Journal of Human Development and Communication
Volume 12, 2023 [55-68]

THE DEVELOPMENT AND FEASIBILITY TESTING OF LEARNER-PACED DIGITAL VIDEO COURSEWARE

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ABSTRACT

Since the COVID-19 epidemic across the world happen, educators are enthusiastic to use technology to aid students in their learning. The young adults specifically the university students are becoming more and more dependent on digital technology thanks to simple access through technology devices. The learning environments among university students are drastically change due to the COVID-19 epidemic which has highlighted the importance of digital video in teaching and learning. This paper aims to highlight the development of digital video learning courseware and the findings of its pilot testing. Researcher conducted pilot testing in investigating the use of digital video and its effects on students' knowledge achievement, computational thinking (CT) self-efficacy perception, and perceived motivation. The results of pilot test indicated that the digital video learning courseware is a valid and reliable learning courseware for providing digital video knowledge to university students. This article describes the development of the courseware as well as the pilot testing.

Keywords: Learner-paced, digital video learning courseware, pilot testing, Waterfall-ADDIE model, segmenting principle

1.0 INTRODUCTION

To create a high-quality final output, courseware creation should be based on a certain learning model and instructional systems design. Courseware can be defined as computer programs or supplementary material developed for educational or training practices. Choosing instructional tactics, media, resources, learning objectives, and assessment are all steps in the iterative process of designing instructional systems (Huang et al., 2019). Goal-oriented and learner-centered, focusing on expressive performance, predicting and measuring results, procedures based on empirical and experimental evidence, interactive, evaluation and self-correcting, as well as team effort are some of the characteristics of instructional systems design (Huang et al., 2019). Developers typically use the ADDIE approach, which combines analysis, design, development, implementation, and evaluation. There are various instructional design models that can be used. Guidelines for creating the courseware should be based on instructional design ideas and models. However, the researcher discovered that the proposed co-model of Waterfall and ADDIE model by Eller (2015) is the right research methodology model to be adapted after examining and reviewing a number of research works linked to the creation of courseware software. In order to produce the digital video courseware, this study modified the co-model of the Waterfall and ADDIE models and integrated the phases.

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2.0 LITERATURE REVIEW

The Integrated Waterfall-Addie Model

These days, creating an instructional learning application or learning courseware demands more than just focusing on the material; it also needs to incorporate technology to keep up with the development of new technologies and the world of digital natives. As a result, an instructional designer could use the system or software development model rather than just the instructional design model when creating learning materials that especially involve the usage of technology. According to the needs, the developer can also merge the models for software development and instructional design. Because there are certain similarities and crossovers between the two models while coming from separate domains. A broad scope of projects with a high number of learners will require the instructional designers to produce a large and efficient software to support the conditions. It is inevitable that they will need to improve their learning courseware sooner or later. The software development model will therefore need to be adjusted by the developer.

In order to create the digital video learning courseware, this study integrates the ADDIE model for instructional design and the Waterfall model for software development. Eller (2015) recommended the integration of both models and emphasised the significance of the Waterfall software development model being combined with the ADDIE model as the instructional design model. Eller had gone into great depth about how the Waterfall and ADDIE models may be combined to foster greater collaboration between software developers and instructional designers.

Eller (2015) claims that a co-model of the Waterfall and ADDIE models was suggested to create a path for an organisation. However, the researcher modified the steps of the ADDIE and Waterfall models to suit the goals of this study. The linear Waterfall model, which has six steps, was combined with the ADDIE model, which has five phases. Figure 1 displays an integrated Waterfall-ADDIE model.

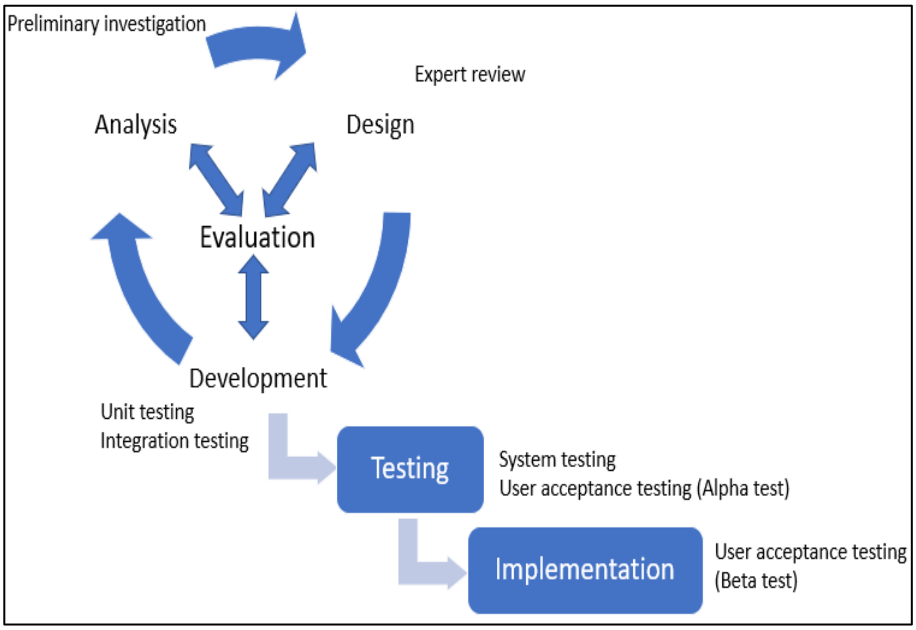

Figure 1. The Integrated Waterfall-ADDIE Model

The phases of the integrated Waterfall-ADDIE model are depicted in Figure 1. According to Eller (2015), the integrated Waterfall-ADDIE model consists of six phases:

i. Analysis phase: Learning circumstances are examined and discussed in order to determine the goals and objectives of the digital video courseware as well as the learner's profile and needs.
ii. Design phase: Strategies for digital video courseware that address learning challenges are planned.
iii. Development phase: To create educational software or courseware that support the learning process.
iv. Evaluation phase: To examine how the developed educational system addresses the challenges in the classroom.
v. Testing phase: To examine how the developed educational system addresses problems in the classroom.
vi. Implementation phase: To set the instructional courseware into practise in a classroom.

The Phases of Waterfall-ADDIE Model

Analysis Phase

The integrated Waterfall-ADDIE model's analysis phase performs similarly to the ADDIE model's function. Before beginning the design phase, the analysis phase is used to pinpoint the correct requirements, provide justifications, and offer some solutions. The digital video courseware is seen as a knowledge building in this study. The educational material is viewed as a sense-making activity in which the student attempts to construct a clear mental image from the courseware (Mayer, 2014b). The aim of the courseware for this study is the remembering, where students acquire the ability to recognise the offered content in the courseware is.

The retention test identified three types of multimedia learning outcomes: no learning, rote learning, and meaningful learning (Mayer, 2014b). The purpose of this project is to design courseware that will help students learn in a meaningful way and advance their knowledge. It is believed that students would learn from the course materials and be able to arrange their knowledge into an integrated representation. The reason the courseware is able to promote meaningful learning is because it comprises integrated words and pictures.

The course materials' objectives are for students to be able to independently learn the stages involved in making a digital video and be able to do so practically in the future. The creation of this course material also serves to advance internal goals for the study of digital video. The fundamental curriculum for video production from the four universities that make up the Malaysian Technical University Network (MTUN) serves as the foundation for the learning objectives for digital video. The video production stage is the essential aspect of digital video that students must be taught in order to help them create a proper video shooting, according to the corresponding instructors from the four MTUN universities. The course materials' primary focus is on the fundamentals of digital video, specifically:

i. Basic features of camera
ii. Learn the types of angles
iii. Learn the types of shot
iv. Learn the types of movement
v. Understand the algorithm concept for basic steps in creating digital video

Design Phase

The integrated Waterfall-ADDIE model's second step, design, aims to confirm target performances and appropriate testing strategies. In order to create the digital video learning courseware, researchers modified Gagne's Nine Events. When task analysis refers to the instructional design process, it means that different learning activities are included in a course to help students reach their objectives. The task list should be completed in four steps, which are to reiterate the statement's purpose, affirm the lesson's aim, identify and categorise the key tasks, and indicate any prerequisite knowledge and skills. The digital video courseware includes the goals, primary tasks, and recaps modules.

The segmenting principle in Mayer's Cognitive Theory of Multimedia Learning (CTML) (Mayer, 2001) was used in this work to emphasise the learner-paced mode and was adapted for the Gagne's nine events (Gagne et al., 2005; Kruse, 2008). The Gagne's Model of Learning by Gagne (1985) was implemented into the courseware as guidelines for the design and organisation of the content. Gagne's nine events of instruction consist of nine elements: (i) grasping the learners' attention; (ii) describing the learning objectives; (iii) encouraging the learner to recall prior knowledge; (iv) presenting the learning content; (v) providing the learning guidance; (vi) eliciting performance; (vii) providing learning feedback; and (viii) accessing performance.

To make sure that this courseware is able to nurture the conceptual development of the students, all aspects of Gagne's nine events have been modified. The Gagne's nine events are modified as a framework for creating suitable instructional video. This report addressed each of the nine instructional events and the suitable methods used to create the digital video courseware. Gagne's nine events' nine steps were modified based on the details provided by Gagne et al. (2005) and Kruse (2008). By offering information that may be chosen by the learner, the learning content for digital video is offered to encourage the conceptual growth of the audience. From the main menu, students can pick the modules they want to study. According to their needs, students can go back and review previously learned courses or return to the main menu. Therefore, this study utilised the CTML principles as a macro strategy to present, cue, and segment the lesson content in order to offer successful instruction. The goal was to carefully develop and provide learner-selectable information.

In order to organise the instructional information in a relevant way and give the student explanations and examples of demonstrations, the researcher additionally emphasises the segmenting principle. The main menu was created by the researcher and consists of components that offer the users a choice. The course material covers five aspects of digital video, including i) fundamental camera features, ii) different types of angles, iii) different types of shots, and iv) different types of movement. To stimulate student participation in learning, the lesson's material was delivered in several different ways and with the use of a variety of media, including video, demonstrations, pictures, and animation. The designed courseware uses animation, video, and graphic formats to communicate its material. Students can pick up some fundamental digital video production skills.

The courseware's material serves as a tool to help the students understand the fundamental principles of digital video production. Additionally, this study refers to the Neilsen and Molich's 10 heuristics user interface design guidelines to make sure that the courseware's interface design is appropriate for the user and to prevent any interface design faults. There are several rules that can be used while creating software, however Nielsen's user interface design recommendations are the most applicable (Nielsen (1994).

This study adapts the 10 heuristics for user interface design laid out by Neilsen and Molich. The ten user interface design principles are regarded as heuristic evaluation since they serve as a general guideline for software development. It might expedite the designing process and give the software developer higher satisfaction. In software usability testing, a heuristic evaluation is a technique that aids in identifying issues with user interface design. The following are the 10 heuristics user interface design principles that have been modified in this study:

i. The courseware visibility.

Each module in the digital video courseware has a title and the corresponding navigation menu button, along with navigation tips. When utilising the programme, the navigation tips and suitable navigation menu may always help the learner maintain track of their learning progress. The courseware's interfaces display the necessary modules and sub-modules as needed.

ii. Courseware interfaces represent the real world

The English language, which is the primary language used in Malaysian tertiary education, was employed in the construction of the digital video courseware. Instead of employing any computer science vocabulary, the words, phrases, and ideas utilised in the programme are carefully selected based on user familiarity. The information displayed in the programme is also arranged according to logical and natural progression.

iii. User choice and control

The previous, next, and main menu buttons are offered by the digital video courseware to give users flexibility while browsing the programme.

iv. Prevention of errors

The digital video courseware's design and development took error prevention into account as users navigated the programme. In order to avoid mistakes, students must first master all of the content before moving on to the next module.

v. Consistent and standards

Each link button used in the courseware has its own name and performs a different purpose as it moves from one module to the next. As a result, students did not have to be concerned that two buttons would have the same purpose.

vi. Recognise rather than recall

To minimise the student's memory load, the digital video courseware employed the common button and modified CTML principles to organise the information. The student can see the clear instructions and straightforward interactions for each module, so they don't need to recall how they work. The courseware's buttons and icons were picked with care to help students recognise them rather than just recollect them, ensuring that they are familiar to them.

vii. Flexible and efficient

For both experienced and inexperienced students, the course material is adaptable and simple to utilise. It can accommodate both pupils with and without prior knowledge of the subject matter.

viii. Aesthetic and simple interface design

To spare the students from having to do any additional duties, each module in the programme is finished with an appealing and straightforward design. The researcher stays away from any unnecessary navigation or stuff that can confuse the student.

ix. Help and manual documentation

In the courseware, the researcher offers navigational advice to the students. By following the navigational hints and step-by-step instructions, students can effortlessly navigate and learn all the courseware's content.

x. Aid users in identifying, diagnosing, and fixing errors

The researcher accurately identifies the issue and provides a constructive suggestion for a solution in the courseware, which communicates error messages in simple language (no error codes). In order to aid users in recognising and noticing them, the researcher also provides visual treatments.

Applying Cognitive Theory in Multimedia Learning (CTML)

The courseware was developed using the 12 principles of Cognitive Theory in Multimedia Learning (CTML) (Mayer, 2009). The 12 principles of CTML are: the coherence principle, the signaling principle, the redundancy principle, the segmenting principle, the pre-training principle, the modality principle, the personalization principle, the voice principle, and the image principle.

Researcher designed the digital video learning courseware in accordance with the CTML principles. The CTML principle allows for the integration of many principles into a single module rather than just one module for each principle. When presenting the students with the available fundamental camera characteristics and camera support tools, the functions of signaling, spatial continuity, and temporal principles are used. Students are exposed to these tools and are familiar with how to use each one should they come across it in a studio. The highlights of each module

are indicated by signals denoted by arrows. The usage of the spatial continuity concept was proved by the words that described the element that appeared close to the photos.
In order to ensure that students can comprehend the meaning of the visuals, researcher delivered words and graphics at the same time rather than continuously as highlighted in temporal principle. In this module, the signalling, spatial continuity, and temporal concepts can be used to highlight and illustrate to the students the camera support tools. In addition, according to Mayer's (2009) multimedia principle, words and pictures portrayed combined in a multimedia courseware are superior than words alone. With the aid of courseware's images and words, students can learn more effectively.

When creating a module to represent knowledge of digital video creation, researcher adapted several principles in creating a better short video for the courseware: (i) the coherence principle, (ii) dual coding theory, (iii) personalization principle, and (iv) image principle. Researcher used advanced text-to-speech generator that provides humanlike machine voice in the short video narration and avoid from include the speaker's picture. The CTML principles are adapted to make sure that students may learn more effectively and comprehend the important concepts that the researcher wants to emphasise in the specific modules.

In order to highlight the learner-paced mode, researcher adapted the pre-training principle which enable students to recognise and understand the fundamental features of a camera. If students are able to operate a camera and have a fundamental understanding of how cameras work, they may learn digital video production more efficiently. In addition, researcher applied segmenting principle to allow for user-paced segments instead of continuous. As a result, students have the freedom to decide which module they wish to learn through the courseware first. There are 12 principles of CTML that have been adapted in developing the digital video courseware as follow:

i. Multimedia Principle:
The integration of text with related pictures, animations, or videos on the screen of digital video courseware is more effective compare to text or picture alone.
ii. Spatial Contiguity Principle:
Digital video courseware is more successful when text and related images, animations, or videos are displayed together on the screen.
In order to aid the student in understanding, the texts used in the courseware are situated next to the photographs.
iii. Temporal Contiguity Principle:
The courseware presents the texts and pictures simultaneously in the courseware.
iv. Coherence Principle:
In the courseware, the course material displays the texts and images concurrently, and researcher only includes relevant texts, images, and audio. Any irrelevant multimedia components that can distract students or impair their ability to concentrate are removed.
v. Modality Principle:
The courseware uses advanced text-to-speech generator with the pictures presented rather than use the written text with pictures.
vi. Redundancy Principle:
Instead of using written text with visuals, researcher use the advanced text-to-speech generator. Although the researcher employed narration, written text, and animation to support the dual-coding theory, it nonetheless took the redundancy principle into account to prevent retaining narration, written text, and animation simultaneously. By selecting the silent option, students can choose to have written text that is animated.
vii. Signaling Principle:
Researcher adapted the signaling principle to highlight the important ideas and uses arrows to show them the camera's parts.
viii. Pre-training Principle:

The courseware applies the pre-training principle by introducing the students with recaps module and basic camera features and camera support tools to make them more prepared before they move to the next modules.

ix. Personalisation Principle:
Researcher adapted the personalisation principle in order to avoid overly formal, complicated, and lengthy materials, the course material uses narration and simple, everyday language in its text.

x. Voice Principle:
To provide machine voice, the researcher used a sophisticated text-to-speech generator. Since university students are the study's target audience, they are seen as digital natives who are accustomed to machine voice technology. If it is not their preferred method of learning, they do have the option to mute the courseware's speaker.

xi. Embodiment Principle:
The on-screen agent does not make any gestures that would be considered human because the human voice and embodiment principle work so well together. Previous research has covered the fact that an on-screen assistant using a computer voice and human-like gesturing has no good benefits. Additionally, adding superfluous gestures for the on-screen agent will bore users who are university students, who are the courseware's primary audience. This claim was supported by Loranger et al. (2010), who found that young adults prefer a straightforward design to one with fanciful and pointless additions.

xii. Image Principle:
In order to support the audio narration, the researcher uses an on-screen agent to replace the presenter's face.

The digital video learning courseware also presents the content using the proper menu and modules. The researcher also included next buttons and provided controls for the video's speed, pause, and play. This study also highlighted the learner-paced mode in segmenting principle in developing the courseware.

DEVELOPMENT

Applying Learner-Paced: Segmenting Multimedia Learning (CTML)

According to Scheiter (2014), learner paced or learner control in multimedia learning is different from interactivity. By sequencing, pausing, and choosing the information, the student can control the learning material through interactivity. There have been numerous studies on the use of learner-paced instruction to help students who are experiencing problems with essential overload (Hasler et al., 2007; Lusk et al., 2009; Mayer et al., 2003; Mayer & Chandler, 2001; Scheiter, 2014).

Previous studies have employed a variety of methods to emphasise the learner-paced, including the "Continue" (Mayer & Chandler, 2001) and "Next" (Scheiter, 2014) buttons, a list of questions (Mayer et al., 2003), and a pause function (Hasler et al., 2007; Wang et al., 2020). Furthermore, learner paced can improve students' performance and motivation Scheiter (2014). According to a study by Hasler et al. (2007), learners who received the learner-paced predetermined segment treatment outperformed learners in the continuous group. Hence, as the main focus of this study is the learner-paced mode, the following figures demonstrate on how the segmenting principle was adapted.

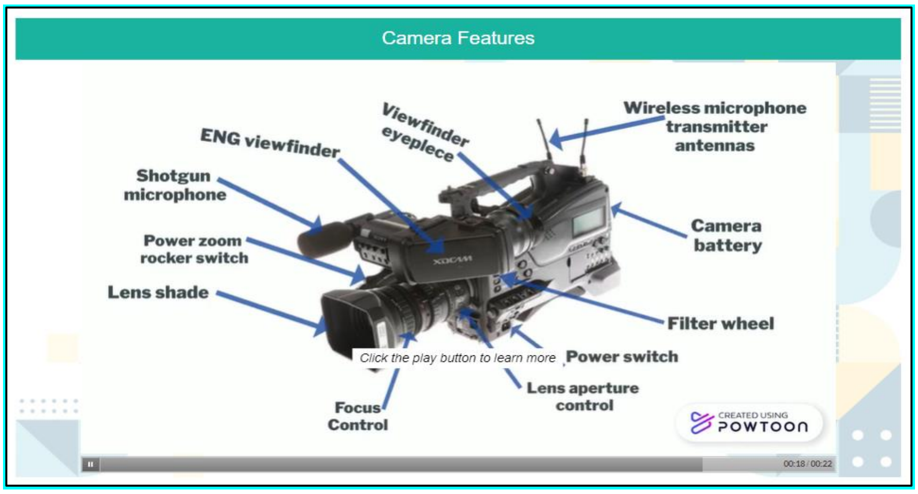

Figure 2. Snapshot of learner-paced digital video learning courseware

Figure 2 shows that students can pause, play, and scroll the video presentation according to their preferred learning pace. While Figure 3 shows students are able to choose any modules from the menu to learn first.

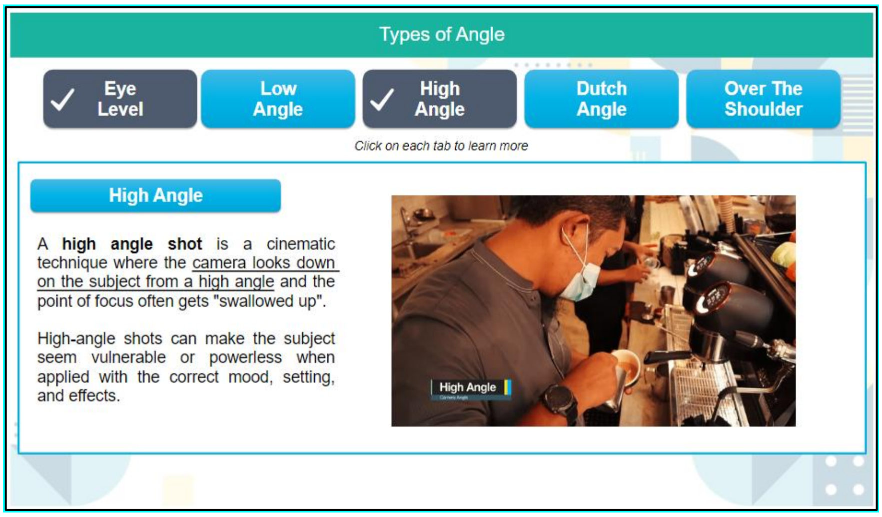

Figure 3. Snapshot of learner-paced digital video learning courseware

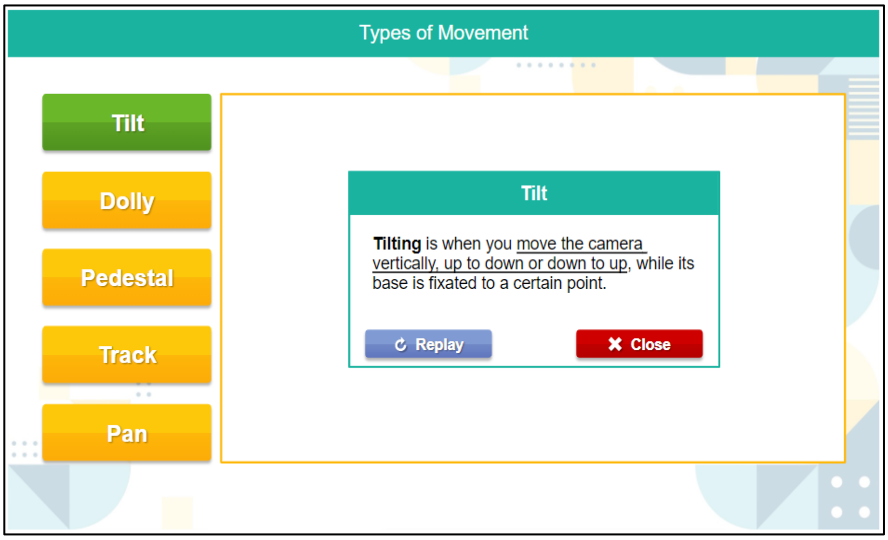

Figure 4. Snapshot of learner-paced digital video learning courseware

Figure 4 shows students can pick any modules from the courseware menu to learn first. In addition, students are asked whether they want to proceed to the next module or replay the same content again as shown in Figure 5.

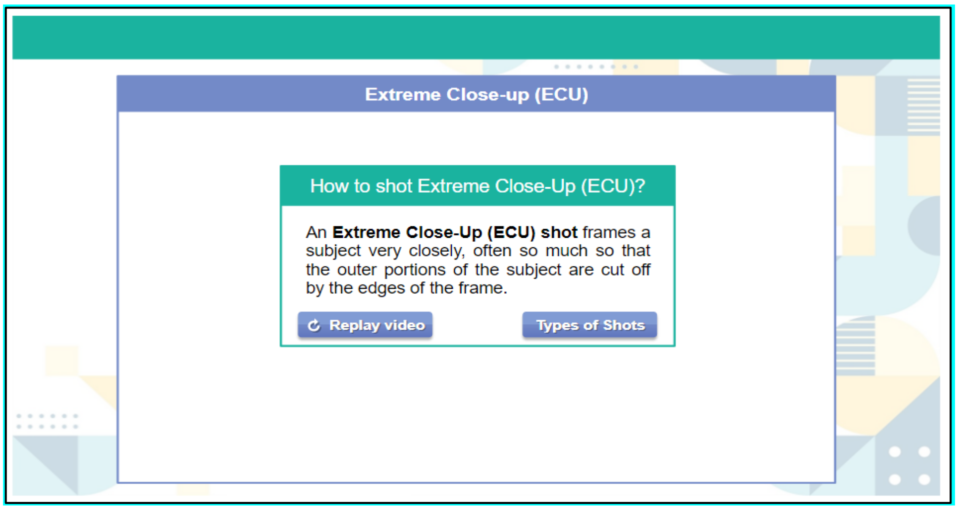

Figure 5. Snapshot of learner-paced digital video learning courseware

Development Phase

The third stage of the integrated Waterfall-ADDIE model is called development. According to Huang et al. (2019), there are six steps in the ADDIE development phase which are; i) produce content, ii) produce or choose supporting media, iii) produce guide for student, iv) produce guide for teacher, v) formative reviews, and vi) conduct the feasibility testing using a pilot test.

Producing Content for Courseware

The video production example utilised in the courseware's video teaser was taken from Youtube. The digital video courseware's content was used to search for the chosen example of video production. In order to capture the students' interest and entice them to apply the course materials, the example of video production was selected. The courseware's material is based on a digital video production syllabus that was taken from the MTUN universities.
According to the content expert, the syllabus is pretty close to any syllabus for the same or related subject from institutions in Malaysia or abroad. Based on the assigned narration scripts, videos that reflect certain courseware units have been produced. For greater content, the video was shot, and some animations were produced. To help the students better understand the topic, some video and animation have been adopted from YouTube.

Selecting and Producing Supporting Media for Courseware

The researcher acquired the relevant 2D graphics at the first stage of the production of the courseware. The Internet, lecture notes, and other resources are used to obtain graphics, which are all saved in graphic format (.jpeg, .png, .bmp and .gif). Video editing software includes Adobe Premiere Pro, Microsoft PowerPoint, and Powtoon.

Before starting to construct the courseware, the researcher completed the animation and video editing. After the video, audio, graphics, and 3D editing processes are complete, all of these components are brought together on one major platform. 800x600 resolution Articulate 360 software was used to create the main platform.

Producing Guide for Student

The courseware includes a number of menus that are intended to help students learn more effectively while avoiding any technical difficulties. The following is an example of a digital video courseware module:

Title and the creator of the courseware's name are on the first page.
The welcome page doubles as a login page and a trailer.
The page with navigational advice provides instructions for using the courseware.
Congratulations page where students are recognised for successfully finishing a digital video course.
The last page includes a thank-you note for the student using the courseware as well as other information for them to review.

Producing Guide for Facilitator

The relevant lecturers at each MTUN university who will serve as the facilitator and provide information on all tasks, processes, and dos and don'ts throughout the experiment are given the protocol documents. The courseware files and links for all the instruments have also been made available to the facilitators. As a result, the facilitator will adhere to all the instructions in the paperwork, distribute the test and survey to the students, and monitor and record their progress during the experiment.

Conducting Formative Evaluation

Before going on to the implementation phase, this stage aims to update the course materials. The researcher employed two assessments in the integrated Waterfall-ADDIE model to enhance the intended instruction, make sure it can achieve the goals, and address the performance gap. Both formative and summative evaluations are involved. Before moving on to the execution stage, the lesson plan is improved through formative evaluation. Every process entails design and development phases, where the researcher gathers materials to create the courseware and is thought of as formative evaluation.

Evaluation Phase

In order to validate the information utilised in the courseware, the evaluation phase involved expert reviews. The researcher then kept working on the courseware. By carrying out unit testing and integration testing, the evaluation activities are carried out during this phase to make sure that each function and the sub-modules are properly integrated.
Unit testing and integration testing were both carried out throughout this period of development. Each sub-component included in the courseware, such as the video, animated picture, sound, link, and button, was tested individually during the development phase in order to make sure there were no bugs before combining all the sub-components. Before the sub-components are integrated, the developer performed the unit testing. The unit testing evaluation activities continue until all functions and submodules have been tested. Each component created, including animated images, short videos, and audio, will be included in the digital video courseware. The operation of the digital video courseware was evaluated after the integration of all the parts.
The researcher then carried out integration testing as part of the evaluation tasks to make sure that all of the sub-components could be connected to one another and that there were no bugs. Every module of the courseware was tested by the developer during the development phase, which also included the integration testing. To make sure that all the sub-modules are properly integrated and that no errors occur, the integration testing procedures are looped repeatedly. The researcher then carried out system testing and user acceptance testing (UAT) to check that the courseware was well-developed and met the system and user requirements after the sub-modules and modules in digital video courseware had been successfully integrated.

Testing Phase

The fifth phase of the integrated Waterfall-ADDIE model is the testing phase. The researcher then carried out every job in accordance with the process that would be used in the actual experiment once the construction of the courseware is complete during the testing phase. Before the actual testing is carried out, the researcher implements all the instruments used in this study during the pilot testing, which is regarded as the final evaluation task. Determine the evaluation criteria and choose the evaluation instruments are the two tasks that make up this activity. In order to evaluate the students' knowledge achievement, computational thinking (CT) self-efficacy perception, and perceived motivation, assessment forms use three criteria. The survey and exam were chosen by the researcher as the study's evaluation tools.

There are four instruments used in this study which are Thinking Styles Inventory (TSI), Digital Video Learning Material Test (DVLt), CT Self-Efficacy Survey (CTSe), and Instructional Materials Motivational Survey (IMMS). The TSI's goals are to recognise and categorise students' thinking styles and assess whether there is a connection between thinking style and knowledge achievement, perceived CT self-efficacy, and perceived motivation. Students choose their thinking styles using a Likert scale with 7 points. The reliability test was carried out to 96 students in order to investigate the consistency of the TSI instrument's reliability for various research participants and contexts and to demonstrate that it is reliable to be used throughout time which is Cronbach's alpha reliability values of 0.95.

The items of Digital Video Learning Material Test (DVLt) used in this study were adapted from a variety of sources, including websites for teaching video creation (NCSU College of Education, 2005), opinions from specialists, and relevant themes from lecture notes on video production. All of the DVLt instrument's items have a Cronbach's alpha internal consistency reliability coefficient of 0.75, which is considered acceptable for this study.

This study developed the CT Self-Efficacy Survey (CTSe) by adapting several reviewed item scales from Computing Attitude Survey, CTS, CPSES and SPSCTS. The reliability test was carried out to investigate the consistency of the CTSe instrument's reliability for various research participants and contexts and to demonstrate that it is reliable to be used over time which is Cronbach's alpha value of 0.97.

The Instructional Materials Motivational Survey (IMMS) was created by Keller (1987) to evaluate a student's level of motivation in academic settings. The four ARCS components form the basis of the IMMS evaluation (Attention, Relevance, Confidence and Satisfaction). The reliability test was conducted to investigate the consistency of the IMMS instrument's reliability for various research participants and contexts and to demonstrate that it is reliable enough to be used throughout time which is Cronbach's alpha value of 0.97.

Implementation Phase

The integrated Waterfall-ADDIE model's sixth step is the implementation. In general, the implementation phase is used in study by the majority of researchers that used the Waterfall or ADDIE models. The standard operating procedures for the implementation phase are established for the lecturer and students, according to Huang et al. (2019). To ensure that courseware is successfully provided, the researcher carefully identified and organised the activities of the lecturer and students. The majority of studies used summative evaluation activities that were conducted on actual users as part of the integrated Waterfall-ADDIE model deployment process. While the process of collecting data during the implementation phase is known as the summative evaluation. The results acquired from the actual experiment are used in this study's summative evaluation.

3.0 RESULTS AND DISCUSSION

Prior to the main study, a pilot test was conducted to assess the processes and collect data. A pilot test can identify any flaws in the methodology or design of a research study, enhancing its effectiveness and calibre. As a risk-mitigation strategy to lessen the possibility of a larger project failing, the pilot testing was carried out using the same methods as in the actual study. 30 individuals from various batches of the same university's "Bachelor of Computer Science (Interactive Media)" programme took part in the pilot testing. Nielsen (2012) claims that five participants are sufficient for a test to verify that the findings are generalizable.

However, the researcher conducted the pilot testing with 32 students, separating 16 participants into Group A who were exposed to learner-paced digital video learning courseware and the other 16 participants into Group B who were exposed to control group. This was done to avoid data contamination and to ensure that the results are generalizable. Descriptive statistics analysis was used to examine the variations in the mean scores for the dependent variables between the pre-test and post-test results from the pilot testing. According to Table 1, the knowledge score for the Group A and Group B treatment groups varies between the pre- and post-test. The total knowledge score results demonstrate the improvement in students' scores between the pre- and post-intervention tests.

Table 1. Descriptive Statistic for Knowledge Score in Pilot Testing

	Group A		Group B		Overall	
	Pre	Post	Pre	Post	Pre	Post
Sample size	16	16	16	16	32	32
Mean	21.63	28.06	22.19	31.25	21.91	29.66

As shown in Table 2, the CT self-efficacy perception results likewise demonstrate an increase in mean scores between the pre- and post-test. Results for the learner-paced digital video learning courseware (Group A) are higher than those for the control group (Group B) based on the variances between mean scores.

Table 2. Descriptive Statistic for CT Self-Efficacy Perception Score in Pilot Testing

	Group A		Group B		Overall	
	Pre	Post	Pre	Post	Pre	Post
Sample size	16	16	16	16	32	32
Mean	3.86	4.27	3.67	4.17	3.76	4.22

Descriptive statistics analysis was used to examine the findings of a post-test questionnaire about students' reported motivation. The researchers found that the mean score for students' perceived motivation increased along with an increase in CT self-efficacy scores. The students' perceived motivation for the Group A is higher than the Group B, as shown in Table 3.

Table 3. Descriptive Statistic for Perceived Motivation Score in Pilot Testing

	Group A	Group B	Overall
	Post	Post	Post
Sample size	16	16	32
Mean	4.25	4.04	4.15

The overall outcomes of the pilot testing are presented in Tables 1, Table 2, and Table 3. All the tables highlight the variations between the pre- and post-tests in terms of knowledge achievement, perceptions of CT self-efficacy, and the students' high scores for perceived motivation. The mean scores show that learner-paced digital video courseware (Group A) is better than the control group (Group B) knowledge achievement, CT self-efficacy, and perceived motivation among the MTUN students.

The learner-paced mode, which is highlighted in the segmenting principle of CTML, is one of the new innovations in concept and methods employed in educational technology that the researcher introduced in this study. In order to examine the effects on students' achievement of knowledge, CT self-efficacy perception, and perceived motivation, the researcher also highlighted the integration of computational thinking (CT) with learner-paced mode in segmenting concept. Findings show that students who were experienced the learner-paced mode outperformed the control group in terms of test scores.

The innovative use of the Waterfall and ADDIE models in the development of the digital video learning courseware was also acknowledged by the researchers. To the best of the researcher's knowledge, no research has been done to emphasise the integration of the Waterfall and ADDIE models in the development of the digital video earning courseware.

In this study, researcher opines that the developed digital video learning courseware increases students' knowledge of both CT's interdisciplinary domains and digital video production. It improves their knowledge of 21st century competencies, which put an emphasis on digital competency and CT competencies. The integration of the segmenting principle (learner-paced) and CT skills also boosting the students' self-efficacy in the field. It improves their ability to define and assess issues and formulate sensible plans for solutions.

The researcher found that there has not been much advancement in digital video production, that are appropriate for Malaysian university students. It is because, to the best of the researcher's knowledge, there is no study integrating the segmenting principle (learner-paced) and CT for a digital video subject has been done. The development of the digital video learning courseware is therefore anticipated to improve student achievement in terms of knowledge, CT self-efficacy perception, and perceived motivation toward learning materials related to video production among Malaysian university students.

In this context, this study aids in educating Malaysian university students about digital video development. This is meant to aid universities in learning more about subjects connected to video production. Students from foreign universities, colleges, or even secondary school students who are interested in digital video production can also use the courseware. It is hoped that through developing this digital video learning courseware, university students will have a better understanding of the subject of learning to produce digital videos.

The developed courseware is intended to help university students improved comprehension and understanding the topic of digital video production in the future. The digital video learning material comprises the various types of camera techniques, types of movement, types of shot, as well as the crucial part is nurturing the students with the algorithmic thinking, which can increase students' knowledge achievement, CT self-efficacy perception, and perceived motivation in these disciplines. In order to better understand the effects of these factors, future research should be expanded to include analyses of learning style, metacognition, cultural values, learner style preferences, gender, and cognitive styles. These factors might be a part of other elements that very well might affect how students learn through multimedia.

4.0 CONCLUSION

The development of digital video learning courseware used learner-paced predetermined segments with the intention of examining how they affected students' perceived motivation, CT self-efficacy perception, and knowledge achievement. A learner-paced is essential for giving students a flexibility in their learning and allow them to decide when and how to perform tasks and activities. Based on the findings, researcher found that students who have flexibility in deciding their own learning pace achieving better outcomes in terms of knowledge achievement, CT self-efficacy perception, as well as perceived motivation. This paper also highlighted the use of integrated Waterfall-ADDIE model in developing the digital video learning courseware. The researcher believes that the integrated Waterfall-ADDIE model can be applied in any of educational application or learning courseware development. It is due to the facts that the integrated Waterfall-ADDIE model concentrates on both software development and instructional design, which involving many testing such as unit testing, integration testing, system testing, and acceptance testing. Hence, future researchers could design a better courseware or application that is free from defects or faults.

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