



Research Article

DEVELOPMENT AND PILOT EVALUATION OF INTERACTIVE VIDEO LECTURES FOR HIGH SCHOOL MATHEMATICS WITHIN A FLIPPED CLASSROOM MODEL

Ngo Minh Duc*, Pham Quoc Bao

Ho Chi Minh City University of Education, Vietnam

**Corresponding author: Ngo Minh Duc – Email: ducnm@hcmue.edu.vn*

Received: July 22, 2026; Revised: August 10, 2026; Accepted: August 15, 2026

ABSTRACT

This study used an educational design and development research approach to develop and pilot a structural framework and a set of design principles for interactive video lectures in flipped high school mathematics. The aim was to support students' participation in preclass learning and immediate knowledge acquisition. The framework drew on cognitive load theory and the ICAP framework. The timing of embedded questions was aligned with the video structure, whereas their cognitive demands were guided by Bloom's taxonomy and the instructional process prescribed in the Vietnamese 2018 General Education Curriculum. A one-group postintervention feasibility study involved 60 Grade 10 students at a high school in Ho Chi Minh City. Data sources included learning analytics recorded in the learning management system, students' responses to embedded interactive questions, and a short postvideo quiz. Data were analyzed using completion rates and item-level response accuracy. All students completed the assigned preclass videos, providing preliminary support for the feasibility of the proposed framework and its potential to support preclass learning. However, because the pilot study included neither a control group nor a pretest, the results do not establish whether this approach is more effective than traditional instruction.

Keywords: Bloom's taxonomy; cognitive load theory; flipped classroom; interactive video lectures; the ICAP framework

1. Introduction

The flipped classroom model is an instructional approach that makes effective use of technology. In this model, students are expected to study new content before coming to class. In class, teachers have more time to dedicate to discussion, problem-solving, and expanding on topics to foster higher-order thinking.

Previous studies have shown that the quality of learning materials strongly influences students' participation and motivation during the preclass learning stage (Abeysekera &

Cite this article as: Ngo, M. D., & Pham, Q. B. (2026). Development and pilot evaluation of interactive video lectures for high school mathematics within a flipped classroom model. *Ho Chi Minh City University of Education Journal of Science*, 23(9), 2046-2057. [https://doi.org/10.54607/hcmue.js.23.9.5952\(2026\)](https://doi.org/10.54607/hcmue.js.23.9.5952(2026))

Dawson, 2015; Bishop & Verleger, 2013). Here, interactive video lectures are considered an effective learning medium for this phase, supporting teachers' in-person instructional activities in exploring new concepts (Ghilay, 2021). Integrating questions and tasks throughout the learning process, compared to traditional videos, enhances interaction, autonomy, and learning interest, while supporting learners in self-assessing their level of understanding (Deslauriers & Wieman, 2011; Karmila et al., 2021). This medium helps clarify complex concepts, thereby improving self-study efficiency within the flipped classroom framework.

In Vietnam, several studies have explored the application of videos or interactive video lectures across various subjects within the flipped classroom model, including primary and secondary education (Nguyen & Bui, 2020; Tran et al., 2024) and interactive video lectures (Ngo & Nguyen, 2025). These studies generally suggest that the success of flipped learning is closely connected to the quality and design of instructional materials. Traditional resources often fail to stimulate proactive learning, whereas interactive video lectures promote active participation and enhance academic outcomes. Although video-supported learning and flipped classroom instruction have shown promise, research on interactive video lectures for high school mathematics remains fragmented. Few studies have developed a clear structural framework or examined how video structure, cognitive load, learner engagement, question types, and interaction timing work together. This study therefore addresses the need for a more systematic approach to designing interactive videos for flipped mathematics instruction.

To address these gaps, this study proposes a framework and design principles for interactive video lectures in flipped high school mathematics, illustrated through Grade 10 mathematics videos and examined in a pilot implementation of students' preclass learning.

2. Research methods

2.1. Research design

This study adopted an educational design and development research approach and consisted of two main phases. The first phase focused on synthesizing relevant theories and developing the structural framework, design principles, video scripts, and embedded interactive questions, which were used to design several interactive video lectures for Grade 10 mathematics. The second phase involved a pilot implementation using a one-group postintervention feasibility design. Data from embedded video questions, short quizzes, and classroom observations were used to examine the feasibility of the proposed framework and describe students' participation and learning performance. Participation rates and response accuracy were then analyzed to assess the usefulness of the videos and the proposed framework. Since the pilot did not include a control group or pretest, it was not intended to establish a causal comparison with traditional instruction.

2.2. Participants and Research Context

The pilot involved 60 Grade 10 students from two intact classes at a public high school in Ho Chi Minh City, Vietnam. The intervention was carried out over 2 weeks, from September 22 to October 5, 2025, as part of the regular curriculum unit on the law of sines and the law of cosines. During this period, students accessed the learning materials and

completed the assigned learning activities through the Matheractive learning management system. The classes were selected through convenience sampling because they were taught by the researcher. All students had access to a smartphone or laptop and an active Matheractive account, which enabled them to access the learning materials and complete the required activities remotely.

2.3. Development Procedure

The interactive learning materials were developed through a structured five-stage process: (1) reviewing empirical literature on cognitive load optimization and active video learning; (2) conceptualizing the four-part video framework and its eight design principles; (3) drafting pedagogical scripts and corresponding interactive questions; (4) producing, editing, and uploading the videos to the learning management platform; and (5) iteratively refining the video interface and question logic based on pilot data.

2.4. Research Instruments

Quantitative data were collected directly through Matheractive, a web-based learning management system developed on the Moodle platform. The platform recorded students' video completion, responses to embedded questions, and response accuracy for each item. Each interactive video lecture included at least five formative questions placed at different points in the video, based on the theoretical principles identified in the literature review. The questions used multiple-choice, drag-and-drop, and short-answer formats. After completing the videos, students took a five-item quiz on the Matheractive system to assess their knowledge and understanding. The quiz was administered separately from the videos and included both single-answer and multiple-answer multiple-choice questions.

To describe students' immediate learning outcomes during the preclass phase, the study examined their accuracy on the embedded questions and the postvideo quiz. These results were used to describe students' initial performance and assess the feasibility of the proposed framework, rather than to draw causal conclusions.

3. Results and discussion

3.1. Design Principles for Interactive Video Lectures and Embedded Questions

The flipped classroom model is implemented through two main phases: the preclass phase (consisting mainly of preclass tasks) and the in-class phase (focusing on discussions and application activities). During the preclass phase, students engage in self-directed learning by interacting with mathematical content through interactive video lectures and other instructional materials. The in-class phase is then devoted to addressing unresolved issues, facilitating discussion, and engaging students in higher-order problem-solving activities under teacher guidance. In this study, we propose a set of design principles for interactive video lectures aligned with this instructional process, with a particular emphasis on their role in supporting the preclass phase.

3.1.1. Structural Framework of Interactive Video Lectures

Interactive video lectures can be viewed as a simulation of classroom learning interactions between teachers and students; therefore, they should follow the lesson structure specified in Official Dispatch No. 5512/BGDĐT-GDTrH (Ministry of Education and Training [MOET], 2020). Accordingly, the proposed video structure consists of four components:

Part 1: Engagement Activity – Identifying the Problem or Learning Task. This section introduces the lesson and presents a problem-based situation to stimulate learning motivation.

Part 2: Knowledge Construction Activity. This involves organizing exploratory tasks and institutionalizing knowledge in combination with practice, while providing model solutions for illustrative examples.

Part 3: Resolving the Initial Problem. This part addresses the opening situation (if applicable). Alternatively, the teacher may introduce a new situation related to the current content for students to discuss and resolve collectively during the in-class phase.

Part 4: Conclusion and Summary. This section systematizes the knowledge acquired in the video through mind maps, thereby helping students grasp the key concepts.

In addition, extended applications or engaging situations related to the newly learned content may be presented at the end of the video to enhance learner interest. Application activities are not included in the video itself but are instead implemented during in-class instruction.

3.1.2. Embedded Interactive Questions in Video Lectures

In the flipped classroom model, videos play a central instructional role instead of functioning merely as supplementary materials (Bishop & Verleger, 2013; Graham, 2004). The practice of “embedding” questions within these videos helps maintain student engagement while also providing opportunities to assess student competencies (OECD, 2019).

According to the ICAP framework (Chi & Wylie, 2014), students are more likely to develop mathematical competencies when video lectures encourage engagement at the constructive or interactive level. The question format (closed or open-ended) does not solely determine the cognitive level; a closed-ended question can still reach the constructive level if it requires the learner to perform intermediate reasoning steps (Renaud & Murray, 2008).

In line with Laurillard (2012), an effective video must be designed as a sequence of activities involving interaction between the learner and the content through feedback. Consequently, the development of mathematical competencies requires instructional videos to incorporate a combination of problem-based situations and a set of feedback questions aimed at competency development. Questions function as a form of online lesson planning. They can provide evidence of students’ learning processes and give teachers additional information about competency development.

A critical issue emerging in research is how to design videos with meaningful interactions. Hung et al. (2017) identified specific points at which interactive elements can be incorporated into videos. Building upon this foundation, we propose types of interaction (see Table 1) that are compatible with the video structure developed in this research.

Table 1. Design of Interactive Learning Activities Embedded in Video Lectures

Interactive learning activity	Scaffolding function	Integration points
Type 1: Engaging	Engaging learners and laying the groundwork for further interaction in the lecture. Correctness is not evaluated.	Part 1: Engagement Activity
Type 2: Prompting	To guide students' thinking toward the targeted knowledge. The activity also encourages learners to reflect and think more deeply about what they are learning.	Part 1: Engagement Activity / Part 2: Knowledge Construction Activity
Type 3: Experiencing	To provide illustrative examples to establish a coherent connection between theory and practice, enabling learners to achieve a deeper understanding of the knowledge.	Part 2: Knowledge Construction Activity: Following the knowledge construction phase
Type 4: Facilitating	To provide additional practice exercises following the illustrative examples to enhance comprehension and retention of essential information through repetition and deeper engagement with key content.	Part 2: Knowledge Construction Activity: During the practice phase (if applicable)
Type 5: Demonstrating	To facilitate the transition from theory to practical application by revisiting the question from the opening scenario or providing real-world scenarios.	Part 3: Resolving the Initial Problem (if applicable)

At specific points in the video, appropriate interactive questions can be embedded to enhance the overall effectiveness of interaction. Drawing on Bloom's taxonomy and the question design frameworks proposed by Nguyen (2020) and Shorser (1999), which provide tools for assessing cognitive levels, we propose principles for designing question systems that focus on the three lower levels of Bloom's taxonomy—remembering, understanding, and applying. This focus is consistent with the preclass phase of the flipped classroom model, in which students are expected to acquire and consolidate foundational knowledge before engaging in higher-order learning activities during class. The proposed principles further specify how these cognitive levels can be reflected in the design of embedded questions (see Table 2).

Table 2. Principles for constructing question sets based on Bloom's taxonomy

Cognitive level	Learning outcomes
Remember	Assess students' recall of facts, data, definitions, rules, and concepts. (What? Where? How? When? Define, List, Describe?)
Understand	Assess students' ability to explain meanings, interpret information, connect data, and identify the nature of concepts they have learned. (Why? How? Compare, Relate, Calculate, Distinguish?)
Apply	Assess the ability to apply acquired knowledge to solve mathematical problems or real-world issues. (How?; Is there any solution for?; Find a method, Calculate, Apply?)

3.1.3. Principles for Designing Interactive Video Lectures

To deliver video content effectively to learners, designers must consider three key factors: cognitive load, student engagement, and active learning (Brame, 2016). The design of instructional videos should be informed by both cognitive load theory, which emphasizes the limited capacity of working memory (Sweller et al., 2011), and the cognitive theory of

multimedia learning, which explains how learners process and integrate information through visual and auditory channels (Mayer, 2009). These perspectives provide a theoretical basis for design principles such as signaling, segmenting, coordinating visual and auditory information, and removing irrelevant elements. Based on these considerations, we propose that interactive video design should address both pedagogical and technological requirements (see Table 3).

Table 3. Principles for Designing Interactive Video Lectures

Principles	Illustrations
Cognitive Load	
[P1] Signaling key content by using symbols, effects, and audio.	Use keywords to highlight important elements. Change colors or contrast to emphasize relationships within the information. Add category tags and icons to mark or signal ongoing activities.
[P2] Using segmenting to break down the amount of information provided.	Divide one lesson into multiple videos. Keep videos short (from 6 to 15 minutes).
[P3] Using guiding questions.	Use questions to pose problems at the beginning of each video segment.
Audio and Visual Design	
[P4] Effectively combining visual and auditory channels for efficient information delivery.	Narrations in the video must be accompanied by appropriate illustrative images. Ensure that the visual and auditory channels are congruent with each other.
[P5] Using conversational language	Narrations should create a sense of social presence (avoid regional dialects and slang). Include greetings at both the beginning and the end of the video.
[P6] Moderate speaking rate with intonation	Use intonation and inflection in voiceovers. Maintain a moderate speaking pace with clear pronunciation. Include pauses (2–5 seconds) between different segments.
[P7] High-quality audio and visuals	Audio must be clear and free of background noise. Images and film clips cited from other sources must be high quality.
[P8] Limiting irrelevant elements	Avoid adding background music. Do not use complex backgrounds.

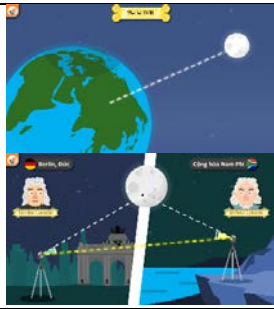
To effectively operationalize [P1], we propose incorporating specific icons and header tags (illustrated in the table below) to mark the current activities within the video. This enables students to easily track their progress and identify which part of the lesson they are currently studying.

3.2. Research Illustrations

To illustrate the Grade 10 content on the law of sines, we developed a 13-minute video [P2]. According to MOET (2018), the learning outcomes established for this video include recognizing the law of sines formula, explaining the law of sines, and calculating side lengths and angles in a triangle using trigonometric relations. The video is structured into three parts

(see Table 4), and the competencies we aim to develop in this video are mathematical modeling and mathematical thinking and reasoning.

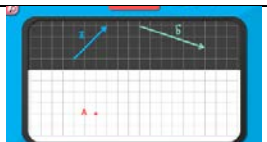
Table 4. Excerpt from the Video Script: “The Law of Sines” (Grade 10)

Contents	Scripts	Pedagogical Intent	Illustrative frame
Part 1: Engagement Activity			
Problem Statement: Measuring the distance to the Moon	Hello class, do you know what this is? [...] Hmm, but just how far is it from the Earth to the Moon?	The script fulfills [P5] by starting with a friendly greeting and using personal pronouns (“class”, “you”), creating an interactive feel that makes students feel part of the lesson. Additionally, [P6] is demonstrated through vocal intonation, such as using rhetorical pauses or thinking interjections to evoke curiosity and create anticipation before posing the question.	
Guiding Question	So, how can they determine the distance from where we stand to that distant Moon?	Through this guiding question [P3], we set a clear objective for the video: Encouraging students to apply their knowledge to think about “determining the distance from the Earth to the Moon.” This serves as a lead-in to the main lesson.	
Part 2: Knowledge Construction Activity			
The Law of Sines	Let’s return to the problem of measuring the Earth – Moon distance earlier. [...] How can we calculate the lengths of sides BC and AC ?	[P1] In each segment, the video provides introductions to orient students toward the next content. The script is built on a mathematical modeling approach, starting from a real-world problem (measuring the Moon), converting it into a triangle model for calculation and gradually formulating the law.	
Part 4: Conclusion and Summary			
Mind Map	Now, let’s summarize all the knowledge we’ve learned in this video through the following mind map.	Summarizes all the knowledge explored in the video using a mind map for better retention.	

In the illustrative script, only three sections were included instead of the four sections proposed in the framework. This was because the initial problem introduced in the Engagement Activity was addressed during the Knowledge Construction Activity, making a separate Resolving the Initial Problem section unnecessary.

As discussed earlier, combining activities with interactive questions can facilitate the development of specific mathematical competencies. We provide an additional illustration through a four-part instructional video on “Addition of Two Vectors” (see Table 5).

Table 5. Excerpt from the Video Script: “Addition of Two Vectors” (Grade 10)

Contents	Scripts	Illustrative frame
Part 1: Engagement Activity		
Aircraft Landing Situation	“Hello class! Did you know that airplanes usually land on a runway? Under normal conditions, to land correctly and safely, the aircraft’s heading must align straight with the centerline of the runway.”	
Part 2: Knowledge Construction Activity		
Addition of Two Vectors	In a Robocon competition, An programmed a robot to perform two movements with displacements represented by two vectors, $\overline{AB}$ and $\overline{BC}$, respectively.	
Part 3: Resolving the Initial Problem		
Resolving the Opening Situation	[...] In this case, the aircraft is affected by both the wind and the engine; therefore, the actual velocity vector of the aircraft is the sum of two vectors, $\vec{a}$ and $\vec{b}$.	
Part 4: Conclusion and Summary		
Mind Map	Finally, let’s observe the following mind map to systematize the knowledge regarding the addition of two vectors .	

Based on the principles of questioning and the timing of embedded interactions, we present examples of interactive questions for the video on the law of cosines (see Table 6).

Table 6. Interactive Questions in the Video: “The Law of Cosines” (Grade 10)

Question	Type	Interactive Activity
Please propose a method to determine the distance between the starting point and the ending point.	Paragraph entry	Type 1: Engaging
[Understanding] Predict the result when substituting HB and AH to calculate the length of side AB .	Drag and drop	Type 2: Prompting
[Understanding] Given triangle ABC with $\hat{C} = 115^\circ$, $AC = 8$ and $BC = 12$. Calculate the length of side AB in the triangle. (Round the result to the nearest whole number).	Short answer	Type 3: Experiencing

After completing the scripts and interactive questions, we designed the visual frames using tools such as PowerPoint and Canva and edited them using video editing software, such as CapCut for PC and Filmora. Links to the illustrative videos are provided below:

“The Law of Sines” (Grade 10): <https://youtu.be/TLpd9Etsw3I>

“The Law of Cosines” (Grade 10): https://youtu.be/_wOmOM0zFMw

“Addition of Two Vectors” (Grade 10): <https://youtu.be/4pXtselny9E>

3.3. Pilot Implementation

Using the law of sines and the law of cosines as illustrative content, we conducted a pilot implementation with 60 tenth-grade students at a high school in Ho Chi Minh City. The students were assigned to complete interactive video lectures on the law of sines and the law of cosines before coming to class. During class time, students were divided into eight groups to engage in discussions and collaboratively solve real-world problems at the application and higher-order application levels.

3.4. Pilot Results and Discussion

Evaluating Student Performance in Preclass Interactive Video Lectures

Table 7. Results of Interactive Responses in the Video: “The Law of Sines” (Grade 10)

Question	Percentage (%)	Objective
IQ1.1	-	Engagement and introduction to the lesson
IQ1.2	-	Formulating the law of sines
IQ1.3	83	Formulating the law of sines
IQ1.4	92	Formulating the law of sines
IQ1.5	67	Formulating the law of sines
IQ1.6	98	Formulating the law of sines
IQ1.7	87	Formulating the law of sines (including R)
EX1.1	75	Calculating side length of a triangle using the Law of Sines
EX1.2	87	Calculating the circumradius of a triangle using the Law of Sines

Regarding the assignments provided before the start of the lessons on the law of sines and the law of cosines, the results indicate a 100% student participation rate.

The responses to questions [IQ1.1] and [IQ1.2] indicate that students were actively engaged in the video-viewing process, as evidenced by ideas ranging from creative and intuitive suggestions to those that were not yet feasible. In [IQ1.2], the collected data indicate that students were able to introduce an auxiliary altitude to solve the problem, thereby demonstrating mathematical reasoning and logical thinking skills.

The average correct response rate in the exploratory activities exceeded 60% (see Tables 7), indicating that students were able to activate prior knowledge to gradually construct the formulas for the law of sines. This result also reflects the appropriateness of the designed questions and confirms the supporting role of interactive video lectures during the preclass phase.

For the illustrative examples, correct response rates ranged from 70% to 90%. Although some students made errors, such as rounding errors, the responses indicated that students could apply the formulas to solve basic problems. These descriptive results suggest that the interactive videos were feasible for preclass implementation and may have supported students' acquisition and application of basic mathematical knowledge. The results also provide a basis for teachers to offer additional support to students who made errors during subsequent in-class instruction.

Evaluating Preclass Knowledge Acquisition

Table 8. Results of the Short Multiple-Choice Quiz Administered After the Videos

Question	Percentage (%)	Objective
Q1-Understanding	85	Calculate side length in a triangle using the Law of Cosines
Q2-Understanding	88	Calculate side length in a triangle using the Law of Cosines
Q3-Understanding	82	Calculate side length in a triangle using the Law of Sines
Q4-Understanding	97	Calculate side length in a triangle using the Law of Sines
Q5-Remembering	100	Identify the Law of Sines and the Law of Cosines

The data recorded in the system indicate that a substantial proportion of students could apply knowledge presented in the instructional videos to basic mathematical problems. Accuracy rates were higher on the postvideo quiz than on several embedded examples. However, the items differed in content and difficulty, and no statistical comparison was conducted.

These findings provide preliminary descriptive evidence concerning the potential role of interactive videos in supporting students' preclass learning and can offer teachers valuable feedback regarding students' levels of understanding and their conceptions of the content. This, in turn, serves as a basis for making appropriate pedagogical adjustments in the preclass preparation phase and the in-class instructional process.

With regard to the face-to-face classroom phase, we observed active student participation in application activities involving real-world problems. Based on observations and records, we noted several positive indicators related to mathematical modeling, thinking, and reasoning competencies through students' responses and group discussions.

4. Conclusion

This study developed a four-part structural framework, five types of interactive learning activities, and eight design principles for interactive video lectures in flipped high school mathematics. The framework integrates cognitive load theory, the ICAP framework, and Bloom's taxonomy to guide decisions concerning video structure, content segmentation, audiovisual presentation, interaction types, and the placement of embedded questions. This integration represents the principal theoretical contribution of the study. The pilot implementation with 60 Grade 10 students demonstrated that the framework was technically and pedagogically feasible in the participating context. The descriptive results further indicated that many students could answer questions at the remembering, understanding, and basic application levels. In the broader instructional implementation, most students achieved the expected learning outcomes and were able to apply their knowledge to solve mathematical problems at both application and higher-order application levels. These findings suggest that interactive video lectures can support students' preparation before class and provide useful information for subsequent classroom instruction. They also allowed teachers to track video completion, review students' responses to embedded questions, and identify areas of difficulty before the in-class lesson. The flipped classroom model also created more opportunities for in-class practice, discussion, problem solving, and support for students who needed further assistance.

The findings should be interpreted as preliminary evidence because the study used a small convenience sample from one school and a one-group design without a pretest or control group. The assessment instruments also require further validation. Future research should examine the framework with larger and more diverse samples, validated instruments, stronger experimental designs, and delayed posttests. Further studies should investigate how the type and timing of embedded interactions affect cognitive load, student engagement, mathematics-specific competencies, and long-term retention, and extend the framework to other Grade 10 mathematics topics.

❖ **Conflict of Interest:** Authors have no conflict of interest to declare.

❖ **Acknowledgments:** This research is funded by Ho Chi Minh City University of Education Foundation for Science and Technology under grant number CS.2025.19.64.

REFERENCES

- Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: Definition, rationale and a call for research. *Higher Education Research & Development*, 34(1), 1–14. <https://doi.org/10.1080/07294360.2014.934336>
- Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. In *2013 ASEE Annual Conference & Exposition*. American Society for Engineering Education. <https://doi.org/10.18260/1-2--22585>
- Brame, C. J. (2016). Effective educational videos: Principles and guidelines for maximizing student learning from video content. *CBE—Life Sciences Education*, 15(4), es6. <https://doi.org/10.1187/cbe.16-03-0125>
- Chi, M. T. H., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational Psychologist*, 49(4), 219–243. <https://doi.org/10.1080/00461520.2014.965823>
- Deslauriers, L., & Wieman, C. (2011). Learning and retention of quantum concepts with different teaching methods. *Physical Review Special Topics – Physics Education Research*, 7, 010101.
- Ghilay, Y. (2021). Text-based video: The effectiveness of learning math in higher education through videos and texts. *Journal of Education and Learning*, 10(3), 55–63. <https://doi.org/10.5539/jel.v10n3p55>
- Graham, C. R. (2004). Blended learning systems: Definition, current trends, and future directions. In C. J. Bonk & C. R. Graham (Eds.), *Handbook of blended learning: Global perspectives, local designs* (pp. 3–21). Pfeiffer Publishing.
- Hung, I.-C., Kinshuk, & Chen, N.-S. (2017). Embodied interactive video lectures for improving learning comprehension and retention. *Computers & Education*. <https://doi.org/10.1016/j.compedu.2017.10.005>
- Karmila, D., Putri, D. M., Berlian, M., Pratama, D. O., & Fatrima. (2021). The role of interactive videos in mathematics learning activities during the COVID-19 pandemic. *Advances in Social Science, Education and Humanities Research*, 532, 141–144. <https://doi.org/10.2991/assehr.k.210222.022>
- Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*. Routledge.
- Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9780511811678>
- Ministry of Education and Training. (2018). *Chương trình giáo dục phổ thông môn Toán* [General education curriculum for mathematics] (Issued together with Circular No. 32/2018/TT-BGDĐT dated December 26, 2018).
- Ministry of Education and Training. (2020). *Developing and organizing the implementation of school education plans* (Official Dispatch No. 5512/BGDĐT-GDTrH, December 18, 2020).
- Ngo, M. D., & Nguyen, T. T. (2025). Designing and using interactive videos in teaching “Three conic sections”: A flipped classroom model. *Ho Chi Minh City University of Education Journal of Science*, 22(5), 874–887. [https://doi.org/10.54607/hcmue.js.22.5.4529\(2025\)](https://doi.org/10.54607/hcmue.js.22.5.4529(2025))
- Nguyen, T. H. (2020). Applying Bloom’s taxonomy in teaching applied mathematics through the questioning method. *Journal of Science, Hanoi Industrial Textile Garment University*.

- Nguyen, T. K. T., & Bui, D. P. (2020). Teaching mathematics towards developing critical thinking competency for grade 9 students through the flipped classroom model. *Vietnam Journal of Education*, 471, 36–41.
- OECD. (2019). *PISA mathematics framework*. OECD Publishing.
- Renaud, K. M., & Murray, H. G. (2008). A comparison of a subject-specific and a general measure of critical thinking. *Thinking Skills and Creativity*, 3(2), 85–93. <https://doi.org/10.1016/j.tsc.2008.03.005>
- Shorser, L. (1999). *Bloom's taxonomy interpreted for mathematics*. University of Victoria.
- Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory*. Springer. <https://doi.org/10.1007/978-1-4419-8126-4>
- Tran, V. H., Ngo, K. Q., Le, H. Y., Nguyen, T. B. T., Nguyen, T. H. T., & Dang, T. P. T. (2024). Designing digital learning materials to support the flipped classroom model in experiential activities for primary school students. *Journal of Educational Equipment*, 1(312), 31–34.

**PHÁT TRIỂN VÀ THỬ NGHIỆM VIDEO BÀI GIẢNG TƯƠNG TÁC
TRONG DẠY HỌC TOÁN TRUNG HỌC PHỔ THÔNG
THEO MÔ HÌNH LỚP HỌC ĐẢO NGƯỢC**

Ngô Minh Đức*, Phạm Quốc Bảo

Trường Đại học Sư phạm Thành phố Hồ Chí Minh, Việt Nam

**Tác giả liên hệ: Ngô Minh Đức – Email: ducnm@hcmue.edu.vn*

Ngày nhận bài: 22-7-2026; Ngày nhận bài sửa: 10-8-2026; Ngày duyệt đăng: 15-8-2026

TÓM TẮT

Nghiên cứu này sử dụng cách tiếp cận nghiên cứu thiết kế và phát triển trong giáo dục nhằm xây dựng và thử nghiệm một khung cấu trúc cùng một hệ thống các nguyên tắc thiết kế cho bài giảng video tương tác trong dạy học Toán ở trường trung học phổ thông theo mô hình lớp học đảo ngược, với mục tiêu hỗ trợ sự tham gia học tập và tiếp thu kiến thức ban đầu của học sinh trong giai đoạn tiền lớp học. Khung này được xây dựng dựa trên Lí thuyết Tải nhận thức, khung ICAP, thời điểm chèn các câu hỏi được xác định dựa trên cấu trúc video, còn mức độ nhận thức của câu hỏi được thiết kế theo Thang đo Bloom và tiến trình dạy học được quy định trong Chương trình giáo dục phổ thông 2018 của Việt Nam. Nghiên cứu tính khả thi sau tác động với thiết kế một nhóm được thực hiện trên 60 học sinh lớp 10 tại một trường trung học phổ thông ở Thành phố Hồ Chí Minh. Dữ liệu được thu thập từ các phân tích học tập được ghi nhận trên hệ thống học tập, câu trả lời của học sinh đối với các câu hỏi tương tác được chèn trong video và một bài kiểm tra ngắn sau video. Dữ liệu được phân tích dựa trên tỉ lệ hoàn thành, độ chính xác của từng câu hỏi. Việc tất cả học sinh hoàn thành các video được giao trước giờ học cung cấp những bằng chứng ban đầu về tính khả thi của khung đề xuất và tiềm năng hỗ trợ hoạt động học tập của học sinh trước giờ học. Tuy nhiên, do nghiên cứu thử nghiệm không có nhóm đối chứng và không thực hiện bài kiểm tra trước can thiệp, kết quả chưa cho phép đưa ra kết luận về việc liệu cách tiếp cận này có hiệu quả hơn phương pháp dạy học truyền thống hay không.

Từ khóa: thang đo nhận thức Bloom; lí thuyết tải nhận thức; lớp học đảo ngược; khung ICAP; video bài giảng tương tác