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# DEVELOPMENT AND USABILITY OF PROPOS-BIO MULTIMEDIA MODULE FOR BIOLOGY FORM FOUR CELL DIVISION TOPIC

RASIKUMARI A/P MUNIANDY

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DISSERTATION PRESENTED TO QUALIFY FOR A
MASTER'S DEGREE IN EDUCATION (BIOLOGY)
(RESEARCH AND COURSEWORK MODE)

FACULTY OF SCIENCE AND MATHEMATICS
SULTAN IDRIS EDUCATION UNIVERSITY
2022

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## ACKNOWLEDGEMENT

Thanks to the Almighty God, on His permission that I managed to complete my research successfully. It would not have been possible for me to finish writing this thesis without the invaluable assistance, support, advice, encouragement and inspiration of several individuals. Hence, I wish to present my appreciation to all those who extended their support in many ways. First and foremost, I would like to express my deepest sincere gratitude and appreciation to my principal supervisor, Profesor Madya Dr. Che Nidzam binti Che Ahmad for her valuable guidance, comments, advice and support from the beginning of my research until the end of this thesis. I owe particular thanks to experts for valuable advice and comments, especially in developing the Propos-Bio Multimedia Module. Not to forget, I would like to acknowledge my respondents for providing accurate and reliable information toward accomplishing the research objectives. My great appreciation and enormous thanks also go to my family, especially to my parents Mr. Muniandy a/l Singaram and Mrs. Manoranjitham a/p Subramian, for their constant prayer and encouragement throughout my postgraduate study. Special thanks also due to my husband, Lingaswaran a/l Arjunan, and my children, Tharrviena Lingaswaran, Jayahvarshan Lingaswaran and Kumares Lingaswaran, who remain constant sources of encouragement, inspiration and strength. Finally, many thanks to all my friends and colleagues, who directly or indirectly assisted me in any respect towards the completion of this research.

I thank you all!

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# ABSTRACT

This study aimed to develop and determine the usability of a multimedia module named Propos-Bio multimedia module for the topic of Cell Division. The design used in this study is the developmental design based on ADDIE Model. A total of 44 Biology teachers from 25 secondary schools in Kinta Utara, Perak were chosen as respondents through a random sampling method. Five Biology experts were selected to determine the validity of the multimedia module. Three instruments employed in this study were expert validation, reliability and usability questionnaires. All the instruments were valid and reliable for this study. The data were analysed using percentage of expert agreement to detemine validity, Cronbach alpha for reliability and mean for usability of the module.The finding shows that the developed multimedia module has a good validity and reliability with 93.3% of expert agreement and Cronbach alpha value 0.90. The Propos-Bio multimedia module also has a good usability in terms of usability of the module and user-friendliness with a high average mean value of 4.3. In conclusion, the Propos-Bio multimedia module has good validity, reliability and usability and is suitable for use in the teaching and learning of Biology form four in the topic of Cell Division. Implications from this study suggest that the Propos-Bio multimedia module which integrates the multimedia elements and problem-posing instructional strategy can be used as an additional teaching aid to teach the topic of Cell division and to emphasise communication, collaboration, creativity and critical thinking (4C) among students.

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# PEMBANGUNAN DAN KEBOLEHGUNAAN MODUL MULTIMEDIA PROPOS-BIO UNTUK TOPIK PEMBAHAGIAN SEL BIOLOGI TINGKATAN EMPAT

## ABSTRAK

Kajian ini bertujuan untuk membangunkan dan menentukan kebolehgunaan modul multimedia yang dinamakan modul multimedia Propos-Bio bagi topik Pembahagian Sel. Reka bentuk yang digunakan dalam kajian ini adalah reka bentuk pembangunan berdasarkan Model ADDIE. Seramai 44 orang guru Biologi dari 25 buah sekolah menengah di Kinta Utara, Perak telah dipilih sebagai responden melalui kaedah persampelan rawak. Lima orang pakar Biologi telah dipilih untuk menentukan kesahan modul multimedia. Tiga instrumen yang digunakan dalam kajian ini ialah soal selidik pengesahan pakar, kebolehpercayaan dan kebolehgunaan. Semua instrumen adalah sah dan boleh dipercayai dalam kajian. Data dianalisis menggunakan peratusan persetujuan pakar untuk menentukan kesahan modul, alpha Cronbach untuk kebolehpercayaan dan min untuk kebolehgunaan modul. Dapatan kajian menunjukkan modul multimedia yang dibangunkan mempunyai kesahan dan kebolehpercayaan yang baik dengan 93.3% persetujuan pakar dan nilai alpha Cronbach 0.90. Modul multimedia Propos-Bio juga mempunyai kebolehgunaan yang baik dari segi kebolehgunaan modul dan mesra pengguna dengan purata nilai min yang tinggi iaitu 4.3. Kesimpulannya, modul multimedia Propos-Bio mempunyai kesahan, kebolehpercayaan dan kebolehgunaan yang baik serta sesuai digunakan dalam pengajaran dan pembelajaran Biologi tingkatan empat dalam topik Pembahagian Sel. Implikasi daripada kajian ini mencadangkan modul multimedia Propos-Bio yang mengintegrasikan elemen multimedia dan strategi pengajaran *problem-posing* boleh digunakan sebagai bahan bantu mengajar tambahan untuk mengajar topik Pembahgian Sel dan menekankan komunikasi, kolaborasi, kreativiti dan pemikiran kritis (4C) dalam kalangan pelajar.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| CTML | Cognitive Theory of Multimedia Learning |
| CVI | Content Validity Index |
| DNA | Deoxyribonucleic Acid |
| DSKP | Dokumen Standard Kurikulum dan Pentaksiran |
| EPRD | Education Planning and Research Division of the Malaysian Ministry of Education |
| HOTS | High Order Thinking Skills |
| ICT | Information and Communication Technology |
| I-CVI | Item-level Content Validity Index |
| ID | Instructional Design |
| ISD | Instructional System Design |
| KBSM | Kurikulum Bersepadu Sekolah Menengah |
| KSSM | Kurikulum Standard Sekolah Menengah |
| LOTS | Low Order Thinking Skills |
| MOE | Ministry of Education |
| NEM | New Economic Model |
| PBL | Problem-Based Learning |
| PP | Problem-posing |
| PPIS | Problem-posing Instructional Strategy |
| S-CVI | Scale-level Content Validity Index |
| STEM | Science, Technology, Engineering and Mathematics |
| SPM | Sijil Pelajaran Malaysia |
| TSTS | Thinking Skills and Thinking Strategies |

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|---|---|
| TTM | Traditional Teaching Method |
| ZPD | Zone of Proximal Development |

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| D4 | Usability of Propos-Bio Multimedia Module |
| E1 | Virtual Innovation Competition 2021 |
| E2 | Seameo Innovation Teaching festival |
| F1 | Intellectual Property for Conceptual Framework |


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# CHAPTER 1

# INTRODUCTION

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## 1.1 Introduction

The Malaysian education ministry has implemented a curriculum transformation on the Secondary Integrated Curriculum (KBSM). KBSM is strengthened and improved to ensure that the curriculum is always relevant to the needs of the 21st-century challenges and the challenges in line with the Government Transformation Plan. The new curriculum is known as Kurikulum Standard Sekolah Menengah (KSSM). KSSM emphasizes the development of the necessary skills in students to meet the ever-changing challenges of the world by applying the knowledge, skills and values contained in Science, Technology, Engineering and Mathematics (STEM) (MOE,2016). The subjects covered in this area of STEM are Science, Physics, Maths, Chemistry, Biology, Computer Science and Design and Technology.

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STEM education plays an important role to develop and promote economic growth in both developing and developed countries to move forward. The Ministry of Education Malaysia implemented various strategies for the Science, Technology, Engineering and Mathematics (STEM) subjects in an effort to produce more experts in these fields for the benefit of the nation. Malaysian government through the New Economic Model (NEM) aims to create 1.3 million jobs in STEM discipline in various sectors by 2020 (Hafizan, Shahali, Ismail, & Halim, 2017). In order to meet the demands of the workforce as directed by the government, the students must be equipped with a basic STEM foundation to meet the challenges and realities of their future careers.

STEM education is aimed to develop individuals' 21st-century skills (Walker, Cammy, Ellis, & Seibert, 2018). 21st-century skills emphasized on creating students who are able to apply technology through the digital age literacy, be creative and critical in their thinking and possess excellent interpersonal and social skills (Tuan Soh, Arsada, & Osman, 2010). In addition to supporting the development of 21st-century skills, STEM education emphasizes three fundamental elements which are problem solving, innovation, and designing that has a significant place in every countries' agenda (Khairuddin, 2020). Problem-solving, critical thinking, creative thinking and scientific thinking are important in enhancing the Higher Order Thinking Skills (HOTS) among students.

Higher Order Thinking Skills (HOTS) is the ability to apply knowledge, skills and values in making reasoning and reflection to solve problems, make decisions, innovate and create something (MOE,2013). Education Blueprint (2013) recommended

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that Malaysian students have to cultivate 'higher order thinking skills' (HOTS) in curriculum and instruction in order to prepare the students to be globally competitive. Even though the schools start to embed different strategies to enhance the critical thinking in the teaching and learning processes in science, but unfortunately many of the students today are still not equipped with HOTS (Aziz, Ismail, Ibrahim, & Samat, 2017). One reason students are not currently developing the skills of communication, critical thinking and problem solving are that there are a lot of pressure placed on teachers and students to achieve results (Carlgren, 2013). Instead, higher-order thinking skills should be an important aspect of the teaching and learning process, because the major goal of teaching is to ensure that students can think and solve problems critically, and this can be achieved when students are not just taught a series of routine activities just for the examination, but more on lessons that teach them how to think and create for themselves (Chinedu Caleb Chidoziea, 2014). Therefore the teachers need to cultivate the higher-order thinking skills among the students in order to produce globally competitive students.

## 1.2 Background Research

Biology subject is a subject for science majors. The subject of Biology was introduced in Malaysia in 1972 with 10 schools which the syllabus was modified from the Nuffield 'O' Level Biology course from England (Arshad, 2015). The objective of the curriculum is to broaden the understanding of the concept and application of science to real-life situations. The aim of the KSSM Biology Curriculum (Secondary School Curriculum) is to provide students with the knowledge and skills of science and technology and

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enables them to solve problems and make decisions in their daily lives based on scientific attitudes and values (Ministry of Education Malaysia, 2012). Hence, the science process skills and manipulative skills are given the appropriate control in biology subjects.

Many students conceive that biology is a subject that is difficult and abstract (Subahan 1997; Carlgren, 2013). This is because the students believe that the subject involves more memorization techniques rather than critical thinking (Miri, David, and Uri, 2007; Zeidan, 2010; Hasni, Roy, & Dumais, 2016). This causes many students to be less interested and unable to master the subject. Teaching strategies and teaching methods play important roles in motivating students to learn Biology effectively (Çimer, 2012). The use of technology in teaching and learning Biology is crucial in this digital era in order to generate interest among the students (Almarabeh, Amer, & Sulieman, 2015). The use of technology will enhance the effectiveness of teaching and learning of biology.

Multimedia learning is becoming increasingly popular in teaching and learning activities in schools as multimedia can overcome problems or constraints encountered in the traditional chalk and talk method (Osman & Lee 2014). Multimedia elements that incorporate text, graphics, animation, audiovisuals that stimulate the audience's senses and visualize abstract concepts that are difficult to express with words (Osman & Lee 2014). Previous studies have shown that students involved in multimedia learning show higher information retention than traditional methods since the interactive multimedia can stimulate more than one sense at the same time (Teoh & Neo, 2007). Multimedia is suitable for all students with different learning styles and

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backgrounds knowledge as it combines media elements such as visual, auditory, reading and kinaesthetic. Multimedia becomes to become an effective tool to promote critical thinking and problem solving among the students (Teoh & Neo, 2007). However, the multimedia presentation can also be less effective if the elements such as animations, narration, images and text are wrongly inserted and violated multimedia presentation principles. On-screen text and images or on-screen text with narration have to be organized well to avoid cognitive load among the students (Makransky, Terkildsen, & Mayer, 2017). Therefore, well-organised multimedia can improve the understanding of the students.

Many teaching strategies seem to evolve rapidly to promote HOTS and to make learning more fun, effective and appropriate for students with diverse backgrounds and abilities. Problem-solving assumed as one of the students-centred learning methods which was implemented to apply in the classroom to sharpen the critical thinking skill among the students. On the other hand problem-solving method typically still followed a traditional model of instruction in which students spend most of their time-solving problems created by others; including textbook publishers and teachers. Integrating problem posing practice in the classrooms is one of the effective ways to create a student-centred learning environment (Beal & Cohen, 2012). Problem posing (PP) refers to the generation of a new problem or a question by learners based on the given situation (Mishra & Iyer 2013). Problem posing is useful for identifying the knowledge deficit and opens a way to knowledge exploration. In another study by Kapur (2015) showed that problem-posing is more effective to transfer the knowledge, procedural knowledge and conceptual understanding compared to problem-solving. Problem-posing has a very high potential to enhance students' performance and give

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students a deeper understanding of the topic. Students who generate their own problems or questions have performed better in the exam and HOTS task (Mishra & Iyer, 2015)

Hence, this study will focus on the development of a multimedia module that integrates the problem-posing instructional strategy (PPIS) to deliver the lesson more comprehensively. The multimedia module is known as Propos-Bio multimedia module. The word "Propos" in the multimedia module derives from the problem possing instructional strategy (PPIS), 'pro' means 'problem' whereas 'pos' means possing'. The researcher decided to develop the Propos-Bio multimedia module by integrating the problem-posing strategy to overcome the problems faced by the students as well as the teachers in teaching and learning Biology. Hope the Propos-Bio multimedia module will help the students to gain a deeper understanding of Biology topics.

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**1.3 Problem Statement**

In order to prepare the students towards literate science students, Malaysian curriculum intendes to embed HOTS in curriculum and instruction in the classroom to promote science-literate citizens to face the high demand across the nation nowadays. However, teaching and learning strategies applied in the classroom will be influenced whether the thinking skills can be infused in the teaching and learning process in the classroom (Miri, David, & Uri, 2007). Traditional teaching method (TTM) used nowadays involves technology but still the teaching-learning processes focusing on teacher-centred learning (Choi, Lindquist, & Song, 2014). Until this date, even though many teachers have been exposed to a variety of teaching method and integrated to a

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variety of technological strategies, the teaching and learning processes still happened from the teacher to the students because of many factors such as time constrain and lack of teaching and learning resources at school (Cho & Brown, 2013). The teacher uses a different strategy to deliver the information but mainly the teaching and learning process is focused on the teacher-centred learning (Thomas & Watters, 2015). TTM like lecturing in a certain way is also effective to teach a basic concept to the students such as introduction to the topic and in many tasks that involve LOTS item (Jarjoura, Tayeh, & Zgheib, 2015).

Biology is one of the science subjects that can be choose in pure science stream classes at daily schools. Students' difficulties in learning biology have been studied by various researchers across the world (Artun & Coştu, 2013; Carrió, Larramona, Baños, & Pérez, 2011; Çimer, 2012; Kramer & Myers, 2013; Patel, 2012; Yarden & Yarden, 2010). Biology subject is considered too difficult and abstract (Çimer, 2012). Biology is considered a tough subject because it consists a lot of dynamics and abstract processes which cannot be visualised (Yarden & Yarden, 2010; Nasriha, Mohamed, Nidzam, Ahmad, & Setyaningsih, 2021). Furthermore, Biology is misunderstood as a memorizing subject without involving HOTS (Hasni et al., 2016). Students tend to memorize the contents but do not have a deep understanding of the concepts involving the processes. Both students' content knowledge and confidence are important in determining students' level of understanding about science concepts (Oztas, 2014).

The topic Cell Division is one of the topics which consists of numerous of abstract concepts that are difficult for the students to understand (Ramon, Bello, & Bauchi, 2019; Nasriha et al., 2021). This topic has been the focus of this study because

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this topic is very important and has to be mastered by students in order to understand other processes in Biology. Students can be taught an onerous concept in a lesson by involving them more in HOTS tasks, so the concept in the subject becomes easier to understand and more meaningful to them (Carlgren, 2013). Genetics related topics, such as mitosis and meiosis, genes and chromosomes, and Mendelian genetics, are among the topics in Biology considered hard to be understood by students (Matawali, Bakri & Jumat, 2019). The concept of mitosis and meiosis are always misunderstood by many students (Fauzi & Mitalistiani, 2018). Studies over twenty years shows that the understanding of students on these concepts remains partial and incomplete. One reason why students may have difficulty with the concept of mitosis and meiosis is because this concept requires students to visualize and think about biological processes at the cellular level (Dikmenli, 2010).

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Overloaded Biology curricular and interdisciplinary nature of Biological concepts, and difficulties with the textbooks are the other factors preventing students from learning biology effectively (Çimer, 2012). Furthermore, practices in classroom that used a static diagram to explain the processes also contributed to this issue. The dynamic and abstract concept in Biology cannot be well explained using a static illustration (Artun & Coştu, 2013) because static illustrations often lead to misunderstanding among students (Yarden & Yarden, 2010). From this teaching and learning practices, many of students experiences a misconception in understanding the basic concept in Biology.

Biology curricula is said to be a large curricula to be taught at school. There are many topics, concepts, or issues that need to be covered in Biology. The time

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allocated to teach them was not enough compared to the other science disciplines, such as physics or chemistry (Çimer, 2012). The time constrain will restrain teachers from bringing off many activities and experiment in the classroom. Teachers also need to accelerate at certain topics to ensure the timeline plan by the school department can be achieved. With time constrain issues faced by teachers at school module can be seen as the solution to this issues.

Despite all the these challenges, there have been innovations in the way of teaching in the classroom nowadays. Teachers start to embed technology and multimedia in the teaching and learning process in the classroom. It is also proven hat multimedia is a powerful tool to enhance students learning experience and motivations in the classroom (Furió, Juan, Seguí, & Vivó, 2015; Hong, Lin, Hwang, Tai, & Kuo, 2015; Chiu & Mok, 2017). Further, book publisher also provides courseware that is compiled in CD-ROM together with the activity book, however, many information did not comply with the syllabus provided by MOE. Based on the issues discussed, there is a need to develop an effective module to teach the topic Cell division in a more explicit way to students and subsequently comply with the curriculum specification provided by MOE. To increase HOTS in students, other teaching methodologies need to be blended in the multimedia presentation to make sure the tool can enhance the thinking skills and at the same time will enrich the students learning experience.

To involve students in HOTS tasks and items, there is a need to use a different strategy in the classroom. In order to enhance HOTS among students, the problem-solving strategy has been widely used in the classroom to tailor education to the students. However, practice in the classrooms still typically follows the traditional

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model of instruction in which students spend most of their time-solving problems created by others such as textbook publishers and teachers (Beal & Cohen, 2012).

There is a need to blend in problem-solving with another instructional strategy to induce high order thinking skills among students. Problem-posing is one of the instructional strategies used majorly in mathematic domain to enhance thinking skills. From a few studies done before, it showed problem-posing can help students develop new knowledge and have a deeper understanding of the topic. Situating students in the problem-posing role requires them to take a much more active and responsible role in their own learning (Nardone & Lee, 2010). This will be very challenging and will anticipate more efforts and responses from teachers to prompt and coach students to generate their own questions. Furthermore, students who considered as a novice and are lack of prior knowledge need model questions to be imitated in order for them to construct their own questions.

Problem-posing will allow the student to ask themselves with questions and start to build up a series of questions and answers regarding the lesson after that. Asking questions is very important to enhance thinking skills but yet many of our students today do not ask questions in class (Mishra & Iyer, 2015). The types of questions asked mirroring the level of understanding that students have about the topic. Problem-posing instructional strategy (PPIS) involves many students centre activities such as communication, collaboration, creativity and critical thinking. This activity is also known as 4C element that is part of the 21st-century pedagogy component in teaching and learning. The embedding of 4C element in PPIS will make PPIS become more effective.

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In PPIS, students will pose a problem and start to communicate and collaborate in a group to find solutions and answers to their own questions. Based on Zone of Proximal Development (ZPD) developed by Lev Vygotsky, students tend to reach a deeper understanding of the lesson with the help of teachers and more capable peers (Karimi-Aghdam, 2017). In order to create their own questions, students need to think critically and creatively to present the questions and answers to teachers and peers (Singer & Voica, 2013). Students who involve in problem-posing activity, shows proving result, deeper understanding in HOTS task (Da Ponte & Henriques, 2013). However, there are very limited studies of PPIS implementation in Biology subject.

Hence, this study will focus on the development of a multimedia module that can effectively visualize the abstract and dynamic processes regarding the concepts and applications in biology. This module is also carefully designed to help teachers deliver the content of the subject successfully without worrying about time constrain to develop a teaching material. This module will integrate the multimedia usage and problem-posing instructional strategy (PPIS) to deliver the topic in a more comprehensive way and at the same time enhance HOTS among students. The module developed will be complete up with activities that use problem-posing and will emphasize on active learning that involves problem-posing 4C elements which are: creativity, collaboration, communication and critical thinking processes to make sure the students engage in the learning that occurs in the classroom. 4C elements that are implemented in this module are believed to stimulate and enhance thinking skills among students.

The module is known as Propos-Bio Multimedia Module. In order to increase the students understanding in cell division, an innovative teaching method should be

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introduced in the Biology classroom. Therefore, the implementation of Propos-Bio Multimedia Module is crucial in this situation. By implementing this module, it is our hope that students will gain a deeper understanding of the concept of mitosis and meiosis and further rectify their misconceptions towards the topic to the extent of enhancing students' performance in this topic.

## 1.4 Purpose of the Study

The purpose of this research is to develop Propos-Bio Multimedia Module for Form Four Biology students in Perak.

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## 1.5 Research Objective

1. To develop a Propos-Bio Multimedia Module for teaching the concepts of mitosis and meiosis among Form 4 Biology students.

2. To determine the usability of Propos-Bio Multimedia Module.

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## 1.6 Research Questions

From the objective of this study, the research questions have been listed to complete the study. The research questions for this study are:

RQ1: Does the Propos-Bio Multimedia Module have good validity and reliability?

RQ2: Does the Propos-Bio Multimedia Module have good usability?

## 1.7 Conceptual Framework of Research

This session will propose the conceptual framework for this research. The conceptual framework will combine the cognitive theory of multimedia learning by Mayer & Moreno (2002), problem-posing instructional strategy, the curriculum of Biology and ADDIE model to develop the Propos-Bio multimedia module.

The cognitive theory of multimedia learning serves as the foundation for the development of the Propos-bio multimedia module. The cognitive theory of multimedia learning is based on three cognitive science principles of learning: the human information processing system which includes dual channels for visual and auditory processing, each channel has a limited capacity for processing, and active learning which entails carrying out a coordinated set of cognitive processes during learning. The cognitive theory of multimedia learning emphasises that meaningful learning occurs in the presence of pictures and words rather than the words alone due to the way the brain

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processes information. However, not all forms of multimedia messages are equally effective to be presented in the multimedia presentation. Hence, multimedia messages should be well-designed to promote meaningful learning and reduce cognitive load among learners. Hence, all these three multimedia principles were taken into account in developing the Propos-bio multimedia module.

A multimedia module without effective teaching strategies do not foster critical thinking among students. Therefore in this research, the problem-possing instructional strategy was integrated with the multimedia learning approach to cultivate the 4C elements, critical thinking, collaboration, communication and creativity among students. Activities in the Propos-Bio multimedia module were constructed based on the problem possing instructional strategy whereas the content of the Propos-Bio multimedia module was developed based on the KSSM Biology curriculum. The content of the module should be carefully selected so as to coincide with the target group.

Propos-Bio multimedia module was developed using ADDIE model that consist of five phases which are analysis, design, development, implementation and evaluation. This model was chosen because it is a systematic instructional design model in developing multimedia teaching tools more effectively. A well-developed Propos-Bio multimedia module will undergo a process of expert validation, reliability testing and usability testing. The Propos-Bio multimedia module was introduced to five experts to check the content validity of the module. The reliability of the module was investigated during pilot study. Finally, the usability of Propos-Bio multimedia module was studied during the evaluation phase.

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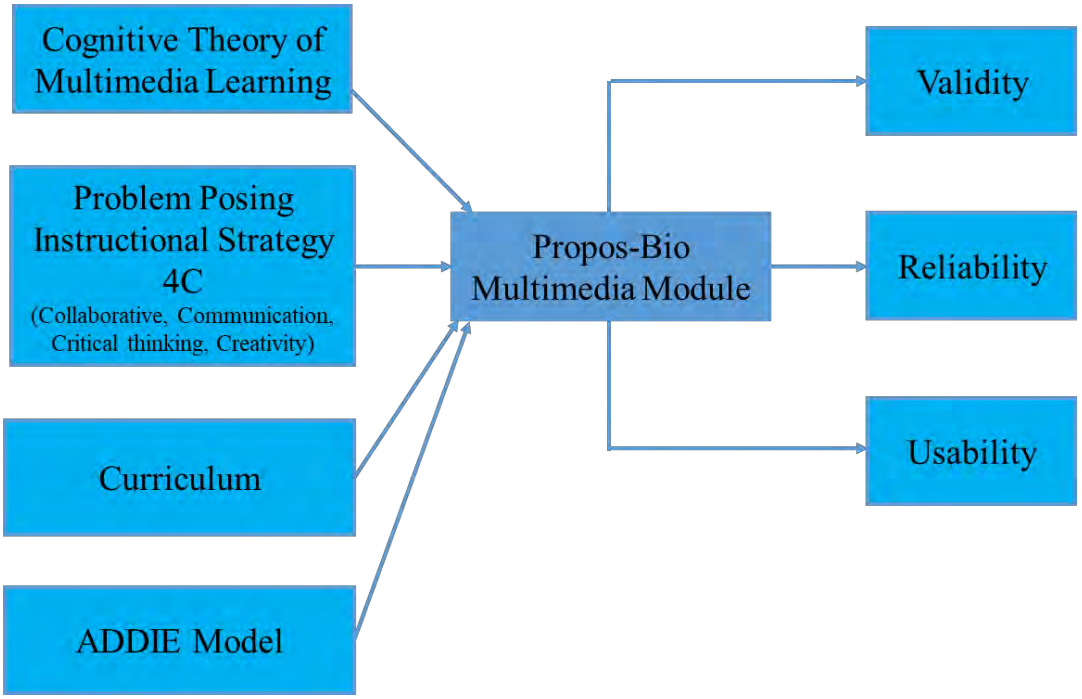


*Figure 1.1.* Conceptual Framework of Propos-Bio Multimedia Module

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## 1.8 Importance of the Study

### 1.8.1 Teachers

The use of teaching materials allow teachers to deliver the lessons more effectively. Due to time constraint, teachers face difficulties in developing and preparing effective teaching materials to convey the biological topics more efficiently. Thus, the Propos-bio multimedia module will reduce the teacher's burden in preparing teaching materials for the topic of cell division. The teachers can use the Propos-Bio multimedia module as teaching material to teach the topic of cell division.

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### 1.8.2 Students

Propos-Bio Multimedia Module integrated the multimedia elements and the problem-posing instructional strategy (PPIS). Through PPIS, students can impose HOTS in order to complete the task given in the module. Furthermore, PPIS will impose a critical thinking approach that will enhance HOTS among students (Beal & Cohen, 2012). Practically, Propos-Bio Multimedia Module will provide an effective module to promote problem-posing among the biology students.

### 1.8.3 Ministry of education

To this date, problem-posing instructional strategy in Malaysia is not widely used as systematic teaching strategy in the classroom. The problem-posing instructional strategy is widely used as a pedagogical approach in mathematics education in the US (Singer & Voica, 2013) to promote critical thinking skills to students but the usage is very limited in Biology subject. Thus, the development of the Propos-Bio multimedia module will expand the implementation of the problem-posing instructional strategy in biology subject.

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## 1.9 Limitation of the Study

The topic covered in this study is only limited to one chapter from Form Four Biology curriculum specification which is "Cell Division". This topic has been chosen in this study because it contains a fundamental concept of mitosis and meiosis which are later in need to be applied in other topics across the syllabus in biology.

The samples for this research involve teachers from twenty-five secondary schools in kinta district. Subjects that are used as sample in this research do not represent the whole population of schools in Malaysia. However, the findings of this research can be generalised to other population that have same characteristic with the sample group used.

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## 1.10 Operational Definitions

The following are the definitions of constructs investigated in this research.

### 1.10.1 Propos-Bio Multimedia Module

In this research, the Propos-Bio Multimedia Module is a multimedia module which integrates the multimedia presentation with a unique problem-posing instructional strategy (PPIS). Problem-posing is an instructional strategy where the students will generate their own questions based on the content taught by their teacher. The problem will be presented in a written or visual format. To deliver the content of the lesson

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efficaciously, multimedia presentation is used as the main tool to deliver the contents. The Propos-Bio multimedia module consists of a Power Point Presentation, accompanied by appropriate diagrams, animations, narration and videos. Students will use 4C element which are communication, collaboration, critical thinking and creativity to complete tasks in Propos-Bio Multimedia Module. Propos-Bio Multimedia Module will be compiled in USB flash drive which will be convenient for teachers to use.

### 1.10.2 Validity

Validation is an accuracy of the module to measure the content that is supposed to be measured during the teaching and learning processes (Marshall, Smart, & Alston, 2016). In this research, validity refers to the validity of the Propos-Bio multimedia module in terms of module presentation, module content and ease of module use. Evaluation of Propos-bio multimedia module validity is based on these three aspects can be used as a way to assess whether a multimedia module is feasible or not.

### 1.10.3 Reliability

Reliability is referred to the consistency and trustworthy of the measurement tools to give the same score to many individuals at different time exposure (Surucu & Maslakci, 2020). The reliability of a module can be measured through questionnaire developed based on the objective of the module (Sidek & Jamaluddin, 2005). In this research, module reliability refers to the consistency and stability of Propos-Bio multimedia

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modules which can be seen in terms of the extent to which teachers are able to use and implement the modules in their classroom. The reliability of Propos-Bio multimedia modules is determined based on aspects of the module content, module presentation and pedagogical aspects.

### 1.10.4 Usability

Usability refers to the degrees of success users have at learning and using a product to achieve their goals, as well as the users satisfaction with the product (Siti Shahida, Abdul Halim, Mahizer, & Munirah, 2021). In this research usability is defined as the extent to which the Propos-Bio multimedia module is used as a teaching tool by teachers in teaching the concepts of mitosis and meiosis. The aim of usability testing in this research is to enhance the users satisfaction by identifying problems in the Propos-Bio multimedia module in terms of usefulness and user-friendliness.

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## 1.11 Summary

This chapter introduces the issue related to the topic under investigation and explains the basic idea of the research. In particular, this chapter briefly explains the situation and what else needs to be done to encounter problems in biology education and the lacking in the existing literature on the role of problem-posing instructional strategy in Biology subject. This chapter also outlines the questions that set out the problem to be addressed in this research, the research objectives, the expected contributions to be achieved, the operational definition and the overall structure of this research. The next chapter offers a discussion of the existing literature and detailed explanation of the underpinning theories and research questions of this study.

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