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From Watching to Solving: Teachers' Perceptions of Online Mathematics Video Learning in Senior High School

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Abstract. Online mathematics videos are widely used by senior high school students as supplements to classroom instruction, yet apparent comprehension during viewing does not always result in independent problem solving or improved achievement. This qualitative study investigates how five senior high school mathematics teachers perceive the processes through which students learn from such videos, with particular attention to the gap between understanding an explanation and being able to solve a problem. Data consisted of researcher-recorded responses from semi-structured interviews and were analyzed thematically. Participants viewed videos as accessible, replayable resources that can support visualization, revision, and temporary emotional reassurance. At the same time, they consistently distinguished following a fluent solution from generating one independently. They associated this gap with insufficient active processing, limited self-explanation and retrieval, fragile conceptual connections, and inadequate engagement with variant problems. Mathematics anxiety and unstable self-efficacy were perceived as encouraging immediate recourse to videos, providing short-term relief while potentially weakening persistence with difficulty. Teachers endorsed or proposed prediction prompts, purposeful pauses, error analysis, independent reconstruction, variation, and feedback. The study offers a teacher-perceived, hypothesis-generating model rather than causal evidence and suggests that productive video design should convert viewing into cycles of prediction, explanation, practice and reflection.

Keywords: online mathematics videos, problem solving, illusion of competence, mathematics anxiety, self-regulated learning

1. Introduction

Senior high school students' use of online mathematics videos as supplements to classroom instruction. On platforms such as Bilibili, learners can replay explanations, select teachers whose presentation suits them, and access worked solutions when classroom instruction or textbooks appear insufficient. These affordances make videos attractive for revision and problem solving, particularly under examination pressure. Effective supplementary learning, however, depends not only on access to explanations but also on learners' ability to plan, monitor, and evaluate understanding, which are central processes in self-regulated learning [1, 2]. Multimedia explanations

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can support learning when words and visual representations guide appropriate cognitive processing [3].

Yet not all students improve after watching instructional videos. A polished presentation can make each step seem obvious while the student remains unable to select a strategy, reconstruct reasoning, or transfer it to a variant. Thus, understanding while watching and solving independently should not be treated as equivalent outcomes.

This study investigates this discrepancy through researcher-recorded semi-structured interviews with five senior high school mathematics teachers. It examines participants' perceptions of how the gap is produced, how cognitive load, limited active learning, fragile conceptual understanding, mathematics anxiety, self-efficacy, and the instructional environment may shape it, and which online-video features may support movement from apparent comprehension to independent performance. By integrating these accounts with cognitive, metacognitive, and affective perspectives, the study develops a teacher-perceived explanatory model and practical design implications. Its purpose is exploratory rather than causal, because teacher reports illuminate recurring classroom patterns but do not directly measure students' cognition or achievement.

2. Literature review

2.1. The gap between understanding and problem solving in online mathematics video learning

Online video gives students access to expert explanations and allows them to pause, replay, and coordinate verbal and visual information. Multimedia learning depends on selecting, organizing, and integrating information across representational channels, poor coordination may instead overload processing [3]. In mathematics, video can clarify symbolic transformations, diagrams, and links between steps. Worked examples can also reduce unproductive search and reveal problem-solving principles, although learning depends on active processing rather than exposure alone [4].

These advantages may nevertheless coexist with, or contribute to, a comprehension–performance gap. A polished explanation supplies the goal, representation, relevant formula, and sequence of operations. During viewing, a learner recognizes the coherence of an expert-selected path, independent work requires generating that path without external cues. Judgments made during study can be biased by information present while learning but unavailable at the test, creating an illusion of competence [5]. Ease of following a video may therefore be mistaken for an ability to retrieve and reproduce its reasoning.

In mathematics, this gap is consequential because success requires more than recalling statements or procedures. Students must decide which concepts apply, coordinate representations, justify intermediate moves, and adapt methods when surface features change. A demonstrated solution may be reproduced while a variant remains unsolved because the learner's representation is tied to the original example. Immediate clarity is therefore valuable, but it is not evidence of durable conceptual understanding or transfer.

2.2. Cognitive factors behind the understanding–problem-solving gap

Working-memory limitations mean that complex problem-solving may consume resources in search processes that leave little capacity for learning [6]. Instruction should therefore manage unnecessary demands while supporting the construction of usable schemas [7]. Video segmentation and coordinated speech, notation, and diagrams can lower extraneous load. Yet when every decision and

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inference is supplied, learners may perform too little of the processing needed to build and test a schema. The issue is whether released capacity supports generative activity.

Passive viewing increases this risk. Self-explanation research indicates that examples are learned more effectively when students explain why steps are valid, connect them to principles, and identify gaps in understanding [8]. Continuous playback may allow recognition to substitute for these activities. Predicting the next step, completing omitted reasoning, solving before viewing, and reconstructing a solution from memory instead create retrieval and strategy-generation opportunities. Variant problems can then reveal whether knowledge is transferable or remains dependent on the original presentation.

Compact senior high school textbooks may omit intermediate explanations that novices cannot yet infer. Videos can bridge this interpretive gap, but complete external explanations may also discourage students from interrogating definitions, examples, and representations independently. Perceived fluency can further distort metacognitive regulation: material judged already mastered may receive less later practice or classroom attention [1, 2, 5]. Feedback is essential because it relates current performance to a learning goal and clarifies the next action [9]. Transfer may be better supported when viewing is followed by unaided performance, diagnostic feedback, and revision rather than another complete solution.

2.3. Affective factors: mathematics anxiety and self-efficacy

Affective conditions may shape when students seek videos and how they use them. Mathematics anxiety has a robust negative association with achievement, although the relationship may be reciprocal rather than simply causal [10]. Anxiety includes cognitive, emotional, and behavioral responses that can consume working-memory resources and foster avoidance [11]. When difficulty triggers threat, opening a video can reduce uncertainty. Such relief may enable re-engagement, but repeated help-seeking before sustained effort may reinforce the expectation that difficulty cannot be managed independently.

Self-efficacy concerns beliefs about the capability to organize and execute actions required for a task [12]. Stronger efficacy can support effort and persistence, whereas repeated failure may weaken both. Understanding a fluent explanation may raise confidence, but confidence based only on recognition can be poorly calibrated. Subsequent failure during independent work may then reduce efficacy and intensify anxiety. Fear of difficult problems can consequently prompt immediate video use, temporary clarity, limited practice, and renewed fear.

Video reliance is not inherently maladaptive. Videos can model manageable steps, normalize errors, and provide a low-threat entry into challenging content. Their affective value may be more durable when reassurance is paired with attainable independent tasks, graduated hints, informative feedback, and opportunities for genuine mastery [9, 12]. Emotional support and active problem-solving should therefore function together.

3. Methodology

3.1. Research design and participants

This study adopted an exploratory qualitative design to examine how senior high school mathematics teachers perceive students' learning from online mathematics videos. The dataset consisted of the researcher's written records of five teachers' responses to semi-structured interviews. As shown in Table 1, participants were assigned the identifiers T1–T5. T1 taught Grade 11

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mathematics and reported four to ten years of teaching experience. T2 taught Grade 10 and had more than ten years of experience. T3 taught Grade 12 and had more than ten years of experience. T4 taught Grade 10 and had more than ten years of experience. T5 was both a mathematics teacher and an online video creator serving Grades 10–12, with four to ten years of experience in teaching or online education. All participants reported being familiar, to differing degrees, with students' use of online mathematics videos. The sample represented several grade levels and, through T5, included a content-creation perspective.

Table 1. Participant profile

ID	Role	Grade	Experience	Familiarity
T1	Classroom mathematics educator	Grade 11	4–10 years	Fairly familiar
T2	Classroom mathematics educator	Grade 10	More than 10 years	Fairly familiar
T3	Classroom mathematics educator	Grade 12	More than 10 years	Very familiar
T4	Classroom mathematics educator	Grade 10	More than 10 years	Very familiar
T5	Mathematics teacher and video creator	Grades 10–12	4–10 years	Very familiar

3.2. Data collection and analysis

The interview guide covered six areas: students' purposes and patterns of video use, perceived benefits, instances of understanding a video but failing to solve a related problem, cognitive explanations, mathematics anxiety and self-efficacy, and possible improvements to video design. The available document contains researcher-recorded responses rather than verbatim interview transcripts. Consequently, the findings use careful paraphrase and do not present the recorded wording as exact participant quotations.

A combined deductive and inductive thematic analysis was conducted. Initial theory-informed categories were drawn from the study framework, including cognitive load, active processing, conceptual understanding, mathematics anxiety, self-efficacy, and self-regulation. Responses were then compared across participants to identify additional contextual patterns, including examination pressure, parental expectations, textbook accessibility, and platform incentives. Each participant was first treated as an individual case, after which a cross-case matrix was used to examine convergence and divergent or contrasting accounts. Recurrent accounts were developed into themes, while views raised by only one participant were retained as contextual interpretations rather than generalized findings. Because several interview prompts introduced the focal constructs and offered response options, agreement across participants was interpreted as endorsement and elaboration of prompted themes rather than as fully inductive emergence. Participant reports of platform metrics were treated as reported observations because the underlying records were unavailable. The analysis supports an exploratory account of teachers' perceptions, it does not establish the prevalence of the reported behaviors or causal effects on achievement.

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4. Findings and discussion

4.1. Online videos as accessible and often remedial resources

Across the five accounts, online videos were often described as resources used after difficulty had arisen, although preparatory and parent-directed uses were also reported. T1, T3, and T5 associated viewing especially with blocked homework, examination preparation, and urgent searches for solutions. T5 also described peaks around weekends and examinations, although the platform records underlying this account were not available for independent examination. T2 reported substantial use for Grade 10 preparation, T4 highlighted parent-assigned preparation or weekend enrichment, and T5 perceived voluntary preparation-related viewing as uncommon. These contrasts suggest that use may vary by grade, student group, source of direction, and the type of platform observed.

Participants also identified genuine benefits. Replayable explanations could help students recover content missed in class, and visual demonstrations could make abstract ideas more accessible. T2 described videos as translating compressed textbook language, while T5 emphasized animation and simplified expression. These affordances are consistent with multimedia learning and worked-example research [3, 4]. Nevertheless, accessibility did not necessarily produce autonomy. T1 and T2 characterized much viewing as a different form of listening rather than independent knowledge construction. T4 further noted that videos could support students absent from school, but reported limited benefit and possible resistance when viewing was imposed by parents. Thus, video use appeared neither uniformly beneficial nor harmful, its value depended on the purpose of viewing and the learner's subsequent activity, as self-regulated learning accounts would predict [1, 2].

4.2. Fluent following and the transfer gap

All five educators reported frequently observing a gap between apparent understanding during a video and later independent performance. Their examples covered conic sections, function monotonicity, spatial-vector calculations, trigonometric transformations, and geometric cross-sections. Despite different topics, the examples shared a common structure. The video supplied a selected representation, an efficient strategy, and an orderly sequence of operations. Students could follow that completed pathway, yet they became stuck when a condition, representation, or required transformation changed.

Participants distinguished recognition of an instructor's reasoning from the generation of a solution. T1 believed that students remembered the route used for one conic-section problem without understanding why it was appropriate. T2 observed that students could follow a monotonicity proof but could not independently produce the algebraic transformation needed in a variant. T3 emphasized that watching spatial-vector calculations did not replace the paper-based work required to coordinate signs and intermediate results. T4 described attention to an animated trigonometric transformation without successful application to a combined transformation problem. T5 similarly reported that enthusiastic reactions to a three-dimensional animation coexisted with weak performance on a subsequent embedded item, this remains a participant-reported pattern rather than verified behavioral evidence.

These accounts refine the role of cognitive load. Clear presentation may beneficially reduce unnecessary demands [6, 7], but it may also remove opportunities to select strategies, detect errors, and generate intermediate steps. The accounts suggest that the perceived problem was not low cognitive load itself, but insufficient generative processing after support had simplified the task.

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Participants' description of fluency being mistaken for mastery aligns with the illusion-of-competence account [5]. Their emphasis on explaining underlying reasons, reconstructing solutions, and practicing variants also corresponds with research on self-explanation and example-based transfer [4, 8]. The interviews cannot show that fluent videos caused transfer failure, because students' prior knowledge, practice, and video choices were not independently measured. They do, however, consistently locate the perceived gap between supported comprehension and unsupported production.

4.3. Mathematics anxiety, self-efficacy, and recurrent reliance

Participants portrayed emotion as both a reason for viewing and a consequence of viewing outcomes. T1, T3, and T5 described students turning quickly to videos when uncertainty or stalled progress became uncomfortable. T3 viewed examination-period viewing as a form of short-term emotional protection, while T5 associated demand for reassuring, simplified explanations with urgent relief. These perceptions are compatible with evidence that mathematics anxiety and achievement are negatively related and may influence one another [10], as well as with accounts of avoidance under anxiety [11].

The reported effects on self-efficacy were explicitly mixed. T1 noted that an accessible explanation could restore a student's belief that a difficult topic was manageable. Other accounts emphasized a longer-term risk: repeated reliance on complete explanations could leave students insecure when support was absent. T4 added a family-level mechanism, proposing that parental anxiety and compulsory course consumption could shift students' sense of control toward external resources. This view was not shared in equal detail by the other participants and should be treated as a contextual case rather than a common mechanism. In Bandura's terms, confidence grounded in independent mastery differs from confidence generated by ease of following [12]. A tentative cycle, articulated most explicitly by T3 and echoed in elements of other accounts, can be synthesized from the interviews: difficulty may elicit anxiety, video viewing may offer immediate relief, passive following is perceived as limiting independent success, and later failure may encourage renewed reliance. Self-regulation theory supports viewing these cognitive, emotional, and behavioral processes as mutually interacting rather than as a one-way effect [1, 2].

4.4. Contextual conditions and design implications

Table 2. Cross-case themes, shared patterns and boundaries

Theme	Shared pattern	Variation or boundary
Main viewing context	Accounts often emphasized remedial use after difficulty, homework, or examination revision	T2 reported more Grade 10 preparation, T4 emphasized parent-directed preparation or enrichment, T5 perceived voluntary preparation use as uncommon
Conditional affordances	Participants identified benefits, but the form and conditions of benefit varied	Replay, visualization, recovery of missed content, emotional reassurance, and resistance to compulsory viewing were emphasized differently
Understanding–solving gap	All five reported fluent following followed by difficulty on independent or transformed problems	Examples involved different topics and forms of required generation

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Table 2. (continued)

Perceived mechanism	Insufficient active generation or output and weak transfer	Recognition, self-explanation, retrieval, variation, textbook accessibility, examination pressure, family monitoring, and platform incentives were emphasized differently
Affective dynamics	Anxiety was perceived as shaping video use and confidence	Rapid help-seeking was most explicit in T1–T3 and T5, T4 foregrounded transferred parental anxiety and external control, T1 noted short-term confidence gains
Design implications	Video should require observable mathematical thinking or output	Specific proposals included prediction, pauses, reconstruction, error analysis, variants, feedback, family-facing output data, branching, and gated progression

Table 2 shows cross-case themes, shared patterns and boundaries. Four contextual pressures extended the explanation beyond individual cognition. T2 highlighted the compressed presentation of ideas in textbooks, T3 stressed high-stakes examination pressure, T4 focused on parental monitoring and educational consumption, and T5 described incentives to maximize clicks and completion. Because each emphasis was concentrated in one or two accounts, these are possible conditions that may intensify passive viewing, not established properties of every learning environment.

Participants endorsed several prompted design principles that require students to produce mathematical thinking and elaborated on them with context-specific suggestions. Proposed features included pauses for predicting the next step, paper-based reconstruction after viewing, prompts to explain why a method works, analysis of unsuccessful pathways, gradually disclosed hints, and immediate variant problems. These proposals are consistent with self-explanation research [8], the fading and active use of worked examples [4], and feedback that reveals the gap between current and intended performance [9]. T4 proposed reporting demonstrated understanding rather than viewing time to families, while T5 advocated branching choices and problem completion before continued playback.

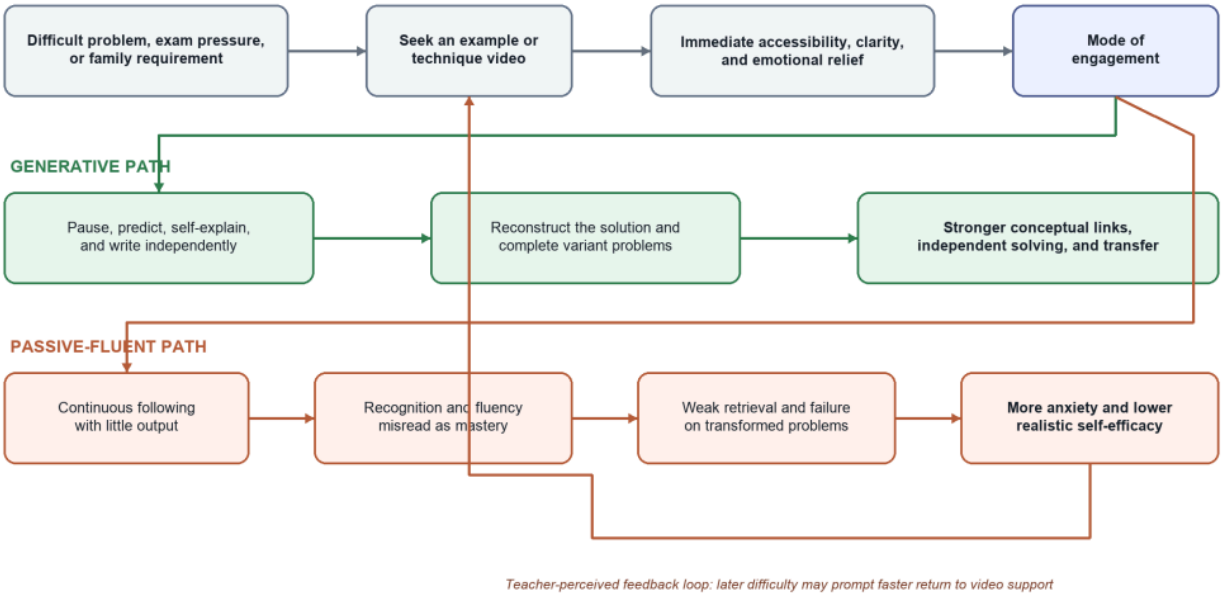


Figure 1. A teacher-perceived model of passive-fluent and generative video-learning paths

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Such features should be interpreted as design hypotheses rather than proven interventions. Forced interaction could become another completion ritual, and poorly calibrated difficulty could overload novices. Effective support would therefore combine manageable guidance with observable student output and progressively reduced assistance. Taken together, the accounts suggest two possible routes after an initially clear explanation (Figure 1). Continued receptive viewing may preserve the understanding–solving gap, whereas prediction, self-explanation, reconstruction, feedback, and varied practice may convert supported comprehension into more independent transfer.

5. Conclusion

This exploratory study examined how five senior high school mathematics teachers perceived students' use of online mathematics videos and the recurring gap between following an explanation and solving a problem independently. Participants frequently described videos as accessible remedial resources for blocked homework, revision, and examination preparation, while T2 reported preparation and T4 highlighted parent-directed preparation or enrichment. Participants recognized genuine benefits in replay, visualization, explanation of compressed textbook material, and short-term emotional reassurance. Their accounts do not support a simple claim that video learning is ineffective.

The central finding is a distinction between supported recognition and unsupported generation. In the examples reported by all five teachers, a fluent video supplied the representation, strategic choice, and orderly reasoning that students later needed to produce for themselves. Participants associated viewing with little prediction, self-explanation, reconstruction, retrieval, or variation with a perceived risk that apparent clarity would coexist with weak transfer. Mathematics anxiety and time pressure were perceived as encouraging immediate help-seeking, while later failure could weaken self-efficacy grounded in independent performance and prompt renewed reliance. This proposed cycle is an interpretive model derived from teacher perspectives, not a verified causal pathway.

The findings suggest that video quality should not be judged only by clarity, brevity, or completion. Potentially productive designs would retain accessible explanations while embedding pauses for prediction, analysis of unsuccessful approaches, graduated hints, independent reconstruction, variant problems, and feedback based on demonstrated output. Such features may turn viewing into a sequence of generation, testing, and revision rather than continuous reception.

Several limitations define the contribution. The small sample cannot represent senior high school teachers generally, and teacher reports cannot directly confirm students' cognitive load, anxiety, self-efficacy, viewing behavior, or achievement. The available data were researcher-recorded responses rather than verbatim transcripts, and reported platform figures were not independently verified. Future work should combine student interviews, viewing logs, confidence judgments, and near- and far-transfer tasks. Experimental comparisons of fluent explanation alone with videos containing generative prompts could then test whether the proposed design features reduce miscalibration and improve durable problem-solving.

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