 show that only 60% of the respondents agreed with items 29 and 34 that the content of the module can be adapted with students from various background and this module can be applied alone. Besides, 90% respondent agreed with items 25 and 27 that the content of this module contains all the basic information that students need to know and the content of this module contains all the basic information that students need to know. Furthermore, all respondent agreed with items 31, 32, 37 and 38. This shows that they agreed on this module contains information that is useful to students, this module provides an opportunity for students to practice the skills they have learned, this module has the potential to be a source of reference for educators and this module has the potential to be a source of reference for students.

Table 5. Overall satisfaction analysis

No.	Items	Percentage (%)	
		Yes	No
24.	The goals of the module were clear.	80	20
25.	The objectives of the module were appropriate for students.	90	10
26.	The content of the module is easy to understand.	80	20
27.	The content of this module contains all the basic information that students need to know.	90	10
28.	The content of the module connected well with the students.	80	20
29.	The content of the module can be adapted with students from various background.	60	40
30.	The planned activities are in line with the teaching objectives of this module.	80	20
31.	This module contains information that is useful to students.	100	-
32.	This module provides an opportunity for students to practice the skills they have learned.	100	-
33.	This module can increase students' level of knowledge.	80	20
34.	This module can be applied alone.	60	40
35.	This module can be applied across other subjects	80	20
36.	This module has effectiveness potential if it used to teach students with learning difficulties.	80	20
37.	This module has the potential to be a source of reference for educators.	100	-
38.	This module has the potential to be a source of reference for students.	100	-
39.	Overall, this module have a very good quality.	80	20

4 Discussion

This study was conducted in order to develop a teaching and learning module that can help educators teaching and learning sessions more meaningful. In the context of this module, ideas on learning techniques have been design and arranged according to student's needs. The results of this module development were expected to provide positive input to certain parties as an effort to produce skilled and knowledgeable students and ensure that they remain quality at all times. However, in order to increase student learning independence can be taken through several steps when using modules, namely: (1) prepared modules with specific subject matter, (2) share modules that will be used

before the implementation of the educators, (3) students need to study the modules given, (4) in the lecture process, educators use a specific learning model with teaching materials in the form of modules that have been given before [22].

ADDIE model is often and suitable to be used in developing modules because it helps researchers to organize projects better according to a set time frame [23]. Although many more module development models such as the Dick and Carey, Waterfall or Hanaffin and Peck, ADDIE model remains the best based on discussions from previous studies. This model commonly used as a model in e modules teaching strategies in the classroom and suitable to be used as a module development models because of the existence of processes based on problem analysis, design, development, implementation and evaluation [24]. Furthermore, the systematic structure of the ADDIE model really helps in developing a teaching module [25].

Next, the 5E's model is a teaching design that is familiar to student-centered learning that also known as inquiry-based learning that encourages students to investigate problems, explore using existing knowledge and make new discoveries as well as understand learning using the expansion of acquired knowledge [26]. This inquiry-based instructional design can usually encourage students to be actively involved during teaching and learning sessions because of the design that educates students to learn through experience [27]. This is in line with the study conducted by Damayanti et al. [28] that state the ability of educators to create innovative learning using the 5E's model has been able to involve all students in teaching and learning activities that have simultaneously helped the educator knows the student's attitude towards the subject. Besides, there was a STEM module that been designed based on the 5E's model in order to help students in rural schools in Sabah which is in line with the Primary Science Curriculum Standards [29].

Formerly, the results of the analysis have shown that all respondents agree that the teaching and learning modules developed has help lecturers and students in making the teaching and learning process easier to understand. The result is in line with Widyastuti & Nurfarida [30] research who develop a statistical module based on the 5E's model that proof to be successful in showing excellent results and good response from students. This is supported by Garzon & Casinillo [31] that state the achievement of students who exposed to 5E guided inquiry model significantly higher compared to the achievement of students exposed to traditional strategy.

Ahmad Nizar et al. [32] in their research state that the development of a designed statistical module the shape with the 5E's model is very practical to be use based on the evaluation from experts, lecturers and even students. Thus, providing action with the 5E learning model can improve students' mathematical connection skills as the essential components and the proper sequence of the 5Es Model were evident in teaching and learning modules development success [33]. It can be credibly concluded that a development and validation of a 5E teaching module is crucially needed by the educators [34]. Therefore, it is important that this proposed module will eventually serve as a guide and model for the TVET educators and student through an inquiry manner instead of utilizing the teacher-centered learning especially in TVET area.

5 Conclusion

Based on the result and analysis that has been conducted, the researcher has found that the main goal of the development of teaching and learning modules have been achieved. The researcher's decision to implement the 5E's model have make the teaching and learning module suitable for students and increase their ability on hypothesis testing topics. Students can use these modules as a reference during teaching and learning sessions. The modules can help them increase their understanding within teaching and learning activities that have been planned. The interactions found during the teaching and learning sessions can enhance their social skills and able to build understanding on their own without guidance from the educator entirely.

Besides, this module can be used as a reference by educators in building their teaching design which is suitable for students. The instructional design of this 5E model is sufficient to increase students' learning motivation; students are able to learn through experience; students develop ideas more creatively according to the situation; presume more meaningful teaching and learning sessions. In conclusion, the teaching and learning modules that been used during the teaching and learning sessions need to take into account students' needs. Therefore, the development of this teaching modules was necessary and able to facilitate students to receive information. The study conducted showed that the teaching and learning activities of the student-centered 5E's model that has been developed have achieve the teaching objectives well.

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