



LinProT: the Feasibility of a Multimedia Courseware for Optimization Methods Course

R. N. Farah, R. N. Hanani

Abstract: *LinProT is an educational courseware for Optimization Methods. LinProT consists of a multimedia package; short video tutorials and scanned pictures QR Code Reader and HP Reveal as Augmented Reality (AR) application. There are three types of modules of Optimization Methods that contain in LinProT courseware, which are notes module, exercises module and tutorial video modules. Users can enjoy new experiences of learning via courseware involving AR application and reduce frustration in learning through boring reading. The objectives in developing LinProT are to produce courseware that allows self-directed learning that meets the needs of students studying Optimization Methods course and to assess its feasibility. This courseware is developed using the ADDIE model that involves five phases; Analysis, Design, Development, Implementation and Evaluation. The researchers tested the feasibility of the courseware to students via questionnaire. LinProT is a new way of learning, promotes interaction, provides experiences, and will improve learning efficiency in terms of time and place.*

Keywords: *ADDIE model, Feasibility, Optimization Methods, Self-Directed Learning approach.*

I. INTRODUCTION

Nowadays, the education system is undergoing rapid developments as various parties strive to enhance education to improve quality of life. Education is the starting point for improving the standard of human life which is the central concern of every agency to improve the country's education system in term of quality and competitiveness.

In Malaysia, the function of the education system is very important in the process of national development. Providing excellent and quality education is one of the continuing efforts being made of Ministry of Education to develop a new generation of millennial that will guarantee the country's future. Therefore, to raise both quality and excellence in education in line with the challenges of the 21st century, the country's education system needs strategic and effective guidance.

One of the initiatives undertaken by the Ministry of Education is to introduce the use of Information and Communication Technology (ICT) in the Teaching and Learning (T&L) process in educational institutions. The fourth Industrial Revolution (IR 4.0) has changed the prospect of educational innovation. IR 4.0 is the current trend in automation and data exchange in manufacturing technologies that include cyber-physical systems, the internet of things and cloud computing [1]. Hence, Education 4.0 is the revolution in innovation which has introduces a new educational model to prepare graduates for future life and work through IR 4.0 [2].

According in [3], teaching methods that focuses on educators will result in passive student engagement. Faculty plays an important role in implementing various methods T&L approach to enables students to reflect, analyze and understand existing learning materials. In addition, students are not only expected to be knowledgeable in gaining information to support the development of existing knowledge, but they are expected to have the wisdom to optimize their knowledge as well [4].

II. THE INTEGRATION OF A COURSEWARE IN TEACHING AND LEARNING

According in [5], students have different psychological and intellectual abilities. Therefore, planned teaching needs to be appropriate, organized at the student level and supported by learning tools to stimulate the growth of the students' potential to the maximum.

The T&L process can be further enhanced and diversified in terms of delivery and acceptance through the internet, networks, databases or other information technology tools. In line with the current trend in education, the use of learning tool is one of the latest alternatives used by educators in T&L. Courseware is one of the more advanced types of educational software in multimedia form. Courseware is more focused on delivering information on specific topics, subjects or courses that are relevant to the process. The use of these tools further enriches learning and provides students with an early introduction to information technology especially in multimedia form. Recent technological developments provide more instructional software or courseware to present information presentation modes as an alternative to traditional media-based teaching methods. With the revolution in computer hardware and software, the use of courseware has increased among users.

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* Correspondence Author

R.N. Farah*, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, Malaysia.

F. N. Hanani, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, Malaysia.

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Compared to other instructional media, computers are the most efficient and effective cognitive tools because of their advantages in terms of interaction and user control. This interaction and user control enable students to control, manipulate and explore information in instructional software and this has a very positive effect on students [6].

Furthermore, the introduction of the latest multimedia authoring software also facilitates the process of providing user control in the developed courseware. With the capabilities of today's authoring software that combines various elements of multimedia as well as its ability to provide user control, courseware is often used in today's learning process.

In addition, the implementation of these tools can motivate students to continue exploring the learning materials well as enriching existing learning approaches through effective and effective T&L processes with the production of interactive learning materials [7]. Courseware is an educational software specifically designed to focus on specific learning that contains relevant learning instructions [8]. The use of courseware in operational research which consists of optimization methods can improve students' understanding of the mathematical methods in Optimization Methods quickly and easily [9]. Based on the preliminary study conducted by the researcher using an early questionnaire from the study, the use of courseware as learning tool in T&L to teach for Optimization Methods can improve the learning process. Therefore, the study developed a courseware named LinProT to use as a learning tool to teach and learn Optimization Methods.

III. COURSEWARE DEVELOPMENT PROCEDURES

Generally, LinProT consists of three main modules namely the notes module, exercises module and tutorial videos module. The name 'LinProT' is a combination of Linear Programming and Transportation Problems. The notes module provides knowledge in Optimization Methods, the exercises module is to strengthen knowledge and skills, and tutorial videos module acts as supplementary material for enhancing knowledge of existing software and websites to solve optimization problems. LinProT was developed as an educational courseware so that students can actively learn by conducting investigations, enhancing creativity and solving problems. It helps to integrate their thinking skills and facilitate understanding of concepts as well as measuring improvements in their understanding of Optimization Methods. The main objective of LinProT is to help students master the concepts in Optimization Methods.

LinProT as a courseware uses two new applications namely QR codes and HP Reveal. QR Code or Quick Response code is a two-dimensional bar code that can be read on a smartphone or computer with a camera, which can be accessed after the code is scanned and allows the user to complete the required action [10]. HP Reveal is an Augmented Reality (AR) application. AR is a visual effect generated by a computer where visual objects are added to a real scene appearing on the display screen. As a result, users who view the real world through the computer screen will

find that there are other objects in existence other than the present reality [11].



Fig. 1. Example of QR Code in Exercise menu at page 7 in Chapter 3



Fig. 2. Example of screen that need to use HP Reveal application to watch videos in Tutorial Video menu

LinProT is developed using the ADDIE model. According in [12], ADDIE model is appropriate in this development because it is one of the models of teaching design or systematic design in the production of effective and user-friendly learning tool. In general, the model consists of five main phases in courseware design, analysis, design, development, implementation and evaluation.

A. Analysis Phase

A preliminary study on the requirements was conducted to identify the elements required by the users in the courseware design. According in [13], analysis is to identify and define design process it serves to direct the researcher in developing the learning tool to meet the needs of the users. Therefore, various aspects of courseware development needed to be taken into account such as target groups, learning topics, objectives and learning outcomes, consumer needs and T&L methods. From the preliminary study's result obtained using questionnaire involving respondents from Optimization Methods students from Universiti Pendidikan Sultan Idris (UPSI), the study found that there is a need for courseware as a learning tool in T&L and LinProT can assist with the T&L process.

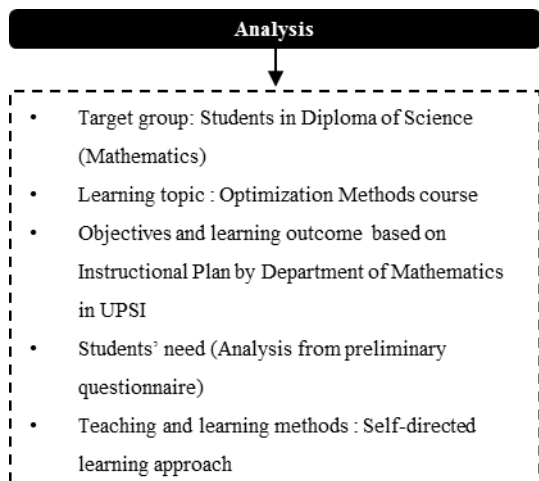


Fig. 3. Aspects in analysis phase

B. Design Phase

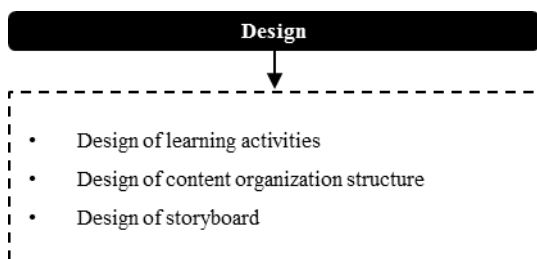


Fig. 4. Aspects in design phase

The design of the notes module, the exercises module and tutorial videos incorporated aspects of learning theory in the courseware. Before the researcher developed the notes and exercises modules, the researcher observed and analyzed the latest instructional plan to teach Optimization Methods at the Faculty of Science and Mathematics in UPSI.

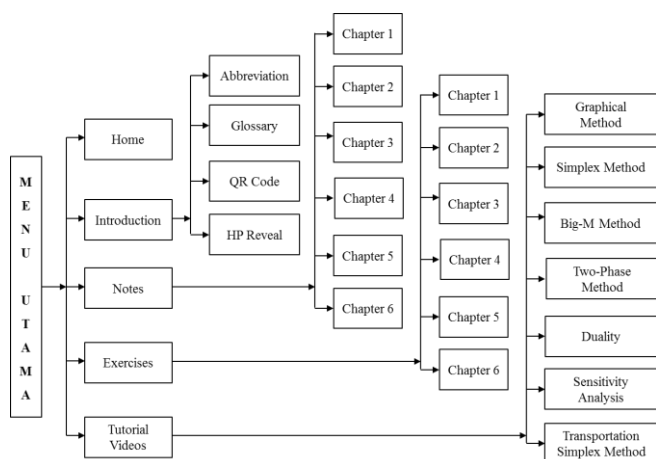


Fig. 5. Organization structure in LinProT

C. Development Phase

The development of the software incorporated some aspects and guidelines such as hardware and software requirements, the use of multimedia technology and development of the LinProT courseware. The multimedia courseware was developed using the Macromedia Director as the main software using simple programming language such as Lingo and Java script.

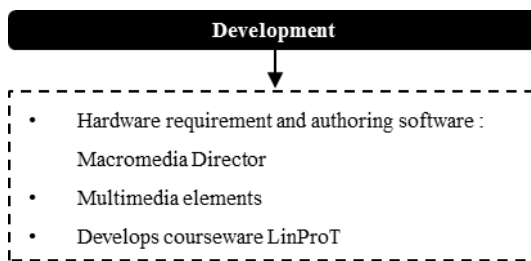


Fig. 6. Aspects in development phase

D. Implementation Phase

The researcher conducted a pilot study in terms of feasibility and potential of actual study to be conducted to increase the validity of the study instrument. The researcher introduced the courseware to some faculty lecturers who have experience teaching Optimization Methods course and experts in education and courseware development courseware to identify potential problems.

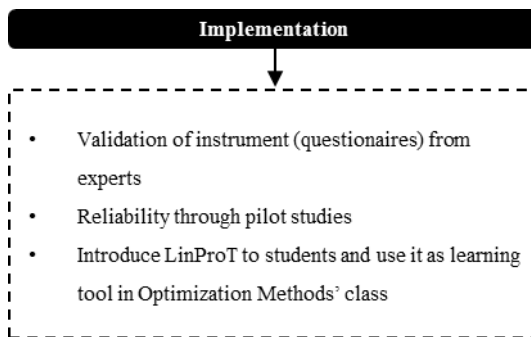


Fig. 7. Aspects in implementation phase

E. Evaluation Phase

The courseware was evaluated in terms of T&L and its assessing the feasibility of this courseware which involves questionnaires of feasibility assessment courseware for students. The data obtained were analyzed by using SPSS 20.0 software.

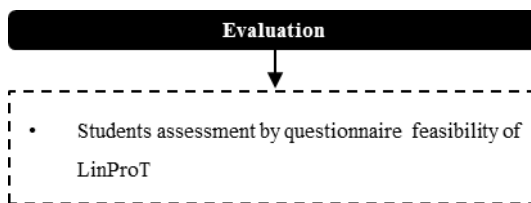


Fig. 8. Aspects in evaluation phase

IV. THE FEASIBILITY OF LINPROT IN TEACHING AND LEARNING PROCESS

According in [14], learning tools need to be evaluated to identify the extent of their usefulness to users. [15] stated that the content of courseware must be relevant as a learning tool and meets the syllabus. Feasibility refers to the relevance of the content, the accessibility of learning objectives in the T&L process, the ability to attract students and the implementation of the T&L process, and the feasibility in the T&L process [16].

The feasibility of the courseware is evaluated according in the needs of the course to enhance understanding, consolidation and to increase knowledge amongst students. Table 1 below shows the results of the feasibility study in the Optimization Methods course which was assessed using the mean score. The instrument involved the use of questionnaires. Sixty-five (65) respondents studying Diploma in Science (Mathematics) at UPSI who had taken the Optimization Methods course answered the questionnaires.

Table- I: The evaluation of the feasibility of LinProT

No.	Aspects of Feasibility of LinProT	Mean Score
I	Interface design and presentation	3.62
II	The ability to attract user	3.56
III	The relevance of the content	3.60
IV	Accessibility of learning objectives in teaching and learning process	3.55
V	Self-directed learning approach	3.53
VI	Feasibility of courseware in T&L process	3.58
		3.57

Based on the interpretation value of the 4-point Likert scale scores adapted from [17], the score between 3.51 - 4.00 is the highest score, 2.51-3.50 is the medium score, 1.51-2.50 is low score and 1.00-1.50 is not related score. Therefore, the result of the feasibility of LinProT courseware was high. The development and feasibility of LinProT courseware in Optimization Methods met the needs of users, especially students of Diploma in Mathematics Science in their learning process by applying basic concepts, training and guidance to enhance their knowledge in this course.

V. DISCUSSION

A. Aspects of interface design and presentation in LinProT

Based on the result, the interface design and presentation of LinProT was suitable for Optimization Methods course and the use of QR Code and HP Reveal application enhanced the presentation techniques and use of the courseware. In addition, the researcher integrated multimedia features such as text, graphics, audio and animation into the courseware so that the design and presentation helps to meet the needs of the students as well as assist their learning process. The application of multimedia features that are attractive and interactive in can encourage students to focus and participate fully in the T&L process [18]. Previous study by [19] stated that mobile technology ideally integrated into the T&L process was in line with current technological trends in Malaysia.

B. Aspects of the ability to attract user

The use of courseware has a lot of positive impact on users, especially on Optimization Methods students. The courseware facilitates the learning of Optimization Methods as learning tool as part of the T&L process and can appeal to students compared to traditional learning methods. The use of QR Code and HP Reveal also played an important role in attracting users. According in [20], the use of AR applications encouraged collaboration between fellow students, and students with faculty members. It also helps to foster

creativity and student imagination. It also allows students to organize and control their own learning and build authentic learning environments that fit with different student learning styles.

C. Aspects of the relevance of the content

The feasibility of the courseware was also evaluated in term of the diversity of the content of LinProT. The LinProT contained the complete course notes module of the course, the exercises module and the video tutorial module contained content relevant to the students. The content in this courseware meets the curriculum and learning objectives of the Optimization Methods course. The researcher referred to experts and the Optimization Methods course outline by UPSI as a guide in formulating the topics and content in LinProT. The content was suited for student use and presented in a systematic and easy-to-understand way.

D. Aspects of the accessibility of learning objectives in teaching and learning process

The study found that the lesson objectives for the Optimization Methods course were achieved. Students opined that the topics and content contained in this courseware met the needs of course and are easy to understand. The learning modules provided also met the learning objectives. Computer software or courseware used in teaching can help students to understand mathematical concepts and principles easily and effectively [21].

According in [22], the goals and objectives are necessary to determine the direction of the learning process to ensure that the learning tools developed meet the learning pedagogy, specific learning objectives based on the syllabus, curriculum guide or textbook. The content of educational software developed for the purpose of T&L should be based on the syllabus and learning objectives. This will result in the teaching process becoming more interesting, focused, structured and timely [23].

E. Aspects of self-directed learning approach

Besides that, the T&L approach emphasizes the design process and software development with the self-directed learning approach. Through this approach, students play an active role in determining the direction and progress of their T&L as educators act as facilitators that guide students towards achieving their learning goals. Mazihah Othman [24], supported this approach since students and educators can benefit from technologically advanced teaching and learning approach as an effective learning tool while also enhancing students' cognitive skills. According in [25], the use of learning tools in accordance with students' cognitive level can facilitate self-directed learning. This is based on their learning needs and flexible learning strategies implemented allow students the time to explore the content in a timely manner to increase their knowledge by using the courseware. The use of the courseware involved both self-directed learning and designed using multimedia technology. The study integrated new information into the module with existing information available through T&L via classroom learning to enhance students' to enable cognitive skills.

The learning content in the notes module was broken down into smaller sub-topics to avoid cognitive overload. Mind maps were also included in the module to help students understand the concepts presented. The exercises module was also designed based on the students' level of education.

F. Aspects of the feasibility of courseware in T&L process

The results showed that students found the use of LinProT in T&L as feasible. The data analysis, discussions and feedback confirmed the feasibility of using LinProT in T&L. It met the students' learning needs and assisted them in acquiring knowledge and skills. The courseware can also help educators to diversify their teaching methods by using LinProT as a teaching material and students can also use it as a learning tool outside the classroom.

This is in line with a study conducted in [26], software feasibility study in T&L is necessary to ensure feasibility and effectiveness for an e-book software used as a ICT tool to help improve student reading skills.

VI. CONCLUSION

The use of LinProT as a learning tool has positive implications for students. The use of self-directed learning in T&L through multimedia courseware is not yet widespread as educators are already ingrained in traditional methods. The introduction of new courseware can be a catalyst for future developments in order to solve the problem of lack of interactive learning tools and software especially in the field of Mathematics. One way to meet the needs of students is to use multimedia courseware. The LinProT courseware has many advantages for users, especially for students taking Optimization Methods courses

The use of AR in education can benefit the T&L process by providing better content by helping instructors to attract students and assisting them to be more focused focus on learning [27]. However, the use of computers in T&L is not meant to replace the instructors' role. They still have other roles to play ensuring that they are more competent, creative and professional in planning the contents of the lessons to integrate ICT in education [28].

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AUTHORS PROFILE



R. N. Farah received her PhD degree in Mathematical Sciences and Applications from Universiti Putra Malaysia in 2012. Now she is an associate professor at Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris (UPSI). Her research interests are applied mathematics, computational mathematics, application of graph theory and mathematical education.



F. N. Hanani is currently pursuing master program in Mathematics Education in Universiti Pendidikan Sultan Idris (UPSI). She received her bachelor degree in Computational Mathematics from Universiti Teknologi Mara (UiTM) in 2013. She majored in science computer, computational mathematics and mathematical education.