

# Development And Usability of an Interactive Multimedia Kit as a Teaching Aid Among Biology Trainee Teachers

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## Abstract

This study was conducted to develop and determine the usability of an interactive multimedia kit known as "Meio-solution". This quantitative developmental research employed the ADDIE model as an instructional design. The kit contained teachers' notes, videos, quizzes, and educational games that can be used as a teaching aid for meiosis topic. The developed kit has been validated by experts in Biology Education while the usability has been obtained from trainee teachers of Bachelor of Education (Biology). A total of 80 respondents were involved using the simple random sampling technique. Two research instruments were used, namely the expert validation form and usability questionnaire adapted from a previous study. The data were analysed descriptively using SPSS software. The findings showed that the Content Validity Index by experts scored 1.0. The perception of the Meio-solution design scored a mean value of 3.84 (SD = 0.27), while the usability scored a mean value of 3.80 (SD = 0.29). In conclusion, this research has successfully developed a validated Meio-solution kit to be used as a teaching aid. The Meio-solution kit has the potential to help teachers improve students' understanding and visualisation of learning meiosis.

**Keywords:** multimedia kit, teaching aid, biology, meiosis, trainee teachers

## Introduction

Since 1967, Malaysia has been implementing the 60:40 Science: Arts policy to meet the demand for science-oriented graduates. However, the goal of achieving this ratio is still far from being achieved, with the percentage of students choosing the scientific stream decreasing to only 40.95% in 2021 [1], compared to 44.36% in 2018 [2]. One of the factors contributing to the decline in student enrolment is the perception that science is a difficult subject to learn [3], leading to low motivation and negative attitudes towards this subject. In addition, the teacher-centred approach, which focuses on the teacher as the main source of knowledge, continues to reinforce the perception that science subjects are uninteresting. Therefore, alternative approaches such as student-centred learning and inquiry-based learning should be adopted to encourage active student engagement in science subjects, using various methods and activities that can engage and motivate students to pursue science as a career choice. The use of multimedia-assisted teaching materials has been seen to have a positive impact on the development of scientific process skills among students [4]. Therefore, the application of interactive multimedia as the primary medium in teaching and

learning processes is one appropriate way to make science subjects more interesting as it has advantages in explaining more complex science principles effectively compared to using only static illustrations.

Biology is an important branch in the field of science. According to the Malaysia Curriculum and Assessment Standard Document, the subtopic of meiosis is one of the topics listed as mandatory to be studied by Form 4 biology students. It is a discipline that provides students with the opportunity to understand how the process of cell division occurs in sexually reproducing organisms. However, there has been a decrease in the student's interest towards this subtopic. Students usually learn the concepts of meiosis simply by memorising the facts without really understanding them [5]. Students cannot draw and produce complete and accurate diagrams of the meiosis process [6] because of the difficulty visualising the microscopic phases of meiosis. Considering these issues, an interactive multimedia kit called Meio-solution was developed to teach the meiosis subtopic. The usability of Meio-solution among biology trainee teachers from University Pendidikan Sultan Idris (UPSI), Malaysia was also evaluated.

## Materials and methods

### Study design

The design of this study was developmental research involving a quantitative approach through questionnaires. The development of the interactive multimedia kit called Meio-solution was based on the ADDIE instructional design framework that consists of five critical phases: Analyse, Design, Develop, Implement and Evaluate. The phases involved are summarised in Table 1.

**Table 1. Application of the ADDIE instructional design framework**

Phase	Task
Analysis	A document analysis was carried out to identify the science topic in need of an interactive multimedia kit.
Design	The design and the content of the interactive multimedia kit were determined.
Development	The interactive multimedia kit that is known as Meio-solution was developed and validated. A pilot study to measure the reliability of Meio-solution was also conducted.
Implementation	A questionnaire was distributed to biology trainee teachers.
Evaluation	The Meio-solution was evaluated based on its design and usability.

### Population and sample

The study involved the participation of biology trainee teachers pursuing a Bachelor of Education (Biology) at UPSI. The population size for this study was 167 biology trainee teachers. The sampling method used was a simple random sampling technique to ensure a fair and unbiased representation of the target population. A total of 30 respondents participated in the pilot test and 80 were involved in the actual study.

### Research instruments

The instrument used in the study was a questionnaire adapted from [7]. The questionnaire contains sections for respondent information and aspects of Meio-solution including its design and its usability. The questionnaire used a 4-point Likert scale: point 1 (strongly disagree), point 2 (disagree), point 3 (disagree)

and point 4 (strongly agree). The questionnaire was validated by three lecturers from the Department of Biology, Faculty of Science and Mathematics, UPSI. A pilot test involving 30 respondents was also carried out to gauge the reliability of the questionnaire.

### Data analysis

The data retrieved from the questionnaire was analysed descriptively involving mean and standard deviation using the Statistical Package for Social Science (SPSS).

### Results and discussion

Meio-solution was developed using Microsoft PowerPoint software. Interactive components that can attract students' interest such as images, videos, graphic interchange formats, transitions, animations, et cetera were included in this multimedia kit. Hypertext features also allowed users to control each button and section in the kit. The Meio-solution used Malay as the main language to help Malaysian teachers and students understand the content better. The front page of the kit is shown in Figure 1A, while Figure 1B displays the examples of meiosis notes. Figure 1C and Figure 1D present the game and quiz, respectively.



**Figure 1.** The main user interfaces of Meio-solution include the front page (A), notes (B), game (C) and quiz (D).

This interactive multimedia kit was validated by three lecturers from the Department of Biology, Faculty of Science and Mathematics, UPSI based on the Content Validity Index (CVI) analysis. Studies that use three or more experts must obtain a CVI value of 0.78 or higher to indicate good and high validity [8, 9]. Table 2 shows the CVI values given by each expert for the Meio-solution kit.

**Table 2. Content validity index for the Meio-solution kit.**

	Content Validity Index
<b>Expert 1</b>	1
<b>Expert 2</b>	1
<b>Expert 3</b>	1
<b>Average</b>	1

Considering the CVI values obtained, this implied the relevance of the Meio-solution’s content to be used as a teaching aid in the meiosis topic. Following that, a pilot test involving 30 respondents was conducted to measure the reliability of the questionnaire based on Cronbach’s Alpha coefficient value. Cronbach’s Alpha coefficient value has a range between 0.0 to 1.0. If the obtained value approaches 1.0, then it shows high reliability. Table 3 shows the Cronbach’s Alpha coefficient value of this study.

**Table 3. Cronbach’s Alpha coefficient value for the reliability of the research instrument.**

Construct	Cronbach’s Alpha coefficient	Indicator
<b>Design</b>	0.893	Good
<b>Usability</b>	0.936	Very good
<b>Average</b>	0.944	Very good

This study obtained a high instrument reliability value of 0.94. Alpha index scores between 0.80 and 0.89 are good, while alpha values exceeding 0.90 indicate very good reliability [10] and effective [11], with a high level of consistency in the questionnaire as the research instrument. This indicated that the questionnaire can be confidently in the actual test used to determine the usability of the Meio-solution.

The results of the actual test involving 80 respondents showed that the developed interactive multimedia kit, Meio-solution had a positive and appealing perception of the design and usability. The data is presented in Table 4.

**Table 4. Perceptions of biology trainee teachers on the design and usability of Meio-solution.**

Construct	Mean value	Standard deviation	Indicator
<b>Design</b>	3.84	0.27	Very high
<b>Usability</b>	3.80	0.29	Very high

In developing multimedia-based teaching material, design aspects such as suitable graphics and colours are very important to be emphasized to attract users. Students can easily remember the topics when the teachers use teaching aids involving appropriate and attractive images and visuals [12]. The study also shows that the text colours used in this kit are easy to read, and the language is clear and not confusing. Learning about the topic of meiosis requires students to be able to distinguish between chromosome structures with homologous chromosomes, the direction of chromatid movement and the process of crossing over. Therefore, the selected teaching aids not only need to use attractive graphics, visuals, and animations but also the selection of text colours and language must be suitable and easy to read to avoid users feeling pressured by looking at the colours that are too excessive or too dark. Good coloured visual aids can attract students’ interest and attention to read the text written in the teaching aid [13]. A design

that is easy to understand with clear instructions makes the learning resource a guide for students to learn the content well [14].

The construct of usability in the questionnaire includes the Meio-solution's content, usefulness, and satisfaction, from the perspective of biology trainee teachers. In this regard, the title, content, and objectives must be tailored to the knowledge and abilities [15] of Form 4 biology students. The study showed that the Meio-solution also aligned with the learning outcomes required for the meiosis subtopic in the Malaysia Curriculum and Assessment Standard Document. The respondents also agree that Meio-solution is enjoyable and has features that help teachers engage with students. Consequently, it also assists students in understanding and reinforcing the concept of the meiosis subtopic. Previous studies stated that multimedia has the potential to aid teachers in conveying scientific concepts more clearly than conventional methods using only static illustrations [16, 17].

## Conclusion

In conclusion, the interactive multimedia kit, Meio-solution has been successfully developed based on the ADDIE model. It also has obtained good validity and perception on the design and usability among biology trainee teachers at UPSI, Malaysia. This study warrants a need for further investigation to be carried out to determine the effectiveness of this kit among biology teachers in actual teaching settings across Malaysia.

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