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The Development of a Patterned Topical Teaching and Learning Module (ToPo) and its Effect on form 4 Students' Achievement on the Topic of the Probability of the Combined Event

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Abstract

Research on the drilling process has proven that more and more Training in mathematics subjects in particular and Education in general will yield good results. But we must realize that drills must also be patterned so that all skills and lessons can be mastered. As a result, the purpose of this study was to develop and test the approach of using a patterned topical module (ToPo) as an alternative method to master the title of Probability of Combined Events in Mathematics form 4, KSSM as much as possible. The first phase involves the development phase of the ToPo module based on the ADDIE model. While the second phase used a quasi-experimental design of a pre-post test of an unequal control group of 60 Form 4 students in a class in a school in Larut, Matang, and Selama. Districts selected by cluster sampling technique. Data were collected using 1 instrument, namely the student achievement test on the topic of Combined Event Probability. Data were analyzed descriptively and inferentially through an independent sample t-Test (ANCOVA test will be used if there is a significant mean difference in the pre-test. In addition, mean and standard deviation as well as thematic qualitative analysis are also used for perception analysis. The analysis compared with a control group. Study. This successfully developed a ToPo module with high index validity and reliability. The results of the student's achievement test on the subject of the probability of combined events for the treatment group were the pre-achievement test mean of 2.8, the post-test mean of 48.43, and the retention test mean of 51.5. This result is very positive and significant that the use of the module (ToPo) increases student achievement. This is proved if you look at the results for the control group only recording the mean for pre is 4.53, post 23.7, and retention 24.4.

Keywords: Patterned Topical Module, Probability of a Combined Event, Learning Module, Achievement in Probability

Introduction

Every human being born into this world has its own uniqueness. If this uniqueness is polished then pioneers are born in various fields such as Albert Einstein (Physics), Bill Gates (Computer software), Jeff Bezos (Businessman), and many more. The same goes for a teaching and learning module. If a module is presented in a patterned form that takes into account all possibilities then the module is a unique module that has the potential to strengthen and maintain students' understanding of mathematics in general and the topic of combined event probabilities in particular. Siti Zabidah (2006) stressed that children are seen to be able to enhance their potential and this depends to the teaching and learning environment and situation.

There is a phenomenon where excellent students are able to solve complex mathematical problems but face problems when answering simple questions only. This is not because they have no knowledge but a lack of exposure to a variety of question forms. When questions are asked indirectly then many students face problems.

If we look at the SPM KBSM mathematics question, the question is not an open question. Each year, the title and form of the question have been identified because the format is clear on what title and what skills will be asked. That is an example of the pattern in the question and even then the percentage of students who get excellent results of A+, A, and A- is still unsatisfactory. Try to imagine what will happen to the SPM question whose format is not explained. Of course, exam results will be logically lower. On that basis, the researcher thinks that there is a need for a module that is not only topical but highlights the characteristics of various forms of SPM format questions so that students are continuously exposed to any possible question format in the examination later. Each skill is grouped and all possible questions are revealed so that students can truly identify weaknesses and then work on overcoming those weaknesses.

Statement of Problem

The problem of learning mathematics is an issue that has always been a major thing in the life of a mathematics teacher. Mathematics is not for unattractive, stereotypical, difficult, and boring subject when compared to other subjects such as language, physical training (Alphin & Saunders, 1996; Lee & Cockman, 1995), and even science (Allchin, 1999; Tan, 1997). Proctor, 1991). Arguably listening to the word math is like hearing a horribly tragic story, especially among rural or outback students. According to Azlina (2003), mathematics is one of the subjects that is considered a "killer subject". Students' perception that mathematics is a "killer subject" will make the process of observing mathematical knowledge more difficult. This is because according to Buxton (1981), anxiety about mathematics has led to the existence of a negative influence on mathematical achievement among students.

In order to maximize the educators' efforts on the students, the Patterned Topical Module (ToPo) in the topic of Probability of Combined Events is necessary and very important to be developed in the Malaysian education system. This ToPo module provides systematically patterned exposure so that each skill is segregated to be seen and mastered. Students will know the elements of their weaknesses on a topic and be able to work in a focused manner.

The achievement of students for the title of probability II that is during KBSM which is equivalent to the title of Probability of Combined Events KSSM is worrying because only 20 percent of the students of SMK Convent Taiping (for example one of the schools in the LMS district) who got full marks for this title (Report Post-Mortem Analysis of SPM Trial, 2018).

The rest of the students did not get full marks and there were also students who did not get any marks for this title. Table 1.7 and table 1.8 show the overall SPM results position at the National and school levels (in the LMS district). Perak states on average ranked eleventh nationally while SMK Convent Taiping ranked third at the LMS district level in 2019 (population area of this study). These school data reflect the reality of student abilities. If in the third position of the district, only 20 percent of the students get full marks in the topic of Probability then more or less the same data for other schools. In this regard, it is very important that an effort such as the production of this ToPo module is undertaken and realized.

Past studies have shown scientifically that students guided in a more focused manner will be able to improve their achievement in the subject. According to Shaharom (1995); Kamdi (1990), a learning activity becomes more planned and systematic when implemented in a modular manner. In line with Burns' (1971) claim that the learning process can be enhanced if a topic from a particular subject is broken down into several sub-headings so that it is easy to read or use through a systematic method. One of the methods considered simple is by constructing sequential teaching and learning materials in the form of modules (Shaharom & Yap, 1991). Therefore, the continuous use of the Patterned Topical Module (ToPo) for the topic of the Probability of Combined Events will improve student achievement.

For some students who do not understand a sub-topic in probability, it is very important for a teacher to use quality methods that are easily understood by his students. The use of textbooks and reference books alone is not able to increase the understanding of the students to the maximum level. Therefore, the use of modules aided by advanced technology in this century can be used to provide a better understanding and interest of students. However, the use of technology must also be supported by quality learning content (Weiser, 2002).

The creativity of teachers introduces alternative methods that make students' understanding more concrete through a variety of means. Thus student achievement can be maintained consistently. Among them is to include all the mathematical knowledge in a module to provide guidance to students. For example, the symbols or notation in this Combined Event Probability heading are as follows, (see Table 1.9).

Table 1.9
Examples of symbols or notation in the title of the probability of a combined event are described to students creatively

\cup Union	Sem \cup a : the teachers place the symbol to complete the word 'semua'. So students can understand the symbols \cup represents the letter 'u' which will make sense 'semua'
\cap intersection	San \cap a : symbol \cap is can be part of a letter m which will carry that meaning 'sama'
P' complement P	P' : means not P. Don't answer P complement but answer not P easier to understand

Source: Matematik Di Mercu Module, 2019-2020

Research Objective

This study focuses on 2 main objectives, namely:

1. Identify whether there is a significant difference in the achievement of the title Probability of Combined Events between form 4 students who follow the teaching method using patterned topical modules (ToPo) and conventional teaching methods.

2. Identifying whether there is a significant difference in the retention of achievement on the subject of Combined Event Probability between 4th-grade students who follow the teaching method using patterned topical modules (ToPo) and conventional teaching methods

Research Questions

1. (a) Does the patterned topical teaching and learning (ToPo) module on the topic of Combined Event Probability have a high degree of face validity?

(b) Does the patterned topical teaching and learning (ToPo) module on the topic of Combined Event Probability have a high degree of content validity?

(c) Does the patterned topical teaching and learning (ToPo) module on the topic of Combined Event Probability have a high-reliability value?

2. Is there a significant difference in the achievement of the title Probability of Combined Events between 4th-grade students who follow the teaching method using patterned topical modules (ToPo) and conventional teaching methods?

3. Is there a significant difference in the retention of achievement of the Probability of Combined Events title between 4th-grade students who follow the teaching method using a patterned topical module (ToPo) and the conventional teaching method?

Literature Review

According to Ngadirin (2003), a module is a teaching material that has been divided into several specific sub-topics, and the arrangement of each sub-topic has a relationship or continuity with each other. It is in the form of course materials (subjects, training, etc.) that are implemented separately to achieve a skill. Noordin's (1992, 1996) study showed that modular teaching methods that use mastery learning strategies have successfully improved students' perceptions of a concept learned and in turn improved their academic achievement. The modular teaching method is also one of the teaching methods that successfully improve students' conception of a concept learned (Noordin, 1997).

Siheset et al (2007) stated that modular teaching methods are suitable for use for self-learning as well as as a material tool in teaching and learning activities. The modular teaching method is a planned and guided teaching method. Planned instruction is a learning system in which the content of the subject is arranged according to the sequence/steps of learning (Asran et al., 2007). These steps are then broken down again into smaller steps (patterns). A student can follow the steps according to the pace of his learning and his learning is reinforced based on the feedback from the assessment given after each step (Asran et al., 2007).

According to Asran et al (2007), the benefits of planned teaching are as follows:

- i) Each student progresses according to his or her own ability, speed, and interest.
- ii) Learning can take place in any place and time and can be repeated and reviewed according to the needs of students.
- iii) Since the content of the subject has been planned, the content is something that is neatly arranged so that learning becomes easy.
- iv) All the problems and complex concepts in the context of planned teaching can be adapted to the abilities of students. The way the content is written or presented can be simplified for weaker students.

- v) The cost of preparing a planned material for the use of a student is cheap if used in a subject that does not always change its content, especially if the planned material is printed in bulk.

Methods / Methodology of The Study

The study design is a structured and strategic planning, to determine how research is done to find answers to research problems that have been set (Kelinger, 1986; Sulaiman, 2002). Courtney (1982); Kelinger (1986) identified two main purposes that are fundamental in producing a study design which is to get answers to each research question and control for variance.

This study is divided into two phases, namely the module development phase and the module evaluation phase. The development of a patterned topical module (ToPo) for the topic of Combined Event Probability based on the ADDIE Model (1987) is discussed in detail in Chapter 4. The second phase of this study uses a quasi-experimental study design with two types of variables namely independent variables and dependent variables. The independent variable in this study is the teaching method which is divided into two levels or categories, namely the teaching method using patterned topical modules (ToPo) and conventional teaching methods. The dependent variables are divided into two, namely student achievement in the topic of Combined Event Probability, and retention of student achievement in the topic of Combined Event Probability.

The second phase of this study used a quasi-experimental study design i.e. pre-test and post-test control group design (Creswell, 2005; Campbell & Stanley, 1963). According to Christensen (2001), a quasi-experimental design is a design used when control over the influence of extraneous variables cannot be fully met. There are three conditions to meet the characteristics of a true experiment study (true experiment) that is, the researcher selects a sample at random, places the sample into the treatment group at random, and can control for independent variables (Kerlinger & Lee, 1999).

In this study, the experimental group was exposed to learning the topic of Combined Event Probability through the teaching method using a patterned topical module (ToPo), while the control group was through the conventional teaching method. Both groups will be given a pre-test to see students' initial achievement on the topic and a pre-questionnaire to identify students' attitudes toward the topic of Probability of Combined Events before treatment is given. The experimental group will be exposed to teaching methods using patterned topical modules (ToPo) during the learning of the topic of Probability of Combined Events and the control group will be exposed to conventional teaching methods during the learning of the topic of Probability of Combined Events. At the end of teaching and learning both groups will be given a post-test to assess their achievement in the topic of the Probability of Combined Events. Four weeks later again both the experimental group and the control group will be given the test retention of student achievement in the topic of Probability of Combined Events to see the retention of their achievement in the topic of Probability of Combined Events.

According to Tuckman (1978), a quasi-experimental design involves one or more treatment groups acting as subjects in various levels of independent variables. For example, a study by Tasir (2002) used a quasi-experimental design to evaluate the effectiveness of multimedia software based on the Gardner Intelligence Diversity factor. While the second example is a study conducted by Sternberg (1995) which uses a quasi-experimental study

design to compare and evaluate the effectiveness of conventional teaching and teaching that applies analytical, creative, and practical thinking skills to intelligent students.

The rationale for selecting a quasi-experimental study design over an actual experimental study design is that it is difficult to place respondents randomly into a control or experimental group (Campbell & Stanley, 1966). This is because the study respondents were classified according to the classification system set by the school. The design of quasi-experimental studies is suitable to be implemented in schools because the determination of respondents in either the experimental group or the control group could not be implemented randomly (Ary, 1985). Best and Kahn (1998); Cates (1985) support the design of the post-test pre-test control group because it is a robust design. The experimental group was taught by teaching method using a patterned topical module (ToPo) for the topic of Combined Event Probability (see Appendix A) while the control group was taught using a conventional teaching method (see Appendix B). Table 3.1 shows the study design in the second phase of this study.

Table 3.1
Study Design in the second phase of the study

Experimental Group	O ₁	X ₁	O ₂	O ₃
Control Group	O ₁	X ₂	O ₂	O ₃

Guidance

- X₁ = Teaching Methods Using Patterned Topical Modules (ToPo)
- X₂ = Conventional Teaching Methods
- O₁ = Pre -Achievement Test
- O₂ = Post-Achievement Test
- O₃ = Retention – Achievement test

Patterned Topical Module (ToPo)

The patterned topical module (ToPo) is an innovation from the existing teaching modules. This ToPo module is more focused because this module is built based on question patterns. These question patterns are segregated according to similar characteristics so that students will be able to have concrete reinforcement when repeatedly solving problems of the same characteristics. All available question patterns are included in this ToPo module. A pattern is a repetitive thing but not the same (has the same characteristics). A relationship is something that is related because of something. Both of these things are important to give us confidence in determining/anticipating the next thing that will happen/ appear. Pattern studies are not only found in the field of mathematics, but also in the fields of art, music, textiles, and so on (Muhamad, 2011).

In addition, this ToPo module collects all the possible question forms that will be asked in the exam. This is very important because students are sometimes unable to delve into the meaning of a question even if it is a low-level question only. This is because they sometimes come across forms of questions that they have never revealed. This is very detrimental to the students as they can actually answer but do not think of the intent of the question. The causes of difficulties in problem-solving are due to students not understanding the requirements of

the question, inability to extract information from the question, failure to plan strategies, and also wrong when making calculations (Saleha & Norbany, 2010). Mathematics trauma, or translated as 'mathematical trauma' can make a student feel unwilling to calculate the reason for fear of being wrong and not understanding what mathematics really is. Roughly speaking, the general feels that mathematics is limited to calculations only, but not many are aware that the decision-making process (including the use of calculations), still requires a certain level of self-confidence that they can do it (Shaharir, 2014).

This ToPo module is also loaded with notes, formulas, and alternative methods not found in textbooks. This ToPo module complements and provides a complete reference for students making it a guide. This is very important because when students have long since left this title they will find it difficult to find a complete reference if in the absence of this ToPo module. To stay in line with educational standards, our teachers must be able to teach mathematics using a variety of alternative techniques and strategies to engage students. This is in contrast to conventional mathematics teaching methods which typically consist of memorization, use of practical numbers and equations (lack of manipulation), worksheets, drill methods, and repetition of similar problems, and are usually teacher-centered (direct instruction). In a 21st-century classroom, a mathematics teacher must integrate unconventional technologies and strategies when teaching mathematics to meet the requirements of national educational standards (Duncan, 2011).

Misconceptions and tips are also worked out so that students do not make repeated mistakes. They will be more cautious if misconceptions have been revealed. The space to relax or relax the mind also decorates this ToPo module to maximize the elements that attract students to approach and use this ToPo module as much as possible. Many students are unable to solve problems due to poor conceptual mastery or misconceptions (Marlina & Nurulhuda 2011). Misconceptions can also occur when students tend to solve Mathematical problems by memorizing Mathematical procedures and operations (Proulx 2007; Zawawi et al., 2009). There are various methods of dealing with misconceptions among students such as making oral assessments, group work, analyzing test questions, and reviewing student exercise books. Analysis of these students' answers will provide findings of misconceptions that occur among students. This is supported by Saleha and Norbany (2010) that effective learning will result if every mistake or misunderstanding that occurs can be discussed during the learning and teaching process that takes place in the classroom. This is also supported by Betty's (2011) study that carefully reviewing student training allows teachers to understand the real problem of student misconceptions.

Next to the activities of PAK 21, the disclosure of KBAT questions is also important content and will give real satisfaction to study the topic of Probability of Combined Events. Students are not just tied to books and papers alone. The activities included in this ToPo module can be performed during PdP

To complete this ToPo module, additional references such as the url of the videos titled Probability of Combined Events are also inserted. Students can be viewed anywhere. At school by using a chromebook supplied by the YTL network company (an internet supply company appointed by the MOE) or at home just use any gadget. The use of video allows students to visualize something learned easily and clearly. Video-based learning is the most effective technology for enhanced learning (TEL) as a resource learning in online learning (Yousef et al., 2014).

Finally, the actual SPM format questions make this ToPo module a patterned and complete module as an innovation and creativity that meets the principles of education so that the increase in human capital can be realized and a high-tech nation can be embodied. Mathematics is one of the subjects that requires understanding and skills in counting, so students should be exposed to sets of exercises that can increase their level of understanding and skills of students have addition to exposing students to the concept of student-centered learning (Zaidatun, 2010).

Principles and Models of Module Development (ToPo)

The term instructional design refers to a systematic process in reflecting the translation of teaching and learning principles by planning instructional materials, information resource activities, and assessments (Smith & Ragan, 2005). According to Reigeluth (1983), instructional design is concerned with an individual's understanding of improving and implementing instructional methods. It is the process of determining the best teaching method to bring about the desired changes such as students' knowledge and skills to master the course content. While Piskurich (2006) states that instructional design is a training program plan from the moment of having it to implement the program.

Within the scope of this study, the instructional design constructed was a Patterned Topical Module (ToPo). This module is built as one of the teaching methods that focuses on various forms of questions classified according to patterns to build concrete skills among students. In the context of this study, the title Probability of Combined Events was chosen as the pilot title for the subsequent researchers to choose other titles. Modular teaching is so important in a course and has been a major aspect of teaching and learning for a long time (Ummu Nasibah et.al, 2015).

Among the advantages that exist of modular teaching are such as cost-effective use, efficient time management, orderly learning, having a method of assessment of learning outcomes, and always consistency (Piskurich, 2006). Smith & Ragan (2005) also stated that encouraging student engagement, supporting effective, efficient, and engaging teaching, facilitating teaching as well as facilitating coordination between objectives, activities, and assessments are advantages of modular teaching. Therefore, developing modules is very important to help its use implement teaching and learning smoothly and with quality.

Good teaching and learning planning will help educators to achieve the set learning outcomes. The ToPo module in this study was developed based on the ADDIE model. ADDIE is an abbreviation for the terms Analysis (Analysis), Design (Design), Development (Development), Implementation (Implementation), and assessment (*Evaluation*) (Gustafson & Branch, 2007; Molenda, 2003).

Findings

Findings from the feedback from the expert evaluation collected through the module content validity evaluation form instrument and the ToPo module reliability evaluation form instrument were analyzed. Data analysis aims to scientifically and systematically prove the module's validity and reliability.

To determine the validity of the content of a module, there are two methods of evaluation analysis made by researchers. Two methods of analysis of the determination of content validity are percentage calculation and content validity index (CVI). The use of the percentage method was made based on the adaptation of the content validity instrument of (Jamaludin

Ahmad, 2015). Based on the views of module experts, a value of 70 percent is considered to have high content validity. This is evaluated using the following formula:

$$\frac{\text{Jumlah skor pakar}}{\text{Skor maksimum (188)}} \times 100 = \text{Tahap Penguasaan Kesahan Kandungan}$$

The result of the analysis of the percentage of expert views on the module is 87.76 percent. The details of the data analyzed using the content validity instrument are explained in table This proves that this module has high content validity.

The table shows the results of the achievement test for the control group and the treatment group:

	Mean		Standard deviation	
	Control	Experiment	Control	Experiment
Pre Achievement	4.53	2.8	8.89	2.61
Pos Achievement	23.7	48.43	17.47	9.91
Retention Achievement	24.4	51.5	17.92	6.61

Results of Independent Samples t-Tests for the Post-Achievement Test of Combined Event Probability Between the Control Group and the Experimental Group

	Levene's test for equality of variances		t test for equality of means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Perbezaan Min	Std. Perbezaan Ralat	Bawah	Atas
Equal variances are assumed	19.392	.000	-6.695	58	.000	-43.133	6.442	-56.029	-30.237
Equal variances are not assumed			-6.695	8	.000	-43.133	6.442	-56.101	-30.166

Referring to the Table above, the results of Levene's test show a value of $p = 0.00 (< 0.05)$. So the assumption of the equality of variances is not met. Therefore, the results of the independent sample t-test will be based on the second line, which is the line 'Equal variance not assumed'. Based on the Table above, the results of the independent sample t-test show that there is a significant mean difference in the post-achievement test of the combined event probability title between students who follow the teaching method using the ToPo module ($M= 48.43, SD=9.91$) and the conventional learning method ($M= 23.7, SD=17.47$), $t(46.02) = -6.70, p = 0.00$. If a value of $p < 0.05$, then the null hypothesis $H03$ is rejected.

This means that students who followed the teaching method using the ToPo module (experimental group) showed a significantly better achievement of the title of the probability

of combined events compared to students who followed the conventional learning method (control group).

Results of Independent Samples t-Tests for the Retention Test of Combined Event Probability Title Achievement Between the Control Group and the Experimental Group.

	Levene's test for equality of variances							t test for equality of means		95% Confidence Interval of the Difference	
	F	Sig.	T	df	Sig. (2-tailed)	Difference	Std. Error	Lower	Upper		
Equal variances assumed	47.513	.000	-6.932	58	.000	-45.233	6.525	-58.295	-32.171		
Equal variances not assumed			-6.932	35.697	.000	-45.233	6.525	-58.471	-31.995		

Referring to the Table above, the results of Levene's test show a value of $p = 0.00 (< 0.05)$. So the assumption of the equality of variances is not met. Therefore, the results of the independent sample t-test will be based on the second line, which is the line 'Equal variance not assumed'. Based on the Table above, the results of the independent sample t-test show that there is a significant mean difference in the achievement retention test of the combined event probability title between students who follow the teaching and learning method using the ToPo module ($M = 51.5, SD = 6.61$ and the conventional learning method ($M = 24.4, SD = 17.92$), $t(35.70) = -6.93, p = 0.00$. The value of $p < 0.05$, then the null hypothesis H_0 is rejected. This means that students who follow the teaching and learning method of the ToPo module (experimental group) show the retention of the achievement of the title and the probability of joining events which are significantly better compared to students who follow conventional teaching and learning methods (control group).

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