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The Deployment of Constructive Video Clips in Teaching Mathematics for High School Students

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ABSTRACT: *This article presents a comprehensive approach to integrating constructivist teaching methods with the use of multimedia in mathematics education. The paper focuses on developing and applying a new concept: constructivist video clips, to create an effective tool that supports the teaching and learning process. By analyzing the theoretical foundations of constructivism and multimedia in teaching Mathematics, we established specific criteria for selecting and creating these video clips. The research also proposes several methods for teachers to produce these clips themselves. A key outcome of this study is the development of a pilot library of constructivist video clips for 10th-grade mathematics lessons, according to the 2018 General Education Program. Additionally, we designed suggested uses for these video clips in specific teaching situations. This research not only provides a theoretical framework but also offers practical potential, pioneering a new direction for applying technology in education. The constructed library of video clips serves as a crucial initial step, laying the groundwork for its further completion and expansion to cover the entire curriculum, ultimately contributing to greater effectiveness and engagement in mathematics learning for students.*

KEYWORDS: **Constructivist teaching, multimedia-integrated teaching, video-integrated teaching, etc.**

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1. Introduction

According to the International Commission on Mathematical Instruction (ICMI) (2008), Mathematics is a fundamental part in human reasoning and logic, and so is an indispensable element in understanding the world ourselves. Learning Mathematics not only helps us to gain knowledge, thereby applying it to other fields, and solving practical problems, but also plays an important role in forming logical thinking and developing intellectual competency for learners. However, Mathematics becomes a "fear" for many students, which is considered as a difficult and unrelated to real-life subject. This situation is partly due to the dominated by theoretical content of curriculum, outdated teaching methods, slow innovation in examination and assessment (Pakshina *et al*., 2012). Moreover, the issue of scores is still a great concern for teachers, students, and parents, resulting in the fact that most students are taught to get high scores instead of understanding the essence.

The 2018 General Education Program is designed with a competency-based approach rather than a content-based approach, demanding for innovation and creativity in teaching methods to stimulate students' interest in subjects in general and Mathematics in particular to encourage students' active participation, proactive knowledge acquisition, and deep comprehension.

During studying in high school and at the Faculty of Mathematics and Informatics, Hanoi National University of Education, the authors were extremely interested in and intrigued by many widely circulated video clips, which is easily accessible on the Internet. For instance, the video https://www.youtube.com/watch?v=aXbT37IlyZQ&t=1s%20 demonstrated vividly and creatively how the sum of n first square numbers is transformed into a third-degree polynomial, which each coefficient reflects a certain mathematical significance. Therefore, a natural question arises: Are there more interesting video clips like this? How can they be used in teaching Mathematics? While searching for more video clips, the authors also tried to explore research in mathematics education related to this topic. It appears that two questions have naturally arisen, posing a research problem. On the one hand, our starting point is constructivist teaching. On the other hand, we investigated multimedia teaching in general and teaching mathematics in particular. It can be said that research on video clips in teaching Mathematics has attracted the attention of many authors. However, there is still a lack of foundation to link video-integrated teaching to constructivist teaching. Besides, we have not found a set of criteria for selecting and using video clips in teaching Mathematics.

2. Methodology

The objective of the research is initially establishing a theoretical basis for deploying constructive video clips in teaching mathematics for high school students, thereby constructing a video clip library accompanied by teaching instructions as a reference for students and mathematics teachers. To achieve these purposes, the tasks include: (1) research on the constructivist perspective in teaching mathematics and the application of multimedia (especially video clips) in teaching mathematics; (2) Identify some criteria for selecting and creating constructive video clips; (3) Construct video library for teaching mathematics.

To carry out the research tasks, the authors used common research methods in educational science, including theoretical research (primarily international comparative analysis), experiential synthesis, and observation.

3. Results

3.1. Theoretical Basis of Deploying Constructive Video Clips in Teaching Mathematics for High School Students

3.1.1. Constructivist Teaching

This paper adopts the term “constructivist teaching” to align with the influential works that first introduced it. We acknowledge that contemporary pedagogy is oriented towards learning, and any reference to ‘teaching’ herein should be interpreted in the modern sense of facilitating learning, or “teaching how to learn”.

Originating from a cognitive theory in psychology, Jean Piaget’s constructivist theory is considered as one of the cornerstones of modern educational theory nowadays. Glasersfeld (1990) mentioned Piaget as a great pioneer in the constructivist teaching perspective.

The core idea of the constructivist theory is that knowledge is constructed by the subject structuring into its internal system and subjective. That means knowledge is actively and positively formed by the subject instead of a result of a passive reception process. Constructivist theory has been applied in many fields, especially in education, and became the foundation for many modern teaching methods. Thompson (2013) stated that the findings from current studies on how students and teachers think and learn are so consistent with constructivism that papers seldom need to declare it as their underlying theoretical framework.

According to the educational psychology textbook (Nguyen *et al*., 2019), when teaching in the constructivist perspective (constructivist teaching), the teacher guides students to explore and construct their own knowledge through constructive learning tasks. In constructivist teaching, students are encouraged to use their own thinking instead of being forced to accept the thinking of others. Specifically, knowledge is actively constructed by students rather than passively absorbed from the external environment. Thus, the active role of students in constructing knowledge is the most important factor. In the traditional teaching perspective, teachers are the center of the teaching process, but in constructivist teaching, that role is shifted to students. Meanwhile, teachers act as organizers and advisors, supporting students’ self-development, self-assessment, and self-learning (see table 1)

Lesh & Doerr (2002) focused on the “Models and Modeling Perspectives” approach, which is presented as an alternative framework that critiques traditional teaching methods and emphasizes the development of conceptual

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Table 1. Traditional Teaching and Constructivist Teaching Perspectives

	Traditional Teaching Perspective	Constructivist Teaching Perspective
Teacher	- Is the center of the teaching process - Transfer all knowledge to students	- Play the role of advisor, provide learning tasks and activities for students - Guide students to construct knowledge
Students	- Passively absorb knowledge	- Is the center of the teaching process -Directly and proactively participate in constructing knowledge

systems or "models" students use to make sense of mathematical experiences.

Non-traditional teaching trends in mathematics (Nguyen, 2015) such as: teaching to identify and solve problems, collaborative teaching, developing and using technology in teaching, and using communication technology information as teaching tools, etc. follow the direction of activating students, organizing students learning through activities proactively and creatively, that are consistent with constructivist teaching.

Constructivist Teaching Process

In 1991, Paul Ernest indicated that Objective mathematical knowledge is reconstructed by the individual into subjective knowledge through interactions with teachers and other people, as well as by interpreting texts and other inanimate sources. Moreover, these interactions with others (and the environment), particularly through negative feedback, provide the mechanism for an individual to develop a "fit" between their personal subjective mathematical knowledge and the socially accepted knowledge. This viewpoint is also consistent with the following constructivist teaching process described by some Vietnamese authors.

The first step in constructivist teaching is to recall and systematize the prior knowledge and skill to set the groundwork for organizing the teaching of new knowledge (Nguyen *et al.*, 2019). For instance, before teaching students about the concept of irrational numbers, the teacher should recall the concept of rational numbers so that students can easily compare and differentiate, or before introducing the concept of derivative, teacher should recall problems leading to this concept, such as calculating the instantaneous velocity of a motion at a time.

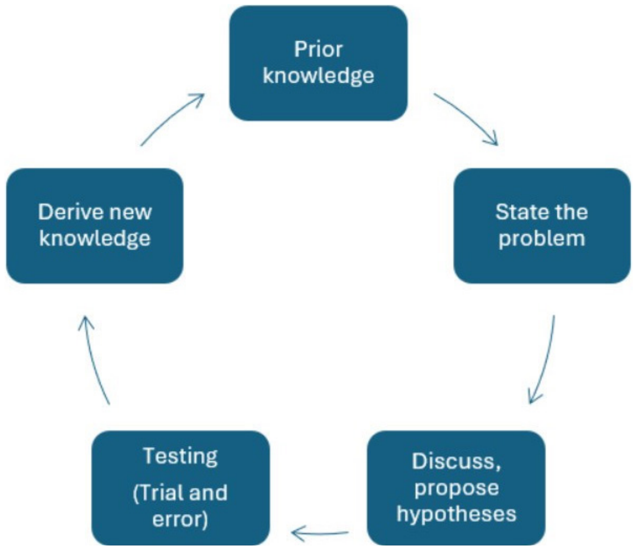

Figure 1. Constructivist Teaching Process

After that, the teacher or students propose a problem-solving situation (problems arise from exercises, practical situations, or from students' curiosity, etc.). According to Nguyen (2015), the teacher should create problem-solving situations that: (1) pose a problem; (2) stimulate cognitive needs; and (3) inspire students' confidence in their ability, instead of presenting the problem directly.

Next, the teacher can organize students in group discussions, which provides them opportunities to not only express their own viewpoints but also listen to others. Hence, students engage in debates and discussions to reach a consensus, thereby proposing hypotheses.

After that, the teacher organizes students to test hypotheses through trial and error, that making mistakes is good, learning through mistakes is meaningful – a remarkable point of constructivist teaching.

Finally, the teacher needs to analyze the results, make conclusions about new knowledge for

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students. Otherwise, students may feel confused and have suspicions about the correctness of their hypotheses.

Constructivist teaching principles

Constructivist teaching needs to ensure some general principles of the learning process. According to Hein (1991), learning:

(1) Is a proactive process, not a passive reception, and it involves students' engagement with the surrounding world.

(2) Is based on language.

(3) Is a social activity (connections with other students and teachers, etc.)

(4) Is a continuous constructive process, which knowledge are formed upon prior knowledge or experience: students cannot absorb new knowledge without sufficient background knowledge. The more they know, the more conducive they are to learning new knowledge.

(5) Is an accumulative process that students need time, reflection, experiences, and ideas.

(6) Must be based on positive motivations since students may not be interested in using the learned knowledge unless they know the reason.

In constructivist teaching, students hold the central role. According to Nguyen (1996), in constructivist teaching, students:

(1) Actively participate and mobilize their existing knowledge and skills into new learning activities.

(2) Actively express their perceptions, opinions, and difficulties in learning activities.

(3) Interact with other students and teachers actively to satisfy the needs of exploring and solving problems.

(4) Adjust what they have gained through learning activities into their own new knowledge.

Nguyen (1996) also had a new perspective about the role of the teacher in constructivist teaching, that teacher is the organizer and controller. Specifically, the teacher:

(1) Transform scientific knowledge into teaching knowledge by constructing teaching situations containing the knowledge that students need to acquire.

(2) Construct socially oriented environments where students can actively construct knowledge for themselves, instead of presenting knowledge for students.

3.1.2. Cognitive Development of High School Students

According to the educational psychology textbook (Nguyen *et al*., 2019), in addition to the general psychological characteristics of teenagers, there are some features of high school students' characteristics as follows:

(1) There are some differences in their learning activities (see table 2)

(2) They have independence, initiative and creativity in cognition

(3) Their personal intellectual operations have reached a level of maturity and could be completely relying on logical propositions

Table 2. The Difference in Learning Activities between Secondary and High School Students.

	Secondary School	High School
Content of Subjects	- Students mainly learn studying methods and initially comprehend scientific concepts	- Higher level of reasoning and greater amount of knowledge - Students must comprehend a system of abstract concepts
Learning Attitude		- Students have higher self-discipline and more active than lower grades - Learning is selective
Learning Motivation	- Mainly are social motivations (honour, reward, etc.)	- Realistic, related to career orientation - Social motivates no longer dominate
The Differentiation between Students in Learning	- The differentiation is not clear	- There is a very clear differentiation in learning among students

Considering the above features in the cognitive development of high school students shows that constructivist teaching is suitable for students at this age since constructivist teaching focuses on student's participation in forming new knowledge actively and in their own way instead of passively absorbing through teacher's lectures. Thus, students can satisfy their independent thinking needs. Besides, students' proactive participation also contributes to helping them overcome laziness or the lack of perseverance.

3.1.3. Video Clips in Teaching Mathematics

Visualization

Visualization is an important concept in education in general and in mathematics education in particular. The Oxford Learner's Dictionary provides two meanings of visualization: (1) The act of forming a picture of somebody/something in your mind; (2) The act of making something able to be seen by the eye.

Komensky (1982) regarded the first and the most important principle in education as visualization since "seeing is believing". He believes that: "Knowledge that relies on sensory perception becomes more authentic". The learning process should be based on not only the proven results but also "what one see by their own eyes, hear by their own ears, taste by their own tongue, feels by their own hands" (Komensky, 1982)

In terms of visual aids in teaching, many authors have provided different definitions, including the remarkable one by Phan (2005). According to him, visual aids in teaching are tools used in teaching process, serving as a tool for students and teachers to influence the subject, stimulating, transmitting, and enhancing the sensory activities of senses, contributing to the formation of sensory materials of the subject to achieve specific teaching and learning objectives.

In the mathematics teaching process, some visual aids such as counting sticks, rectangular models, cube models, etc. and of course, video clips are also considered as a visual aid.

Constructive Video Clips

Video is an English word (French: video), defined by the Oxford Advanced Learner's Dictionary as a system of moving image and sound recorded using digital techniques or stored data on videotape. According to McCombs & Liu (2007), video is a medium (file) that combines auditory and visual channels, distributed in digital format (mostly via the internet nowadays). Despite the different expressions, definitions above all emphasize two factors in video, namely moving image (visual channel) and sound (auditory channel). A video clip is a short video or film segment ("clip" implies shortening or trimming).

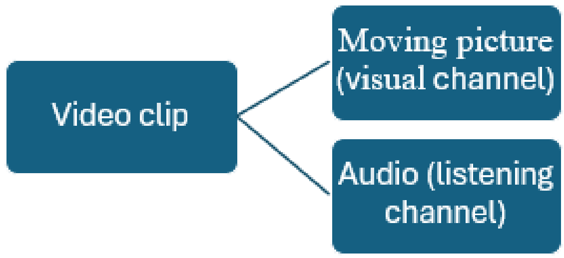

Figure 2. Description of Video Clip

In the context of this article, "constructive video clip" (CVC) is the term used to refer to video clip that contribute to enhance the effectiveness of constructivist teaching and learning process. The author uses the term "constructive video clip" instead of "video clip: to emphasize the knowledge-constructing function of this educational tool. If constructive video clip is used properly, it is not merely a visual aid but can become a powerful tool for teachers to help students engage actively in the knowledge-constructing process – this is also the core and fundamental idea of constructivist teaching.

Video Clips and Students' Cognitive Process

* Video Clips Serve as a Basis for Sensory Perception

According to the dialectical perspective, human cognitive activities progress from vivid sensory perception to abstract thinking and from abstract thinking to reality. This cognitive process occurs in stages, from simple to complex, from low to high, from concrete to abstract, from external to internal essence (Tran *et al*., 2023)

Visual perception plays an important role in

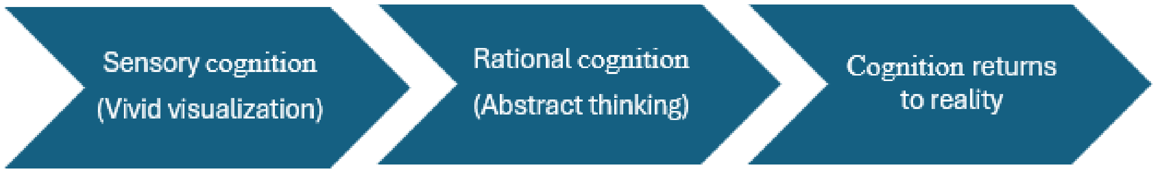

Figure 3. Cognitive Activity Progress

cognitive processes, especially from sensory to perception, which then develops into abstract thinking. Without sensory perception, there is no abstract thinking.

Hence, video clips, as a visual aid, can help students with sensory cognition, and thereby develop their abstract thinking, going deeper into the nature of objects, making the process of acquiring knowledge easier. In addition, video clips with a combination of sound (listening channel) and animation (visual channel) positively impact students' senses, "when the number of sensory organs participates in the cognitive process, the more accurate our knowledge is, a fulcrum to turn unclear symbols into clear, accurate symbols".

* Video Clips Can Promote Critical Thinking Skills

According to Richard Paul and Linda Elder (2002), critical thinking is the process of human thinking in analyzing, evaluating information, and making accurate arguments to provide better information by presenting observation results, experiences, and communications that require better definition. The author Makina (2010) believes that teaching mathematics by requiring students to memorize and mechanically remember without understanding the essence of the problem is counterproductive. Teachers need to teach students how to think, but in practice, they often only teach students what to think (Clement & Lochhea, 1980). To achieve the goal of teaching students how to think, teachers need to help students understand the process of approaching problems and generating problem-solving ideas. This process is often very complex for students, and to address this issue, visualization can be an effective solution.

A good video clip can promote the process of visualization, generating ideas students' mind, contributing to making abstract knowledge clearer. This is also the foundation for students to understand the essence of the problem and continue to apply it to solve assigned tasks.

Video Clips and Cognitive Load

Richard Mayer is an American educational psychologist who has made significant contributions to theories of cognition and learning, especially the issue of multimedia lesson design. He introduced the cognitive theory in multimedia-integrated teaching in (Mayer, 2005). In this theory, Mayer used the concepts of "words" and "pictures" to cover all information in the form of language and images.

Multimedia information is processed by students' eyes and ears. Initially, this information (in the form of images, sounds) is temporarily stored in the sensory memory - where initial

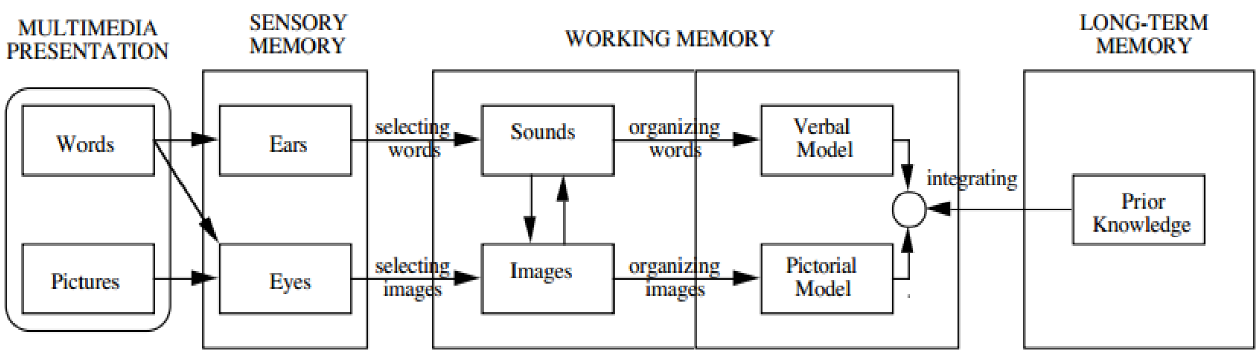

Figure 4. Richard Mayer's Cognitive Theory

information is stimulated into the senses. After the process of selection, some information will be retained and transferred to the working memory, or short-term store. Here, the information will be processed, organized, and integrated with relevant prior knowledge in the long-term memory.

In 1950, American psychologist G.A. Miller – considered one of the founding fathers of cognitive psychology – pointed out that our short-term memory capacity is limited to a certain extent. Specifically, humans can store an average of about seven information units in short-term memory (Miller, 1956). Following Miller's research, many scientists have studied human memory capacity. One of them is the Cognitive Load Theory developed by John Sweller in the late 1980s. The core idea of the Cognitive Load Theory is: Short-term memory has limits, and if overloaded, learning, memory retention, and application abilities will be negatively affected (Sweller, 1988)

According to John Sweller (1988), learners have three independent sources of cognitive load: Intrinsic Cognitive Load (ICL), Extraneous Cognitive Load (ECL), and Germane Cognitive Load (GCL). These three cognitive loads work together to form working memory throughout the learner's learning process. According to Kester *et al*. (2006), Extraneous Cognitive Load, or unrelated cognitive load, occurs when learners expend effort on tasks that do not contribute to their learning goals. Such ineffective tasks deplete learners' cognitive resources and negatively impact the learning process. Conversely, Germane Cognitive Load is the result of learners engaging in activities that aid their learning.

The goal of instructional design is to create learning tasks to control the required cognitive load at an appropriate level, develop instructional designs to reduce extraneous cognitive load, and encourage learners to engage in positive processing to mobilize appropriate cognitive load (Ngo Anh Tuan, 2012). Some studies have shown that videos can meet this goal. Specifically, according to Kester *et al*. (2006), one of the main benefits of video for students is that learning with videos helps reduce extraneous cognitive load and optimize germane cognitive load. In other words, learning with videos helps reduce cognitive overload while optimizing the amount of knowledge directly relevant to learning goals.

* Video Clips Influence Student's Attitudes, Behaviors, and Learning Outcomes

Both groups of authors Zhang *et al*. (2006) and Traphagan *et al*. (2010) have affirmed that students feel interested and excited when learning is combined with video. Therefore, video clips have the potential to enhance positive learning motivation and stimulate intellectual activities, significantly improving learning outcomes. Specifically, Zhang *et al*. (2006) showed that students in environments provided with interactive videos achieved significantly higher learning performance, and the satisfaction level of learners was also higher compared to other classroom environments. Additionally, Traphagan *et al*. (2010) also pointed out that most students reported positive experiences

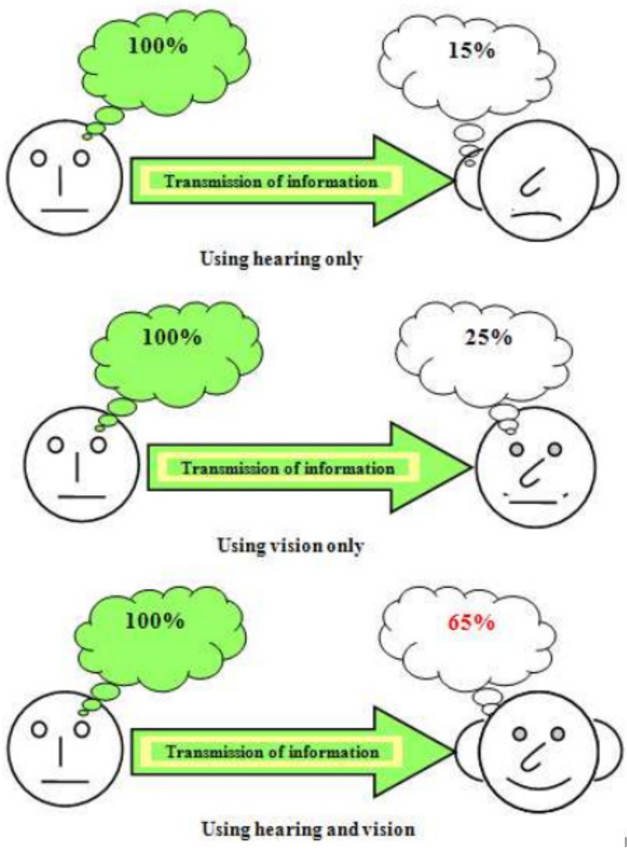

Figure 5. Modality Principle

from using multimedia presentations, along with positive impacts on learning experiences and learning outcomes. Many studies have shown that learning with video has contributed to the development of many skills (Alpay & Gulati, 2010), and students' learning outcomes have also progressed, as demonstrated by test scores.

* Discussing the Impact of Video Clips on Students' Remembering Knowledge Ability

Richard Mayer introduced the Modality Principle. The main content of this principle is: "Learners absorb better and remember knowledge longer when learning combines sound and pictures, instead of just text on the screen." (Mayer, 2005)

According to Pakshina *et al*. (2016), the principle of modality shows that if teaching is in the form of the teacher lecturing and students listening, the efficiency of absorbing and memorizing knowledge is only 15%. This number increases to 25% when teaching through visual channels, and can reach up to 65% when combining both audio and visual channels.

3.1.4. Video Clip and Some Teaching Methods

Flipped classroom

Since 1990s, the flipped classroom model has been formed and widely used, which is considered one of the most positive teaching methods in the US. According to Abeysekera and Dawson (2015), flipped classroom is a model in which instructional contents are conducted outside, or before the class while class time is spent for practicing, interacting, and evaluating. Besides, the interaction and discussion between students and students, students and teacher are the focus.

Bloom's scale of cognitive measurements includes 6 levels: Remembering; Understanding; Applying; Analyzing; Evaluating. In flipped classroom model, students can implement the first 3 levels: remembering, understanding, and applying at home (or before the lesson) reading guided documents or watching video clips provided by the teacher. Meanwhile, 3 levels including analyzing, evaluating, and creating are implemented in the classroom, where students can raise questions that need to be explained by teacher, discuss them in group, present their product, to have a deeper understanding and expand their knowledge.

Based on the above operation of the flipped classroom model, it can be said that knowledge is initially gained by students through guided documents and videos provided by the teacher. Hence, video clips in general and constructive video clips in particular can serve as important materials in flipped classroom models.

Digital Storytelling

According to Albano & Pierri (2017), digital storytelling (DST) is a storytelling method that combines many types of multimedia such as sound, hypertext, video clips, images, etc. Stories provide students with a comprehensive view that can help them to interact, convey knowledge and experience. To serve this method in teaching mathematics, video clips in general and constructive video clips in particular can be used to construct knowledge through digital stories.

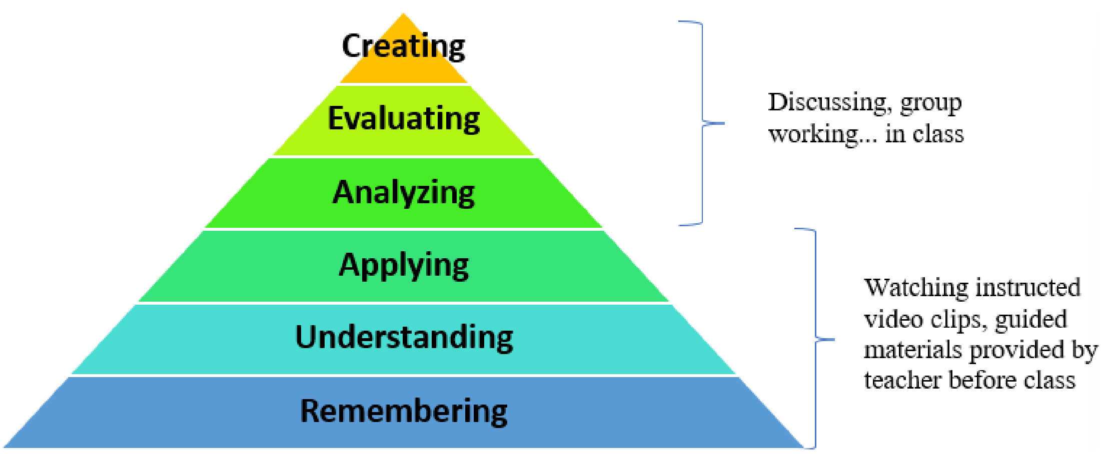

Figure 6. Bloom's Scale in Flipped Classroom

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3.2. Deploying Constructive Video Clips in Teaching Mathematics for High School Students

3.2.1. Some Criteria for Constructive Video Clips

(1) In terms of content, the video must be correct in scientific knowledge; Besides, the content should be arranged in an appropriate order such that new knowledge can be gained by students through their thinking and reasoning based on their prior knowledge (related to other subjects or previous lessons) or their experience in real life. Moreover, knowledge must not be presented directly (for example, like presentation method)

(2) In terms of technology, the video must ensure a good image, sound quality, and high resolution such that students can see the image and hear the sound clearly. In addition, the duration of video should be moderate, not too long to avoid harming students' eyesight or causing boredom.

(3) Encouraging video with text content (if any) presented in audio rather than just text on screen, that provides conditions for students to perform two activities simultaneously: observing the displayed images and listening to the audio explanation. Besides, if the video does not include any audio, the teacher can explain or ask instructive questions for students while showing it.

3.2.2. Some Remarks for Designing a Video-integrated Lesson

In the influential work, Mayer (2015) proposed several principles for designing multimedia-integrated lessons, which can be summarized as follows:

(1) Reducing cognitive overload

(2) Controlling germane cognitive load in a reasonable level

(3) Simulating and increasing system knowledge processing

To ensure these principles, the authors suggest the following remarks for teachers in implementing video-integrated lessons:

(1) Reducing unnecessary content (for example, skipping unnecessary parts of the video, that could be the knowledge that students have already known or too easy for their level)

(2) Emphasizing importance content (for example, spending more time and questions to discuss between teacher and students or students and students in these important parts)

(3) Providing instructive questions to guide students focus on observing to gain core knowledge, avoiding immersion in unnecessary details

(4) Well prepared in terms of time, calculating and arranging carefully so that videos' durations are appropriate to the duration of the lesson

(5) Exploiting the constructive function of video clips (designing guiding questions and related tasks to encourage the proactive, creative and exciting participation of students, etc.) besides the simple function as a visual aid.

3.2.3. Introducing Some Video Sources and Some Ways to Create Video Clips

Nowadays YouTube is recognized as one of the world's largest video platforms, offering a wide array of content that is easily accessible. To find or curate high-quality constructivist video clips for mathematics instruction, teachers can follow a systematic process: (1) First, they should identify the specific knowledge or skills they want students to acquire through the video; (2) Next, they can extract relevant keywords from this topic, and it is beneficial to use English keywords to yield a more diverse range of results; (3) Finally, teachers must critically evaluate the search results based on a set of criteria including content accuracy, pedagogical alignment, and technical quality. Similarly, videos on platforms like TikTok can also serve as useful resources, following a similar search and evaluation method.

Although available videos on social platforms can help teachers save significant time and effort, not all knowledge content has already been expressed in available videos, or some videos (if can be found) are not suitable for the idea of teachers. Therefore, teachers can also create their own constructive video clips by making full use of some popular software such as GeoGebra, Excel; some computer algebra systems such as Mathway, Volfram Alpha; some simulators such as PiliApp, Random number; or some tools for editing such as Canva, Capcut, etc.

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3.2.4. Introducing Some Constructive Video Clips

We have developed a preliminary collection of constructivist video clips for use in 10th-grade mathematics instruction, which serves as a foundational "library". This initial resource contains 30 video clips with a total runtime of approximately 32 minutes, making the average duration just over one minute per clip. This concise format is intentional, as it allows for easy integration into various parts of a lesson without disrupting its flow.

Of the total, 11 video clips were curated from popular online platforms like YouTube and TikTok, selected for their quality and alignment with the constructivist approach. The remaining 19 video clips were original creations, meticulously produced by our team using a variety of software and applications to ensure they directly address specific learning objectives. In addition to the video content, this resource includes practical guidelines for educators on how to effectively implement these clips to foster a dynamic, student-centered learning environment.

Within the scope of this article, we will provide the following illustrative examples from

Table 3. Introduction of Some Constructive Video Clips in Grade 10

Strand	Lesson	Video	Summary of Video Content	Suggestion
Numbers, algebra, and some analysis elements	Sign of quadratic trinomial	https://www.youtube.com/watch?v=RfQRWOAQCb0	The video demonstrates Excel sheet: the first column consists of the values of x (with tiny steps), the following columns are the values of quadratic trinomial. The values of quadratic trinomial turn red if the value is positive and turn green otherwise.	
Geometry and measurement	Conic sections	https://www.youtube.com/watch?v=buhttryIMpE&t=9s	The video describes conic sections by the intersections of a cone and a plane	
		https://www.youtube.com/watch?v=vOVtBqFC1bg&t=2s	Visual simulation of the Dandelin sphere (3D)	
Statistics and probability	Approximate number. Error	https://www.youtube.com/watch?v=gdsb69Ox5ZY	The video describes a conservation between the user and chat GPT, which includes questions about information about data such as distance, atomic number, value of , etc. Then the answers are figures with phrases such as: "about", "approximately, etc.	

this library, showcasing video clips that align with the three main learning strands specified in the 2018 General Education Program.

4. Discussion

This study developed the concept of a constructivist video clip, grounding it firmly in two main theoretical pillars: constructivist teaching theory and multimedia-integrated teaching. By systematically merging these two pedagogical perspectives, we were able to deduce the significant potential for these video clips to enhance student engagement and deepen conceptual understanding in high school mathematics. Beyond a purely theoretical contribution, our work also provided tangible, practical outcomes by proposing specific examples of these video clips along with detailed instructions for their classroom implementation in mathematics lessons. Despite these foundational achievements, a key limitation of the present study is its focus on a theoretical framework without empirical validation. While we have established the conceptual potential and logical feasibility of constructivist video clips, their actual impact on student learning outcomes, long-term knowledge retention, and the development of higher-order thinking skills remains to be proven through rigorous, controlled experimentation. The transition from a promising theoretical model to a proven, effective pedagogical tool requires robust, data-driven evidence. While prior research has indicated favorable student reactions, the attitudes held by mathematics teachers and students regarding the use of constructive video clips warrants further inquiry.

Future efforts will be dedicated to empirically validating our theoretical model through rigorous pedagogical experiments. These studies will employ a quasi-experimental design to systematically compare learning outcomes, student engagement, and competency development between groups using constructivist video clips and those in traditional learning environments by collecting both quantitative data (e.g., test scores, grades) and qualitative data (e.g., student and teacher feedback, observation notes). The data gathered from these experiments will serve to reinforce our theoretical foundations and provide concrete evidence of the constructive video clips'thepact. Besides, a primary objective is to systematically expand the existing pilot library of constructivist video clips to encompass the entire mathematics curriculum for grades 11 and 12. This expansion will transform the current collection into a comprehensive, curriculum-aligned educational resource, ensuring its relevance and utility for upper secondary education. Beyond resource creation, a critical next step is the establishment of a collaborative digital platform. This platform will not only serve as a centralized repository for video clips but also function as a professional learning community where mathematics educators can share, review, and contribute new content. We believe this collaborative model is essential for creating diverse and high-quality educational materials. By empowering teachers to become creators and curators, the platform would foster a dynamic ecosystem of educator-generated resources, ensuring their continued relevance and pedagogical effectiveness. Ultimately, this initiative is envisioned as a significant contribution to the mathematics teaching community, empowering educators with innovative tools to enhance student engagement and deepen conceptual understanding across the curriculum.

5. Conclusions and Recomendation

This study has established a theoretical and practical case for the integration of constructivist teaching theory with multimedia in the context of mathematics education. Our theoretical framework demonstrates that both constructivist teaching and multimedia-integrated teaching, particularly through video clips, have a profound and positive impact on student learning outcomes, especially in fostering the development of key competencies. By merging these two powerful pedagogical approaches, the newly proposed concept of constructivist video clips can effectively "inherit" and amplify their combined advantages, creating a dynamic and engaging learning tool.

The application of this approach is particularly suitable for high school students. At this stage of their academic development, students are characterized by more sophisticated reasoning skills and a greater capacity for active, self-directed engagement. However, the curriculum concurrently introduces increasingly abstract mathematical concepts. This shift from concrete to abstract thinking can pose a significant challenge, especially for tenth-grade students transitioning from middle school. Consequently, the deployment of constructivist video clips becomes not only appropriate but also essential. These video clips can serve as a crucial bridge, transforming abstract ideas into visually intuitive and interactive learning experiences that directly cater to the developmental needs of high school students.

Furthermore, the implementation of a constructivist video clip-integrated teaching approach is feasible within the current educational landscape. Our analysis of the curriculum reveals that a vast majority of mathematics lessons contain content that is well-suited for a constructivist and visual representation. This inherent compatibility suggests that this innovative teaching approach can be seamlessly integrated into existing pedagogical practices. The development of a comprehensive library of such video clips, therefore, represents a practical and scalable solution for enhancing student engagement and understanding.

However, the overusing video clips may lead to redundant and cognitive overload. Hence, the effective integration of constructive video clips requires teachers to practice careful duration and timing, specifically by reducing redundant or basic content while ensuring the duration is appropriately aligned with the lesson plan. We highly recommend that teachers maximize the constructive potential of these clips by emphasizing key knowledge with focused discussions and employing well-designed, instructive questions and related tasks to guide student observation and encourage proactive, creative participation.

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