AsTEN JOURNAL OF TEACHER EDUCATION
VOLUME 8

ASSOCIATION OF SOUTHEAST ASIAN TEACHER EDUCATION NETWORK

Teaching Design Thinking Process with an Interactive Video-based Course to Vocational Students

Patchara Eamcharoen
Faculty of Education, Kasetsart University, Bangkok, Thailand, 10900

ABSTRACT

With Thailand 4.0's emphasis on innovation, this study explores using an interactive video-based course to facilitate innovation creation through design thinking for vocational students in Bangkok. This quasi-experimental pretest-posttest study aimed to develop a course using interactive video technology and evaluate its impact on students' knowledge, attitudes, skills, and satisfaction. Thirty purposively sampled vocational students, selected as an intact class with access to a computer class and laboratory, participated, with data collected through a preliminary survey, suitability and satisfaction questionnaires, and a design thinking process test. The course, developed in three steps, included needs analysis and course development, experiment, and evaluation, with data analyzed using paired t-tests, mean, standard deviation, and content analysis. Results showed significant improvements in students' knowledge and skills, aligning well with national educational goals and student needs. High satisfaction highlighted the effectiveness of interactive elements, though improvements in visual clarity were suggested. This study contributes evidence for interactive video technology's value in vocational education, recommending further research on factors influencing attitude improvement and optimal visual design.

ARTICLE INFORMATION

Article History
Received: September 18, 2024
Revised: December 18, 2024
Accepted: December 19, 2024

Editor-in-Chief
Watsatree Diteeyont, PhD

Managing Editor
Marie Paz E. Morales, PhD

Eamcharoen, P. (2024). Teaching design thinking process with an interactive video-based course to vocational students. *AsTEN Journal of Teacher Education, 8*. 153-171.

Corresponding Author: Patchara Eamcharoen
feduprv@ku.ac.th

Keywords: Design thinking process, interactive video-based course, vocational students

Introduction

Design thinking has become an essential skill for the 21st century, with a strong focus on innovation. It needs to be taught in educational settings by integrating it into academic content for students to learn and practice early in their education (Lahey, 2017). Students with design thinking capabilities will develop different perspectives on problems (Polat & Bayram, 2022), can solve complex problems, and can come up with innovative solutions (Razzouk & Shute, 2012).

Therefore, preparing course learning materials is essential (Retna, 2015). Although diverse course materials are available, video media has been widely recognized for its potential, extensively incorporated into education, and abundantly received popularity. Husna and Fajar (2022) revealed in their study that video media, especially interactive ones, can be considered learning materials. Similarly, Raab et al. (2023) found that embedding interactive elements in educational videos, such as quizzes and annotations, can significantly improve students' learning outcomes by enhancing engagement and comprehension. Aligned with this, Dong et al. (2022) found that interactive video modules with asset-based participatory design thinking significantly engaged students, fostering curiosity and enhancing understanding. This approach led to a more immersive learning experience, with students reporting increased interest, better comprehension, and higher engagement than traditional teaching methods. Its increased utilization has dramatically enhanced the educational experience and positively impacted student learning, presenting opportunities and possibilities in the context of teaching and learning (Castro-Alonso et al., 2019).

An interactive video is a learning tool beyond traditional, lecture-style teaching. It serves as a fundamental form of interaction pivotal to student learning, is a vital part of their learning process, and is an essential factor affecting educational success (Alshehri et al., 2023). As a result, it can optimize learning based on individual needs, learning goals, and other contextual factors (Navarrete et al., 2023).

However, most video media comes from the YouTube platform, which enables only fundamental interactions such as playing, pausing, and linking to other videos. When students are given videos with questions, they often skim or skip them and only answer them, missing out on valuable learning (Pulukuri & Abrams, 2020) due to their inability to interact with the videos. But, using the available features, learning can be made as active and engaging as possible with proper course design.

The use of interactive videos in education has been studied recently in Thailand (see example, Damrongkiattisak & Archaphet, 2014; Khawloueng & Anukulwech, 2019; Suwannaparsop, 2018). However, many of these studies have only looked at higher education—rather than vocational education. Henriksen et al. (2017) highlighted this gap by stating that design thinking is not fully applied in vocational colleges, indicating a need for more attention. Thus, this study aims to determine the most effective methods for providing vocational students with an interactive video-based course

supporting design thinking. The results would provide valuable insights and helpful information for creating an active and engaging video-based learning environment, enabling vocational students to learn at their best with interactive video technology.

Research Objectives

The primary research objectives were the following:

1. Evaluate students' design thinking process before and after the use of an interactive video-based course.

2. Assess student satisfaction with an interactive video-based course and explore their further recommendations.

Literature Review

The following is a review of the research on using interactive video technology to teach vocational students about the design thinking process.

Teaching Design Thinking

The emergence of design thinking is relatively recent in the 21st century as a role to nurture numerous essential qualities recognized as 21st-century competencies in the educational context (Goldman & Kabayadondo, 2017; Koh et al., 2015). Design thinking is the new teaching paradigm that encourages and drives innovation for 21st-century design and non-design students through its five fundamental stages (Elsbach & Stigliani, 2018). The literature suggests a range of three to six stages. However, the process model from the Hasso Plattner Design Institute (D.School) at Stanford University is frequently used in practice (Brown, 2008; Rösch et al., 2023). Therefore, the primary emphasis of this study is this model, as D.School was one of the foremost educational institutions dedicated to fostering design thinking in education (Thi-Huyen et al., 2021). Emphasis is placed on the design thinking content (Beligatamulla et al., 2019), covering five stages. In the empathizing stage, students need to understand the problem to be solved and get engaged directly when the problem arises to gain firsthand experience and deepen their empathy (Aflatoony & Wakkary, 2015), while in the defining stage, students draw information from the empathizing stage to analyze and synthesize the problem to identify the root problem (Val et al., 2019). In the ideating stage, students generate various ideas and are encouraged to develop innovative solutions to address user problems (Henriksen et al., 2017). In the prototyping stage, students create a simple design or prototype to determine whether the solution effectively addresses the problem (D.School, 2019). In the testing stage, students must assess the design and user experience (Val et al., 2019).

Teaching design thinking can vary, but it utilizes many active learning protocols (Beligatamulla et al., 2019). Additionally, technology integration is a promising avenue for creating active and compelling learning experiences. Interactive video technology, for example, offers dynamic course learning materials that capture students' interest and actively engage them in their learning process.

Interactive Videos

Nowadays, videos employing interactive video technology have emerged as a solution for learners, enabling them to fully concentrate on educational materials (Benkada & Moccozet, 2017). An interactive video is a combination of computer and video technologies with a user-friendly interface, in which users can control and select options based on a given set of instructions (Pulukuri & Abrams, 2020). Through an additional layer of data and metadata, it triggers additional types of interactions (Benkada & Moccozet, 2017) to make a video an effective tool for enhancing student learning from its content (Pulukuri & Abrams, 2020).

It can tag, label, navigate within a video, explore screen information, switch perspectives, branch plots, create content summaries, and interact with content or other users in real time (Palaigeorgiou & Papadopoulou, 2016). As a result, interactive videos can support learning in the best way according to individual needs, learning goals, and other contextual factors (Navarrete et al., 2023). In essence, interactive videos employing interactive video technology make learning more creative, active, and engaging, leading to significant educational outcomes.

In summary, the literature review highlights the increasing importance of teaching design thinking to facilitate innovation, particularly in vocational education, and the role of interactive video technology as a modern pedagogical tool in improving student learning outcomes. Design thinking has become the new teaching paradigm and drives innovation for the 21st century through its five key stages: *empathizing, defining, ideating prototyping, and testing*. This model, popularized by the Hasso Plattner Design Institute (D.School) at Stanford University, emphasizes active learning by engaging students in real-world problem-solving and developing creative solutions. The combination of design thinking and interactive video technology creates an immersive and engaging learning environment, aligning with modern educational trends and improving students' outcomes, particularly in vocational education, which often lacks a focus on innovation. Despite interactive videos being widely studied in higher education, they remain underexplored in vocational contexts. Thus, there is a need to investigate how interactive video-based courses can effectively support the design thinking process for vocational students, a gap this study aims to address.

Framework of Study

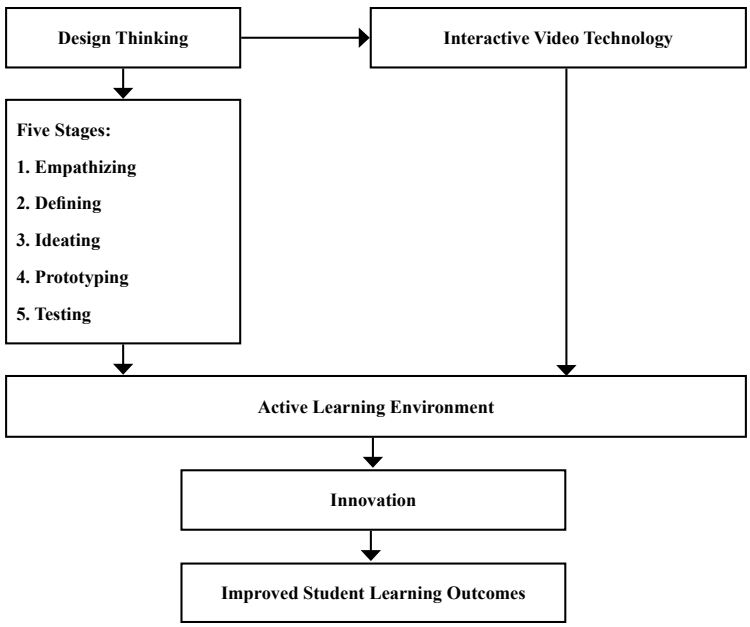
The study is based on design thinking principles and the integration of interactive video technology in education, both of which directly inform the study's purpose and hypotheses. A recent educational paradigm, design thinking nurtures essential 21st-century skills by promoting innovation through its five key stages: *empathizing, defining, ideating, prototyping, and testing* (Elsbach & Stigliani, 2018; Goldman & Kabayadondo, 2017). These stages serve as the solid foundation for the content presented in the interactive video-based course, aligning with the study's objectives to teach and foster design thinking process. This model, primarily associated with the Hasso Plattner Design Institute (D.School) at Stanford University, emphasizes active learning and real-world problem-solving (Brown, 2008; Rösch et al., 2023). On the other hand, interactive video technology provides an interactive platform for delivering this design thinking content. By

enabling students to engage with learning material through interactive features such as branching scenarios, quizzes, and immediate feedback, the videos facilitate engagement, motivation, and practical applications of the design thinking process (Benkada & Moccozet, 2017; Pulukuri & Abrams, 2020). These theories shape the intervention (the interactive video-based course) and determining the metrics for evaluation, including knowledge, attitudes, and skills. The study hypothesizes that by integrating interactive video technology grounded in design thinking principles will lead to significant improvements in students' design thinking process proficiency: knowledge, attitudes, and skills, as well as their satisfaction with the learning experiences. The integration of these theoretical foundations ensures that the research achieve both innovation impact and pedagogically soundness. The following diagrammatic framework illustrates the conceptual framework for this study:

The diagrammatic framework illustrates how design thinking is combined with interactive video technology to create an active learning environment to foster innovation and improve student learning outcomes. It begins with the design thinking model, which consists of five key stages: empathizing, defining, ideating, prototyping, and testing. This model fosters innovation, particularly in vocational education. In parallel, interactive video technology enhances the learning experience by creating an active learning environment that promotes student engagement and active participation. The active learning environment serves as the central components where both design thinking principles and interactive video technology combine, enabling students to engage with the video content actively. As students progress through the design thinking stages, they develop skills in innovation, essential for success in the 21st century. The process comes in two key outcomes: fostering innovation and improving

Figure 1

Framework of the Study



student learning outcomes, as depicted in the framework. Ultimately, integrating these elements aims to improve learning outcomes for vocational students, addressing the need for innovation in this context.

Methodology

This research employed quasi-experimental methods with a pretest-posttest design to assess knowledge, attitudes, and skills related to the design thinking process. An interactive video-based course was utilized as an experimental tool. Three education experts evaluated it to ensure it met established criteria using a suitability questionnaire and pilot-tested by 30 non-targeted vocational students before implementation.

Participants

The participants in this study were 60 purposively selected vocational students enrolled at vocational colleges in Bangkok under the jurisdiction of the Office of Vocational Education Commission. The selection criteria emphasized inclusion of students with access to computer classes and well-equipped laboratory facilities during the experiment. Participation was voluntary, and students were explicitly informed that the study was offered as an extracurricular course. The sampling process began with the selection of one vocational college that willingly participated in the study. The 60 students were divided into two groups: a pilot group and a targeted group, as the computer laboratory could accommodate only 30 students per session. This purposive sampling ensured that participants, selected as an intact class from vocational students with access to a computer class and laboratory during the experiment, met the specific requirements for conducting the study effectively within the laboratory environment.

Instruments

There were four instruments, passing content validity and reliability testing to ensure a consistent, accurate, and comprehensive evaluation of the course.

A 27-item preliminary survey, using a Likert scale along with one open-ended question to gather qualitative insights, was developed based on a literature review to collect data on students' needs for learning the design thinking process and integrating interactive video technology. The content validity of this survey, assessed using the Index of Item-Objective Congruence (IOC), was 0.97, indicating strong agreement among experts that the instrument aligns with the research objective. Once tested with the pilot group, the reliability index was 0.96, demonstrating that the instrument is reliable for use with the targeted group. This instrument consisted of questions targeting specific needs and technological preferences, and the results were used to align the course design with these needs and preferences, informing the establishment of learning objectives, content, and video media.

A 23-item suitability questionnaire, using a Likert scale along with one open-ended question to gather qualitative insights, was structured into four subscales: content relevance (7 items), video media (5 items), interactivity (5 items), and learning (6 items). This questionnaire was designed for expert review to assess the appropriateness and effectiveness of the interactive video-based course. Content validity was ensured through expert judgment, and the feedback was incorporated to refine the course content and structure.

A design thinking process test with 29 items, scored from 0 to 44, was used to assess students' proficiency in the design thinking process. The test included 14 multiple-choice questions focusing on knowledge, 5 Likert-scale items focusing on attitudes, and 5 short-answer questions focusing on skills. The content validity of this test, assessed using the Index of Item-Objective Congruence (IOC), was 0.95, indicating strong agreement among experts that the instrument aligns with the research objective. Once tested with the pilot group, the reliability index was 0.96. Identical pre- and post-assessment test items were used to evaluate students' knowledge, attitudes, and skills before and after engaging with the course content.

A 23-item satisfaction questionnaire, using a Likert scale along with one open-ended question to gather qualitative insights, was adapted from the four subscales: content relevance (7 items), video media (5 items), interactivity (5 items), and learning (6 items). The content validity of this questionnaire, assessed using the Index of Item-Objective Congruence (IOC), was 0.95, indicating strong agreement among experts that the instrument aligns with the research objective. Once tested with the pilot group, the reliability index was 0.97, demonstrating that the instrument is reliable for use with the targeted group. This questionnaire gathered data on satisfaction levels and included feedback for course refinement.

Procedure

Pre-Intervention

Step 1. Needs analysis and Course Development.

The researcher examined a literature review on video frameworks and used a preliminary survey questionnaire based on this review to collect data on students' needs to learn the design thinking process and integrate interactive video technology. This information was used to align the course design with these needs, informing the establishment of learning objectives, content, and video media. After including important content and interactive components, the researcher then uploaded the course to a website. Education experts reviewed the course using a suitability questionnaire with four subscales: content relevance, video media, interactivity, and learning.

Further suggestions were encouraged to improve the course. The course was verified as highly qualified for building a solid foundation of the design thinking process ($\overline{X}$ = 4.09, S.D. = 0.34). Specifically, they rated highly in content relevance, learning, interactivity, and video media, respectively ($\overline{X}$ = 4.67, S.D. = 0.46; $\overline{X}$ = 4.00, S.D. = 0.33; $\overline{X}$ = 3.80, S.D. = 0.35; $\overline{X}$ = 3.67, S.D. = 0.31), with the recommendation that the content displayed should not be excessively long and should summarize only key points. The researcher adjusted the content length to make it briefer, more concise, and easier to understand.

Intervention

Step 2 Experiment.

Using a one-group pretest-posttest design, the researcher experimented with the course among a pilot and a targeted group of vocational students. In this study, vocational students were divided into two groups: a pilot group and a targeted group, with both groups provided access to the course. Their proficiency in the design thinking process across knowledge, attitude, and skills was assessed with identical pre- and post-assessment

test items.

A pilot test was conducted before experimentation with the targeted group to gather feedback on content and interactive elements, including language, graphics, and sound. Emphasis was placed on the need for clear instructions, as the interactive video-based course required learners to interact rather than just watch. The researcher then added the course instructions.

High ratings and feedback from the experts and the pilot test helped validate the course design, development, and implementation regarding content and delivery methods. Adjustments based on education experts' recommendations and pilot test suggestions were crucial for improving the content and delivery methods, making the course more suitable, practical, and impactful for vocational students to ensure a smooth learning experience. As a result, continuous validation through expert feedback and pilot testing should be an integral part of the course development process, guaranteeing ongoing improvements based on empirical evidence.

Then, the targeted group was provided access to a website containing four links: one for the pre-test, one for the interactive video-based course (the intervention), one for the post-test, and one for a satisfaction questionnaire. The researcher was in the computer room, organizing, monitoring, and assisting vocational students throughout the procedure. Before using the course, vocational students were required to take a pre-test to assess their baseline knowledge, attitudes, and skills related to the course content. Once they started using the interactive video-based course, they encountered the welcome page, course instructions, and learning objectives clearly outlined and described on the website before interacting and engaging in the course. They were given sufficient time to familiarize themselves with the course and self-study the course materials within the allotted timeframe, with the researcher present in the room. After course completion, they were asked to complete the post-test, using the same procedure to assess student learning outcomes in knowledge, attitudes, and skills and any significant increase in design thinking process proficiency.

Post-Intervention

Step 3 Evaluation.

This step involves evaluating students' satisfaction using a questionnaire adapted from content relevance, video media, interactivity, and learning, which are the core components of the interactive video-based course to measure their satisfaction and gather feedback for course refinement.

Data Analysis

Descriptive and inferential statistical methods were employed to assess changes in knowledge, skills, attitudes, and satisfaction levels following the course completion. This included calculating means and standard deviations for quantitative data and conducting paired t-tests to determine significant differences between pre-and post-test results. Qualitative data from open-ended questions were analyzed using content analysis to extract valuable insights regarding student learning experiences and suggestions for improvement.

Ethical Considerations

This study complied with ethical research practices and standards. It was granted approval

by the Kasetsart University Ethics Committee (KUREC-SSR65/149). Respect for participants' rights and privacy were firmly ensured. Participants were fully informed about the study's purpose, procedures, and their voluntary involvement. Written consent was obtained prior to their participation, and data confidentiality was maintained throughout the research process.

Findings and Discussion

Research findings from this study are summarized below:

Needs Analysis and Course Development

Students showed a high need for learning design thinking processes ($\overline{X}$ = 3.84, S.D. = .51) and for integrating interactive video technology ($\overline{X}$ = 3.82, S.D. = .54). These significant findings indicate a strong demand for educational resources that address these areas. They highlighted the importance of a course that starts with students' needs in mind first, under Lempas et al. (2021), who emphasized the importance of assessing media needs to support the learning process effectively. Therefore, teachers should incorporate students' needs at the start of course design to foster a learning environment where students feel their needs are met. For the interactive video-based course design and development, there were nine modules, as detailed in Table 1, consisting of design thinking content and interactive elements as learning activities, including a welcome page, course instructions, learning objectives, review results, and end-of-course.

Table 1 shows nine modules within the interactive video-based course. Then, it was published on a website for access. Users (the

Table 1

Nine Modules of the Interactive Video-based Course titled "From Design Thinking Process to Innovation Creation"

Course Materials	Content	Learning Activities	Interactive Elements	Design Thinking Element
Module 1	Innovation	Spot the innovation Why Innovate? Innovation Examples Meet the innovator Harnessing Innovation	Quizzes Carousel Click to Reveal Short Answer Timeline	Expected Design Thinking Process Outcomes
Module 2	Painpoints	Case Study Exploring User Reaction Getting Rewards Spot the Painpoints	Checklist Drop Down List	Empathize & Define
Module 3	Design thinking	Five Key Steps Case Study	Tap Review Quizzes Knowledge Check	Five Key Steps
Module 4, 5, 6,7,8	Empathize, Define, Ideate, Prototype, and Test	How to empathize, define, ideate, prototype, and test	Carousel Short Answer	Five Key Steps
Module 9	Course Summary	Five Key Steps of Design Thinking	Drag and Drop Sequences	Summary of the Design Thinking Process

targeted group) were provided access to a website. They must watch all the videos without skipping ahead and complete each learning activity before being allowed to continue, as the program can be configured to prevent advancing without interacting with the content and completing the assigned activities. Once they finish all modules, they can view them repeatedly.

Students' Proficiency in the Design Thinking Process

Table 2 presents the students' proficiency levels regarding knowledge, attitude, and skill levels. This data addresses the research objective of evaluating students' design thinking process before and after the use of the interactive video-based course.

Table 2 shows the post-course knowledge ($\overline{X}$ = 8.37, S.D. = 2.67) from 14 scores, exhibiting a significant increase compared to pre-course knowledge ($\overline{X}$ = 5.63, S.D. = 2.04), reaching statistical significance at the .05 level. This increase highlights the effectiveness of the interactive video-based course in enhancing students' knowledge of the design thinking process as it facilitates comprehension of the design thinking process. The structured content and interactivity may have contributed to engaging students effectively, leading to better retention and understanding of the concepts presented in the course. The teacher-researcher observed that the interactive elements, such as quizzes, branching scenarios and real-time feedback, significantly enhanced the learning experience. These features aligned with the principles of design thinking, enabling students to engage actively in all five stages: empathizing, defining, ideating, prototyping, and testing, which is in accordance with Dong et al. (2022), who reported that interactive video modules designed with asset-based participatory design thinking engaged students and enhanced their understanding at a significant level. This reaffirms that design thinking is considered as a crucial pedagogical paradigm for developing 21st-century competencies (Goldman & Kabayadondo, 2017; Elsbach & Stigliani, 2018).

Table 3 represents the post-course attitude ($\overline{X}$ = 4.33, S.D. = 0.10), ranging from 1-5 potential scores, indicating that it was not statistically significant at the .05 level when compared to pre-course attitude ($\overline{X}$ = 4.05, S.D. = 0.06). It showed limited improvement in attitudes after the intervention. This outcome implies that additional learning strategies may be required to foster deeper attitudinal engagement

Table 2

Knowledge Level Before and After the Interactive Video-based Course

Knowledge level of design thinking process	$\overline{X}$	SD	Mean Differences	n	t	p
Pre-test	5.63	2.04	2.74	30	4.49	.00
Post-test	8.37	2.67				

Note: $\overline{X}$ *= Mean, S.D. = Standard Deviation, n = Sample Size, t = Test Statistic, p < .05 indicates statistical significance.*

Table 3

Attitude Level Before and After the Interactive Video-based Course

Attitude level of the Design thinking process	Experiment Group				p-value
	Before		After		
	$\overline{X}$	S.D.	$\overline{X}$	S.D.	
Recognizing the ability to innovate	4.10	0.99	4.38	0.68	.21
Desire to develop innovation skills	4.07	0.87	4.19	0.88	.60
Valuing the creation of new and different solutions to innovation	3.97	0.94	4.44	0.77	.03
Curiosity in using design thinking: a popular and trendy tool for innovation	4.11	0.99	4.35	0.75	.27
Valuing design thinking as a primary tool for innovation creation	4.00	1.02	4.29	0.76	.21
Total	4.05	0.06	4.33	0.10	.21

Table 4

Skills Level Before and After the Interactive Video-based Course

Skills level of design thinking process	$\overline{X}$	SD	Mean Differences	n	t	p-value
Pre-test	13.02	1.05	9.91	30	41.29	.00
Post-test	22.93	0.83				

Note: $\overline{X}$ = Mean, S.D. = Standard Deviation, n = Sample Size, t = Test Statistic, $p < .05$ indicates statistical significance.

and transformation. Active learning strategies, such as storytelling, gamification, role-playing or group discussions, which align with design thinking principles, might complement the course content and address this gap better in future implementations. According to Polat and Bayram (2022), attitude development often thrives in immersive and collaborative learning environments. As a result, there should be a more holistic approach to design thinking education, incorporating learning strategies that promote not just knowledge and skills but also attitudes.

Table 4 represents the post-course skills ($\overline{X}$ = 13.02, S.D. = 1.05) from a total of 25 scores, exhibiting a significant increase compared to pre-course skills ($\overline{X}$ = 22.93, S.D. = 0.83), reaching statistical significance at the 0.05 level. This increase demonstrates how effective the interactive video-based course is in skills development. The teacher-researcher observed that the video content provided opportunities for students to develop different perspectives on problems and actively engage with real-world tasks throughout five key stages. These stages were essential in developing students' hands-on skills, as they required learners to see through painpoints and come up with innovative solutions. This aligns with Navarrete et al. (2023), who advocate for interactive videos as tools for promoting active learning and skill application and with Benkada and Moccozet

(2017), who emphasize that interactive video technology helps facilitate engaging learning and active participation, leading to skill mastery.

These significant findings demonstrated a notable improvement in knowledge and skills levels before and after the course, highlighting the effectiveness of the course design and development, practically aligning with students' learning needs and technological preferences to ensure engaging and accessible content. This improvement can be attributed to the practical course design, which incorporated the latest content, design thinking, and the latest technology, interactive video technology, as the post-course learning outcomes were higher than the pre-course learning outcomes. The findings confirmed with Kleftodimos and Evangelidis (2018), who suggested that incorporating interactivity into learning leads to improved outcomes, and Al-Snaid and Altawalbeh (2020), who developed interactive videos and discovered that their interactive videos effectively increased academic achievement. However, the interactive video-based course still needed to change the attitude level. The lack of impact on attitudes indicated limited emotional engagement. It is necessary to explore other factors that may be limiting this effect. Further exploration of learning strategies that enhance positive attitudes through storytelling and gamification is also needed to promote holistic learning outcomes (Razzouk & Shute, 2012; Henriksen et al., 2017; Polat & Bayram, 2022). Additionally, the researcher was instrumental in organizing, monitoring, and assisting students throughout their learning process. Therefore, teachers' support is crucial for maintaining the flow of learning and keeping students on track, and this support must be in place.

Students' Satisfaction with the Course.

After reviewing the course results, vocational students clicked an 'End Course' button to exit and were given a link to a satisfaction questionnaire. This data addresses the research objective of assessing student satisfaction with the interactive video-based course and exploring their recommendations.

Table 5

Student Satisfaction with the Interactive Video-based Course

Student satisfaction with the course	$\overline{X}$	SD	Level
Content relevance	4.24	0.63	High
Video media	4.25	0.74	High
Interactivity	4.19	0.78	High
Learning	4.23	0.73	High
Total	4.23	0.69	High

Note: $\overline{X}$ *= Mean, S.D. = Standard Deviation*

Table 5 shows the overall satisfaction at a high level ($\overline{X} = 4.23$, S.D. = 0.69). These findings indicated that the video media is well-designed with appropriate language, graphics, and sound. The content is clear, concise, up-to-date and valuable, aligning with the established learning objectives. The course facilitated learning by imparting solid knowledge through practical guidelines and real-life examples. It included diverse interactive elements, motivating students to learn with flexible options and accommodating self-paced learning opportunities. This approach prompted students to engage with the content and practice design thinking through various learning activities.

According to their feedback, they desired more precise and impactful visuals that could convey the intended message with clarity and sharpness. Additionally, they suggested adding more novelty to the media to enhance engagement. Students were delighted with video technology and the well-designed and developed course materials that aligned with students' needs and technological learning preferences. Adding interactive elements significantly enhanced the student's learning experience, leading to high satisfaction levels. High satisfaction ratings emphasize the importance of course design and development, yet the need for enhanced media elements highlights ongoing challenges in engagement strategies (Alshehri et al., 2023; Beligatamulla et al., 2019). The results were consistent with Preradović and Lauc (2020), who found that students had higher satisfaction with interactive videos, and also in line with Desai and Kulkarni (2022), who found in their study that interactive video leads to better learners' satisfaction. Therefore, teachers should foster an environment where students feel their feedback is valued, leading to better satisfaction rates. However, while many students showed enthusiasm and completed the interactive video-based course, others became fatigued due to the high number of learning activities and unappealing visuals and graphics. Some activities were more effective than others, and specific visuals did not capture the students' interest or help them understand the content sufficiently. More precise and impactful visuals should be incorporated to satisfy students better when using the interactive video-based course, the content should be revised for greater relevance, and the learning activities they prefer should be included. These changes will enhance student satisfaction and lead to more positive outcomes. Redeveloping the course based on student feedback will optimize its results. These significant findings indicate that, although students were delighted with the course, there remains room for improvement to enhance the learning experience. Implementing feedback mechanisms in interactive videos will allow students to reflect and make iterative improvements, emphasizing real-time feedback's impact on learning outcomes (Aflatoony & Wakkary, 2015).

This study demonstrates the effectiveness of using the interactive video-based course as a learning material for design thinking, as evidenced by the increased learning outcomes and satisfaction following the course. The course's effectiveness stemmed from aligning the content with students' needs, incorporating interactive video technology that students preferred, and designing the course according to specific learning objectives to promote the design thinking process in innovation creation. As a result, the interactive video-based course was demonstrated to be a practical choice for education among various learning media. It transformed passive learning into active learning by transforming videos into active learning tools, augmented with interactive elements to boost engagement, facilitate students, and improve learning outcomes.

Although it has the potential to contribute to effective course design and development within design thinking or across disciplines, there are still areas for improvement to optimize teaching and learning experiences. As the study utilized various types of interactions, analyzing these interactions to identify patterns that lead to optimal results will enhance interaction design. In addition, further investigation into specific visual elements that support content delivery, such as font size, color contrast, sound effects, and graphical representations, could provide valuable insights for optimizing the interactive

video-based course to foster innovation creation among vocational students better.

Implications

Course Design with the Latest Content and Trending Technology

To contribute to future design thinking courses, teachers can enhance teaching and learning experiences by leveraging course design to create transparent, dynamic, and impactful learning materials tailored to students' needs. This includes combining the latest content of innovation creation, such as future-focused design thinking, and incorporating trending technology, like interactive video technology, along with established learning objectives to ensure that learning activities and content are purposefully directed toward promoting desired learning outcomes.

Guidelines for Teaching Design Thinking

This study provides several practical guidelines for teachers in teaching design thinking. Firstly, teachers should start with a sensible course design incorporating modern content and the right technology. They should stay informed about the latest content, technological trends, and widely used tools while emphasizing active learning through interactive elements to keep students engaged in their learning process. Secondly, offering teacher training on designing, developing, and implementing these courses effectively will ensure they are well-equipped to teach to their full potential. Thirdly, teachers should regularly assess students' evolving needs and preferences, analyze interactive elements within the course to identify patterns leading to optimal results, ensure visual elements are appealing before each use, and always obtain feedback after use. This continuous improvement process will refine the course design and enhance its effectiveness.

Conclusion and Recommendations

This study concluded that the interactive video-based course effectively enhances students' knowledge and skills in the design thinking process, particularly when aligned with their learning needs and technological preferences. These findings underscore the potential of integrating interactive video technology into teacher education programs across ASEAN, as it offers a new pedagogical paradigm for developing skills in innovation, essential for success in the 21st century. Although the course significantly improved learning outcomes, the attitude toward the design thinking process did not change substantially. Students' high satisfaction with the course indicates the value of interactive features provided by interactive video technology and up-to-date content. However, improvements in media clarity and engagement could further enhance its effectiveness. With interactive video technology, ASEAN teacher education institutions can better support educators in creating active learning environments to deal with the evolving demands of the region's educational landscape and contributing to the improvement of the quality of teacher education in the region.

However, there is still a need for future research to unleash the full potential of video-based learning environments for optimal learning outcomes and build a stronger foundation of empirical studies as the current study indicates the necessity for educators and policymakers to

use innovative teaching methods, particularly those integrating technology, to prepare students for real-world challenges actively and effectively. This could involve a more specific focus on identifying patterns of interaction, adding a greater variety of interaction types to promote active learning or exploring factors that might be limiting the change in attitude. The impact of specific visual elements such as font size, color contrast, sound effects, and graphical representations should be investigated to determine the best choices for course design. This study has some methodological limitations. The current study investigated changes in knowledge, attitudes, and skills only for a short period. A longitudinal study may be conducted to study the long-term effects on students' learning outcomes when using interactive video courses over time. To enhance the generalizability of the findings due to the limitation of small sample size, a larger and more diverse population with varying class conditions and disciplines, would enhance the generalizability of the findings and contribute to a broader empirical base. Future researchers might also explore how different pedagogical approaches, technological tools, or variations in instructional design influence the effectiveness of interactive video courses in achieving learning objectives. By addressing these limitations, subsequent studies can build a more well-rounded understanding of the potential of interactive video technology in education.

▪ ▪ ▪

Statements and Declarations

Funding Details

This research was funded by the Faculty of Education, Kasetsart University, Thailand.

Disclosure Statement

The author reports that there are no competing interests to declare.

Declaration of Generative AI in Scientific Writing

The author utilized ChatGPT for paraphrasing, editing sentences, and checking grammar. Following this, the author reviewed and revised the content as necessary and assumed full responsibility for the publication.

Acknowledgement

Special thanks to the Faculty of Education, Kasetsart University, for funding this research.

Ethical Approval

This research was granted ethical approval by the Kasetsart University Ethics Committee (KUREC-SSR65/149).

References

Aflatoony, L., & Wakkary, R. (2015). Thoughtful Thinkers: Secondary Schoolers' Learning About Design Thinking. In *3rd International Conference for Design Education Researchers: LearnxDesign* (Vol. 2). https://core.ac.uk/download/pdf/56379364.pdf

Al-Snaid, F. A., & Altawalbeh, M. A. (2020). The effectiveness of interactive video in the achievement of geography for sixth grades in Madaba Governorate schools. *Universal Journal of Educational Research, 8*(10), 4975-

4979. https://doi.org/10.13189/ujer.2020.081070

Alshehri, O. A. O., Zayid, E. I. M., & Sayaf, A. M. (2023). Evaluating the effectiveness of interactive video learning by examining machine learning classifiers models: Graduate students' perspectives. *International Journal of Information and Education Technology, 13*(10), 1625-1637. https://doi.org/10.18178/ijiet.2023.13.10.1971

Beligatamulla, G., Rieger, J., Franz, J., & Strickfaden, M. (2019). Making pedagogic sense of design thinking in the higher education context. *Open Education Studies, 1*, 91-105. https://doi.org/10.1515/edu-2019-0006

Benkada, C., & Moccozet, L. (2017). Enriched interactive videos for teaching and learning. In *21st International Conference Information Visualization* (pp. 344–349). https://doi.org/10.1109/iv.2017.74

Brown, T. (2008). Design thinking. *Harvard Business Review, 86*(6), 84-92. https://www.researchgate.net/publication/5248069_Design_Thinking

Castro-Alonso, J. C., Wong, M., Adesope, O. O., Ayres, P., & Paas, F. (2019). Gender imbalance in instructional dynamic versus static visualizations: A meta-analysis. *Educational Psychology Review, 31*(2), 361–387. https://doi.org/10.1007/s10648-019-09469-1

Damrongkiattisak, W., & Archaphet, N. (2014). Learning achievement through interactive multimedia with different techniques of higher education students, *Chiang Mai. Journal of Management Science Chiang Rai Rajabhat University, 9*(2), 114–140.

Desai, T. S., & Kulkarni, D. C. (2022). Assessment of interactive video to enhance learning experience: A case study [Special Issue]. *Journal of Engineering Education Transformations, 35*, 74-80. https://doi.org/10.16920/jeet/2022/v35is1/22011

Dong, J., Kuo, J., Chen, P., & Bachman, J. (2022). *The design of interactive video modules using asset-based participatory design thinking to increase student engagement in engineering.* [Paper presentation]. ASEE Annual Conference & Exposition 2022, Minneapolis, United States. https://peer.asee.org/the-design-of-interactive-video-modules-using-asset-based-participatory-design-thinking-to-increase-student-engagement-in-engineering

D.School. (2019, October 10). *Teaching and learning.* Stanford University. https://dschool.stanford.edu/programs/teaching-learning

Elsbach, K. D., & Stigliani, I. (2018). Design thinking and organizational culture: A review and framework for future research. *Journal of Management, 44*(6), 2274-2306. https://doi.org/10.1177/0149206317744252

Taking design thinking to school. (2016). In S. Goldman & Z. Kabayadondo (Eds.), *Routledge eBooks*. https://doi.

org/10.4324/9781317327585

Henriksen, D., Richardson, C., & Mehta, R. (2017). Design thinking: A creative approach to educational problems of practice. *Thinking Skills and Creativity, 26*(October), 140–153. https://doi.org/10.1016/j.tsc.2017.10.001

Husna, A., & Fajar, D. M. (2022). Development of interactive learning media based on articulate storyline 3 on Newton's Law material with a contextual approach at the junior high school level. *IJIS Edu: Indonesian Journal of Integrated Science Education, 4*(1), 17–26. https://doi.org/10.29300/ijisedu.v4i1.5857

Khawloueng, D., & Anukulwech, A. (2019). The development of virtual reality interactive 3D learning materials using augmented reality (AR) technology to enhance critical thinking skills in vocational education students with different critical thinking levels. *Journal of Education, 30*(3), 16–29.

Kleftodimos, A., & Evangelidis, G. (2018). Augmenting educational videos with interactive exercises and knowledge testing games. *2018 IEEE Global Engineering Education Conference (EDUCON)*, Santa Cruz de Tenerife, Tenerife, Islas Canarias, Spain, 872–877. https://doi.org/10.1109/EDUCON.2018.8363322

Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H. Y. (2015). *Design thinking for education: Conceptions and applications in teaching and learning*. Springer Singapore. https://doi.org/10.1007/978-981-287-444-3

Lahey, J. (2017). How design thinking became a buzzword at school. *The Atlantic*, 4. https://www.theatlantic.com/education/archive/2017/01/how-design-thinking-became-a-buzzword-at-school/512150/

Lempas, J., Soenarto, S., & Barahama, A. (2021). Need analysis of interactive multimedia development for virtual learning in pandemic. *Journal of Physics: Conference Series, 2111 (1)*, 1-7. https://doi.org/10.1088/1742-6596/2111/1/012032

Navarrete, E., Nehring, A., Schanze, S., Ewerth, R., & Hoppe, A. (2023). *A closer look into recent video-based learning research: A comprehensive review of video characteristics, tools, technologies, and learning effectiveness.* Cornell University. https://doi.org/10.48550/arXiv.2301.13617

Palaigeorgiou, G., & Papadopoulou, A. (2018). Promoting self-paced learning in the elementary classroom with interactive video, an online course platform and tablets. *Education and Information Technologies*, 1-19. https://doi.org/10.1007/s10639-018-9804-5

Polat, S., & Bayram, H. (2022). An investigation into design thinking skills of social studies teachers. *Pegem Journal of Education and Instruction*, 12(3), 208-219. https://doi.org/10.47750/pegegog.12.03.22

Preradović, N.M. & Lauc, T. (2020). Investigating interactivity in instructional video

tutorials for an undergraduate informatics course. *Issues in Educational Research*, 30(1), 203-223. http://www.iier.org.au/iier30/mikelic-preradovic.pdf

Pulukuri, S., & Abrams, B. (2020). Incorporating an online interactive video platform to optimize active learning and improve student accountability through educational videos. *Journal of Chemical Education, 97*, 4505-4514. https://doi.org/10.1021/acs.jchemed.0c00855

Raab, M., Weidinger, J., Hirschlein, N., Meckenstock, J. N., Thron, L., & Ulbricht, E. F. (2023). Understanding the effectiveness of interactive elements in video-based learning: An experimental study. *Wirtschaftsinformatik 2023 Proceedings* (57). https://aisel.aisnet.org/wi2023/57

Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? *Review of Educational Research, 82*(3), 330-348. https://doi.org/10.3102/0034654312457429

Retna, K. S. (2015). Thinking about "Design Thinking": A study of teacher experiences. *Asia Pacific Journal of Education*, 36, 5-19. https://doi.org/10.1080/02188791.2015.1005049

Rösch, N., Tiberius, V., & Kraus, S. (2023). Design thinking for innovation: Antecedents, process, and outcome. *European Journal of International Management, 26*, 160-176. https://doi.org/10.1108/EJIM-03-2022-0164

Suwannaparsop, C. (2018). The development of a video interaction web application for learning for undergraduate students, Srinakharinwirot University (Master's thesis). Faculty of Education, Srinakharinwirot University.

Thi-Huyen, N., Xuan-Lam, P., & Thanh Tu, N. T. (2021). The impact of design thinking on problem solving and teamwork mindset in a flipped classroom. *Eurasian Journal of Educational Research, 96*, 30–50. https://doi.org/10.14689/ejer.2021.96.3

Val, E., Gonzalez, I., Lauroba, N., & Beitia, A. (2019). How can design thinking promote entrepreneurship in young people? *The Design Journal, 22*(Suppl.1), 111-121. https://doi.org/10.1080/14606925.2019.1595853

Bionote

Associate Professor Dr. Patchara Eamcharoen is a full-time lecturer at the Faculty of Education, Kasetsart University. She has earned a BA in Liberal Arts (English) from Thammasat University, an MBA from Queensland University of Technology, and a PhD from Assumption University. Her research focuses on teacher education, entrepreneurship education and innovation.