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ENHANCING STUDENT ENGAGEMENT THROUGH INTERACTIVE VIDEO EDITING IN SCIENCE AND VISUAL ARTS

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Abstract:

Interactive video editing has emerged as a promising pedagogical strategy for supporting 21st-century learning in secondary education, particularly in contexts where student disengagement and digital inequality remain significant challenges. Grounded in Mayer's Cognitive Theory of Multimedia Learning and a learner-centred pedagogical perspective, this study examines how interactive video editing was implemented in classroom practice and how it supported student engagement, conceptual understanding, creativity and reflective learning. Using a qualitative multiple-case study design, the research investigated two secondary school contexts: (1) the use of interactive experimental videos in Science education and (2) the use of structured video documentation in Visual Arts within a Science, Technology, Engineering, Arts and Mathematics (STEAM) approach. Data were collected through semi-structured teacher interviews, student focus group discussions, classroom observations, student reflective responses and performance-related artefacts and were analysed using thematic analysis. The findings indicate that interactive video editing supported more active and participatory learning, strengthened conceptual understanding through visualisation and guided explanation and promoted creativity, reflection and student agency across both subject contexts. The study also found that teachers used interactive video as a pedagogically purposeful tool to support formative learning.

differentiated instruction and learner autonomy. At the same time, challenges related to digital access, infrastructure, teacher readiness and time demands remained evident, particularly in rural and under-resourced settings. This study contributes to educational technology research by demonstrating how structured interactive video editing can function as a learner-centred pedagogical approach that supports more engaging, inclusive and meaningful learning in secondary education.

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Keyword:

Artificial Intelligence, Digital Innovation, Interactive Education, Video Editing



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Introduction

The rapid advancement of digital technologies has substantially reshaped the educational landscape, prompting a shift in the ways learning content is designed, delivered and experienced. In the context of the Fourth Industrial Revolution and post-pandemic educational recovery, video-based instructional materials have gained increasing recognition as effective tools for addressing the multisensory and interactive needs of contemporary learners. Unlike conventional teacher-centred approaches, educational videos can integrate visual, auditory and interactive elements that support memory retention and conceptual understanding. From the perspective of Mayer's Cognitive Theory of Multimedia Learning, learning becomes more meaningful when learners actively process information through both verbal and visual channels in a structured manner (Mayer, 2019; Mayer, 2024). This theoretical perspective provides a strong foundation for understanding why video-based instruction may enhance student learning outcomes.

At the secondary school level, video has emerged as a flexible and dynamic medium that aligns with the characteristics of 21st-century learners, who are generally more familiar with digital environments and multimodal forms of communication. This shift has become more significant with the expansion of video editing technologies, including artificial intelligence (AI), augmented reality (AR), virtual simulations and cloud-based editing platforms. These technologies have expanded teachers' capacity to produce more adaptive, engaging and pedagogically responsive learning materials. More importantly, they enable the design of interactive learning experiences that extend beyond content delivery to support active participation, inquiry and reflection. In this regard, the pedagogical value of video lies not only in its presentation format but also in how its interactive features are intentionally designed to facilitate learning.

Interactive elements such as embedded quizzes, branching pathways, automated subtitles, visual transitions and green-screen effects are no longer limited to media production professionals. Increasingly, these tools are becoming accessible to teachers and can be incorporated into classroom instruction to support more student-centred learning environments. When designed effectively, such features can encourage self-paced learning, sustain student attention and promote deeper engagement with content. This is particularly relevant for students with diverse learning needs, including those in rural or under-resourced contexts, where flexible and reusable digital materials may help reduce barriers to participation. In such contexts, interactive video serves not merely as a technological enhancement, but as a practical means of supporting more equitable and inclusive educational access (Azizan & Hashim, 2021; UNESCO, 2022). This aligns with broader learner-centred and inclusive pedagogical approaches that emphasise accessibility, autonomy and meaningful participation.

Despite the growing use of video in education, much of the existing literature continues to discuss video primarily as a general delivery tool rather than as a pedagogically grounded strategy shaped by clear theoretical principles. Many studies focus on platforms, user perceptions or content categories, while giving limited attention to the instructional design and editing techniques embedded in the videos themselves. Aspects such as content segmentation, visual sequencing, narrative voice-over and interactive features may significantly influence students' motivation, comprehension and engagement, yet these elements remain underexplored in many classroom-based studies. This gap is particularly evident in the context of Malaysian secondary education, especially in under-resourced settings where infrastructure limitations and teachers' digital pedagogical competencies continue to affect implementation (Zawawi et al., 2022). As a result, there is a need for more context-sensitive research that examines not only whether video is used, but how it is structured pedagogically to support learning.

Reports from the Ministry of Education indicate continuing disparities in digital readiness across schools, particularly in rural settings, where internet stability, device access and teacher training remain uneven (KPM, 2023). These challenges highlight the importance of developing practical and sustainable approaches to digital pedagogy that can be implemented within real classroom constraints. In particular, greater attention should be given to teachers' capacity to design and edit interactive instructional videos that are pedagogically purposeful rather than merely technically appealing. This issue is closely linked to the broader need for continuous professional development in digital pedagogical competencies. Without sufficient support, the educational potential of interactive video may remain underutilised, particularly in settings where it could offer the greatest benefit.

This study addresses these gaps by examining how interactive video editing techniques are implemented in authentic teaching and learning contexts and how these practices influence students' engagement, motivation and understanding. The study focuses on two cases: (1) the use of interactive experimental videos in Science education and (2) the use of structured video documentation in Visual Arts education within a Science, Technology, Engineering, Arts and Mathematics (STEAM) approach. By examining these two contexts, the study extends discussion beyond the technical aspects of video production to consider the pedagogical functions of interactive editing in supporting learner-centred instruction. It also explores how such practices may foster key 21st-century competencies, including creativity, self-reflection and higher-order thinking. In doing so, the study contributes to educational technology research by demonstrating how structured interactive video editing can serve as a meaningful

pedagogical strategy in secondary education, particularly in contexts that require flexible, engaging and inclusive approaches to learning.

Reimagining Pedagogy: Why Interactive Videos Matter in Secondary Education

One of the persistent challenges in secondary education is sustaining meaningful student engagement in classroom learning. Traditional lecture-based instruction often provides limited opportunities for interaction, particularly for students who are accustomed to fast-moving, visually rich and participatory digital environments. Contemporary learners are increasingly exposed to platforms that prioritise immediacy, interactivity and multimodal communication. As a result, they often respond more positively to learning experiences that involve exploration, participation and immediate feedback rather than passive reception of information. In this context, interactive video offers a relevant pedagogical response by enabling educators to redesign lessons in ways that are more engaging, structured and responsive to students' learning preferences.

Interactive video is pedagogically significant because it transforms students from passive viewers into active participants in the learning process. In classroom practice, teachers can use interactive videos to present complex concepts through step-by-step demonstrations, embedded questioning, animated explanations and decision-based pathways. For example, a science teacher may explain chemical reactions through an experimental video that integrates quizzes, labelled visuals and branching sequences that prompt students to predict outcomes or interpret observations. Such design features promote what may be described as active cognitive engagement, as students are required not only to watch but also to process, apply and evaluate information throughout the learning experience. This reflects constructivist principles, in which learners build understanding through active interaction with content rather than through one-way transmission of knowledge (Ismail, H.,2023).

Another important pedagogical strength of interactive video lies in its support for differentiated instruction. In most secondary classrooms, students vary in readiness, pace, learning preference and prior knowledge. Interactive video accommodates these differences by allowing learners to pause, replay or revisit specific sections according to their individual needs. Students who require additional support may benefit from segmented explanations, visual prompts or repeated viewing, while more advanced learners may engage with extension tasks or alternative learning pathways embedded in the video. This flexibility increases learner autonomy and can strengthen motivation by giving students a greater sense of control over their learning process. From the perspective of learner-centred pedagogy, such autonomy is essential because it supports more personalised and meaningful learning experiences.

The educational value of interactive video is further reinforced by multimedia learning principles. When visual, verbal and textual information are carefully integrated, students are better positioned to organise and retain new knowledge. According to Mayer's Cognitive Theory of Multimedia Learning, well-structured multimedia materials can enhance comprehension when they reduce cognitive overload and guide learners' attention to essential information. Interactive video editing enables teachers to apply these principles more deliberately through content segmentation, pacing, signalling, narration and embedded interaction. This means that the effectiveness of educational video depends not simply on the presence of technology, but on the quality of pedagogical design underpinning its production.

Interactive videos also hold significant potential for improving educational access and inclusion. In schools with limited resources, large mixed-ability classrooms or inconsistent internet access, well-designed videos can function as reusable and adaptable learning resources. They may be distributed for repeated use, shared across different classes or accessed offline where necessary. For students in rural or underserved areas, this flexibility can help ensure continuity of learning despite infrastructural constraints. For teachers, it offers a scalable way to maintain instructional consistency while still supporting learner diversity. For these reasons, interactive videos should not be understood merely as technological innovations or classroom trends. Rather, they represent a pedagogically grounded medium through which teaching can become more participatory, flexible and inclusive in contemporary secondary education.

Research Objectives

This study was conducted with the following objectives:

1. To explore how interactive video editing supports student engagement, motivation and conceptual understanding in the teaching and learning of Science and Visual Arts at the secondary school level.
2. To examine how selected interactive video elements contribute to active learning, self-regulation and creativity among students.
3. To investigate teachers' pedagogical experiences and the challenges associated with implementing interactive video editing in classroom instruction, particularly in under-resourced rural secondary school contexts.

Problem Statement

Despite the rapid expansion of digital technologies in education, student engagement remains a persistent challenge, particularly at the secondary school level, where conventional teaching approaches may not fully respond to the learning preferences of digitally oriented students. In many classrooms, video content is increasingly used to support teaching and learning. However, its use often remains passive, linear and insufficiently grounded in pedagogical design. As a result, the educational potential of video is frequently underutilised, particularly in relation to student motivation, conceptual understanding and self-directed learning.

Existing studies have largely examined digital platforms, online delivery modes or general forms of multimedia integration, while giving comparatively limited attention to the pedagogical role of video editing strategies. Elements such as content segmentation, interactive layering, narrative voice integration and adaptive branching structures may influence how students engage with and interpret learning content, yet these features remain underexplored in many classroom-based studies. This gap is especially relevant in subjects such as Science and Visual Arts, which require not only conceptual understanding but also inquiry, interpretation and creative expression. In the absence of well-designed and interactive video materials, opportunities for deeper and more meaningful learning may be constrained.

The issue becomes more pronounced in rural and under-resourced schools, where limitations in digital infrastructure and teacher preparedness continue to affect the quality of technology integration. Available reports have indicated uneven access to stable internet connectivity, digital tools and professional training in digital pedagogy across schools, particularly in rural contexts (KPM, 2023). These conditions may restrict teachers' ability to design and implement interactive instructional videos effectively. As a result, the gap between the pedagogical potential of digital technologies and their actual classroom use remains significant, especially in contexts where such tools could provide substantial educational benefit.

In response to these challenges, there is a need for context-sensitive research that examines how interactive video editing can be meaningfully integrated into classroom practice. This includes not only the use of emerging technologies such as Artificial Intelligence (AI) and Augmented Reality (AR), but also the pedagogical strategies that shape how such tools are applied to support learning. Accordingly, this study addresses an important gap in the literature by investigating how interactive video editing functions as a learner-centred pedagogical approach in real secondary school settings, with particular attention to its role in enhancing student engagement, motivation and understanding.

Literature Review

The use of video in education is well established and has long been recognised as a means of presenting abstract concepts in more accessible and visually meaningful ways. However, recent developments in digital pedagogy suggest a shift from using video merely as a content delivery tool towards employing it as an interactive and pedagogically structured learning resource. This shift is particularly relevant in secondary education, where students are increasingly exposed to digital and multimodal forms of communication in their everyday lives. In this context, interactive video editing has emerged as a promising approach for supporting learner engagement, conceptual understanding and creative participation. This literature review examines the role of interactive video editing in secondary education, with particular attention to Science and Visual Arts, where both cognitive processing and creative expression are central to learning.

Multimedia Learning and Cognitive Engagement

The Cognitive Theory of Multimedia Learning, proposed by Mayer, provides an important theoretical foundation for understanding how students learn through multimedia environments. According to this theory, meaningful learning occurs when learners actively process information through both verbal and visual channels, provided that instructional materials are organised in ways that reduce unnecessary cognitive load (Mayer, 2019; Mayer, 2024). Key principles such as segmentation, signalling, coherence and redundancy reduction are particularly relevant in the design of educational videos. These principles suggest that multimedia materials should be carefully structured so that learners can attend to essential information, integrate visual and verbal representations and construct coherent mental models. In subjects such as Science and Visual Arts, where students often encounter abstract processes, symbolic representations or layered meanings, such design considerations are especially important for facilitating understanding.

Recent scholarship further indicates that the effectiveness of multimedia instruction depends not simply on the inclusion of audio-visual elements, but on the pedagogical quality of their design. Poorly designed instructional videos, including those characterised by excessive on-screen text, rapid narration or irrelevant visual effects, may increase cognitive overload and reduce learning efficiency. In contrast, concise and well-segmented videos supported by aligned narration and meaningful visual cues are more likely to promote comprehension and retention (Bland, Guo, & Dousay, 2024). This perspective reinforces the argument that multimedia should not be treated as a decorative supplement to instruction, but as a pedagogical medium whose design directly shapes the quality of learning. It also highlights the importance of video editing strategies as instructional decisions rather than merely technical processes.

Despite the growing recognition of multimedia's educational value, many studies continue to focus on the use of platforms or broad categories of digital content rather than on the pedagogical design features embedded within video materials. Comparatively less attention has been given to how editing strategies such as pacing, sequencing, transition planning and segmentation influence student engagement and learning outcomes. Although Mayer's framework offers useful theoretical guidance, its application in real classroom contexts, especially in under-resourced secondary school settings, remains insufficiently examined. This limitation is particularly significant in contexts where teachers must adapt multimedia principles to diverse learners, varying levels of digital literacy and practical classroom constraints. Greater attention is therefore needed to understand how multimedia design principles can be translated into context-sensitive instructional practice (Noetel et al., 2021; Farida and Clark, 2025).

Interactivity as a Catalyst for Student Engagement

Interactivity has been widely identified as a central feature of effective digital learning environments because it encourages active learner participation rather than passive content consumption. Anderson (2021) argues that interactive learning tools can enhance engagement by prompting students to respond, reflect and make decisions during the learning process. Platforms such as Edpuzzle and H5P allow teachers to embed questions, polls and branching activities directly into instructional videos, thereby increasing opportunities for active cognitive processing. Rather than simply watching a video from beginning to end, students are required to interpret information, respond to prompts and monitor their understanding as they progress through the material. These features also support formative assessment by enabling teachers to gather ongoing evidence of student understanding and adjust instruction when necessary.

Within the Malaysian context, research has also shown positive associations between interactive digital materials and student motivation and performance. Mohd Faizal Abdul Halim (2019), for example, reported that students exposed to interactive learning materials demonstrated higher levels of enthusiasm and stronger academic performance than those taught through conventional approaches. The inclusion of immediate feedback, embedded questioning and gamified elements appeared to contribute to stronger intrinsic motivation and more sustained participation. Taken together, these studies suggest that interactivity may support multiple dimensions of learning, including behavioural engagement, cognitive processing and motivational development. However, the emphasis of existing research varies, with some studies focusing on emotional and participatory aspects of engagement, while others emphasise achievement-related outcomes.

Although the value of interactivity is widely acknowledged, much of the literature tends to examine interactive features as isolated variables rather than as elements embedded within broader instructional design. In many cases, the focus is placed on whether a quiz, hyperlink or clickable prompt is present, without sufficient consideration of how video editing choices shape the overall learning experience. Features such as pacing, voice-over design, narrative structuring and transitions may significantly influence learner attention, reflection and metacognitive regulation, yet these aspects remain comparatively underexplored (Rosalis & De Oliveira, 2023). As a result, an important gap persists between research on technology-enabled interactivity and research on pedagogically intentional video design. Addressing this gap is essential for understanding not only what students do during video-based learning, but also how the structure of the video itself influences motivation, engagement and knowledge construction.

Application in Science and Visual Arts

In Science education, interactive video has become an important resource for representing processes and phenomena that are difficult to explain through static text or conventional classroom demonstration alone. Scientific concepts such as chemical reactions, cell division or motion often require learners to visualise sequences, relationships and invisible processes. Interactive science videos can support this need by combining animation, narration, embedded questions and pause-and-reflect features that guide learners through complex content in manageable stages. Ramasany et al. (2022) reported that students who used interactive science videos demonstrated stronger comprehension and improved performance compared with peers taught through more conventional methods. These findings suggest that interactive video may support conceptual clarity by enabling students to observe processes dynamically while engaging actively with the content.

In Visual Arts education, the pedagogical role of video differs but remains equally significant. Rather than serving primarily as an explanatory tool, video in this context can function as a medium for reflection, documentation and creative expression. Buruntong et al. (2025), through the ARTSCreaSTEAM module, demonstrated how structured video documentation can encourage students to record their artistic processes, explain their decisions and reflect on the meanings embedded in their work. This type of multimodal documentation allows learners to articulate their creative development in ways that static portfolios may not fully capture. It also supports metacognitive awareness by encouraging students to think critically about their choices, processes and outcomes. In addition, video editing activities may strengthen digital literacy and collaborative learning, particularly when students work together to shape visual narratives and communicate artistic intention.

Across both disciplines, interactive video demonstrates considerable pedagogical flexibility. In Science, it functions primarily as a cognitive scaffold that supports explanation, visualisation and conceptual understanding. In Visual Arts, it serves more strongly as an expressive and reflective platform that enables students to externalise and evaluate their creative processes. Despite these differences, both applications illustrate how interactive video can support learner autonomy, active engagement and more meaningful participation in learning. This cross-disciplinary adaptability suggests that interactive video has value not only as a delivery medium, but also as a pedagogical strategy capable of connecting cognitive, affective and creative dimensions of learning. Even so, more empirical research is needed to examine how

these approaches influence longer-term learning outcomes, particularly when students are positioned as both consumers and producers of digital content (Tugirinshuti, Mugabo, & Banuza, 2021).

AI and AR in Video-Based Learning

Recent developments in artificial intelligence (AI) and augmented reality (AR) have expanded the possibilities of video-based learning, particularly in relation to content production, personalisation and visual enhancement. AI-powered tools such as Runway and Descript have made video creation more accessible by automating processes such as editing, transcription, subtitle generation and voice-over production (Runway Research, 2023). These tools may reduce technical barriers for teachers, especially those without formal training in media production and thus broaden access to more polished and adaptable multimedia resources. From a practical perspective, AI tools may also save time and enable teachers to focus more on instructional planning. However, the increasing availability of such tools does not automatically guarantee pedagogical effectiveness. The educational value of AI-supported video production depends on whether these tools are used to support clear learning goals, meaningful interaction and learner-centred design.

AR-based features, including green screen simulations and layered visual environments, have also gained attention for their capacity to enhance contextual understanding and visual engagement. In science education, for example, green screen effects may allow teachers to demonstrate otherwise inaccessible environments or abstract phenomena in more concrete and immersive ways. Norhidayah Abd Halim (2021) found that the use of green screen features in science videos was associated with stronger student attention and improved comprehension. Such findings suggest that AR can enrich the representational quality of instructional materials, especially in areas requiring spatial or procedural understanding. Nevertheless, some current uses of AR remain largely surface-level, functioning more as visual novelty than as a tool for deeper cognitive engagement. This raises questions about how AR can be integrated more intentionally as part of pedagogical design rather than as an aesthetic add-on.

A recurring concern in the literature is that both AI and AR are often discussed from a tool-centred rather than a pedagogy-centred perspective. In many cases, emphasis is placed on what the technology can do, while less attention is given to how it should be designed and implemented to support differentiated instruction, self-regulated learning, creativity or inclusive participation. This issue becomes especially important in under-resourced settings, where limited infrastructure and uneven digital competence may constrain meaningful implementation. Without appropriate pedagogical frameworks and professional support, the potential of AI and AR may remain underutilised or inconsistently applied. There is therefore a need for research that moves beyond technological novelty to examine how these tools can be integrated in ways that strengthen learner agency, accessibility and instructional effectiveness (Bhatti et al., 2017).

Systemic Challenges in Implementation

The implementation of interactive video in education, particularly in rural Malaysian contexts, is shaped by both infrastructural limitations and teacher preparedness. Alias and Rahman (2021) identify teacher readiness as a significant barrier, noting that many educators in underserved areas have limited exposure to digital pedagogy and multimedia editing tools. At

the same time, Azizan and Hashim (2021) highlight persistent disparities in broadband access, showing that many rural schools continue to experience unstable or insufficient internet connectivity. When considered together, these findings indicate that the integration of interactive video cannot be addressed through technical training alone, nor through infrastructure development in isolation. Both pedagogical competence and technological access must be strengthened simultaneously if digital learning initiatives are to be implemented effectively and equitably.

Another systemic issue concerns the tendency of existing research to privilege technological platforms over the pedagogical logic of video editing itself. Although there is increasing interest in video-based learning, comparatively few studies examine how instructional design decisions such as content segmentation, narrative pacing, transition structure and visual emphasis shape student engagement and cognitive load. These features are not neutral production choices; rather, they influence how learners attend to, interpret and retain instructional content. Yet the pedagogical implications of editing strategies remain insufficiently theorised and underexplored, particularly in school-based settings. This limits current understanding of how interactive video can move beyond content delivery to support reflection, autonomy and deeper forms of engagement.

A further limitation in the literature is the relative lack of contextual studies at the secondary school level, particularly in authentic classroom settings involving subjects such as Science and Visual Arts. A considerable proportion of available studies have been conducted in higher education, pilot environments or controlled settings that do not fully reflect the realities of adolescent learners in school contexts. Challenges such as device limitations, uneven digital skills, curriculum demands, and classroom management constraints are often discussed only partially. In addition, although AI and AR are increasingly featured in educational discourse, their classroom integration is frequently described at a surface level, with insufficient attention to how they might support learner autonomy, differentiated pathways or inclusive design. Perhaps most importantly, student voice and creative ownership remain underrepresented in much of the literature, despite their relevance to metacognition, collaboration and digital fluency. These gaps indicate the need for more classroom-based and contextually grounded research that examines interactive video editing as both a pedagogical and practical strategy in secondary education (Noetel et al., 2021).

Methodology

This study employed a qualitative multiple-case study design to examine how interactive video editing was implemented in secondary school teaching and learning and how it influenced student engagement, motivation, conceptual understanding and creativity. The study was informed by a constructivist paradigm, which views learning as an active, socially situated process in which learners construct meaning through interaction, reflection and participation. This paradigm was considered appropriate because the study focused on classroom practices that involved collaborative learning, student-centred engagement and the pedagogical use of digital technologies. A qualitative approach was selected to generate rich, contextualised insights into authentic teaching and learning environments, particularly in relation to the use of emerging technologies in under-resourced school settings. Rather than seeking statistical generalisation, the study aimed to develop an in-depth understanding of teachers' instructional strategies, students' learning experiences and the classroom conditions that shaped the integration of interactive video editing. This methodological orientation enabled a nuanced

exploration of how interactive video editing supported learner participation, reflective learning and student agency across different subject contexts (McNiff & Whitehead, 2011).

Research Design

The study adopted a multiple-case study design involving two secondary school contexts in which interactive video editing was used in different ways within the teaching and learning process. A multiple-case study was considered appropriate because it allowed for in-depth investigation of a contemporary educational practice across more than one bounded context, while also enabling cross-case comparison. Each case was treated as a distinct bounded system defined by subject area, classroom practice, participant group and school context. The first case involved a Science classroom, in which the teacher used interactive experimental videos incorporating narration, embedded questions and visual overlays to support conceptual understanding. The second case involved a Visual Arts classroom, in which students produced structured video documentation of their creative processes as part of a Science, Technology, Engineering, Arts and Mathematics (STEAM)-oriented learning activity. The inclusion of these two cases enabled the study to examine how interactive video editing functioned across two different pedagogical contexts: one oriented towards conceptual explanation and scientific inquiry and the other towards creativity, reflection and artistic expression. Data were collected over a six-week period in order to capture classroom implementation, participant experiences and learning artefacts in each case (Ridder, 2014).

Conceptual Framework

The study was guided by a conceptual framework that integrated Mayer's Cognitive Theory of Multimedia Learning with selected 21st-century learning constructs, particularly student engagement, creativity and metacognitive development. Mayer's theory posits that meaningful learning occurs when learners process information through verbal and visual channels in ways that are cognitively manageable and instructionally structured. In the context of this study, interactive video editing was understood as a pedagogical strategy that could support these principles through features such as segmentation, annotation, narration and embedded interaction. These features may help reduce unnecessary cognitive load while supporting attention, retention and conceptual understanding.

The framework was also informed by the Technological Pedagogical Content Knowledge (TPACK) model, which emphasises the integration of technological tools, pedagogical approaches and subject content in effective teaching. This model was particularly relevant because the study examined not only the presence of digital tools, but also how teachers used them in pedagogically meaningful ways within specific disciplinary contexts. In the Visual Arts case, the conceptual framework also drew on the ARTSCreaSTEAM orientation to support the analysis of student creativity, self-expression and reflective documentation. Taken together, these perspectives provided a basis for examining how interactive video editing supported learner-centred pedagogy while also taking into account contextual factors such as teacher readiness, digital infrastructure and student agency.

Participants and Sampling

Participants in this study consisted of teachers and students from two government secondary schools located in rural districts in Malaysia. Purposive sampling was used to select

participants and cases that were directly relevant to the focus of the study. The schools were selected based on several criteria: their location in under-resourced rural settings, the availability of basic digital facilities such as computers or mobile devices, the teachers' willingness to implement interactive video-based instruction and the relevance of the selected subjects to the study objectives. This sampling strategy was appropriate because it enabled the researcher to obtain information-rich cases that could provide detailed insight into the implementation of interactive video editing in authentic classroom settings.

The first case involved two Science teachers and 20 Form Four students, while the second case involved one Visual Arts teacher and 15 Form Four students. Teachers were selected based on their subject specialisation, teaching responsibilities and prior exposure to digital instructional tools. Students were selected based on their participation in the classroom activities and the provision of parental consent and student assent. The participant group included individuals with different levels of digital familiarity and learning ability, enabling the study to capture a range of experiences and perspectives. This composition supported a contextually grounded understanding of how interactive video editing was implemented and experienced by both teachers and students across the two cases.

Sample Size

The total sample comprised three teachers and 35 students, which was considered appropriate for an in-depth qualitative case study. In qualitative inquiry, sample adequacy is determined not by statistical representativeness but by the extent to which the sample can generate rich, meaningful and contextually relevant data. The relatively small sample size enabled prolonged engagement with participants, detailed classroom observation and close examination of instructional artefacts and participant reflections. In the Science case, the instructional intervention was implemented across five lessons involving 20 students, while in the Visual Arts case, 15 students participated in a structured video documentation project conducted over four weeks. The sample size was therefore sufficient to support thematic depth, cross-case comparison and triangulation across multiple data sources. Although the findings are not intended to be statistically generalisable, they provide transferable insights into the pedagogical use of interactive video editing in similar secondary school contexts.

Research Instruments

Multiple qualitative instruments were employed to ensure data richness and methodological credibility. The primary instrument was a semi-structured interview protocol used to explore teachers' pedagogical experiences, instructional intentions, perceived benefits and implementation challenges in relation to interactive video editing. Interview questions were developed around key themes aligned with the study objectives, including student engagement, motivation, learning support, classroom practice and digital challenges. In addition, student focus group discussion guides were prepared to facilitate shared reflection on students' learning experiences with the interactive videos and video-editing activities (Priya, 2020).

To complement the interview data, the study also utilised document analysis templates to examine lesson plans, teaching materials and student-produced video artefacts. Student reflective responses were collected to capture individual perceptions of learning, participation and self-regulation during the activities. A performance assessment rubric, developed in relation to selected 21st-century skills such as creativity, collaboration, communication and

metacognitive awareness, was used to assess relevant aspects of student performance. The rubric was refined in consultation with participating teachers to ensure contextual appropriateness and alignment with classroom expectations. In addition, a classroom observation checklist was used during implementation to record behavioural indicators of engagement, interaction patterns and the ways students responded to the instructional videos. Collectively, these instruments enabled the researcher to capture multiple dimensions of the teaching and learning process, from instructional planning and classroom enactment to student reflection and learning outcomes.

Data Collection Procedure

Data were collected over a period of six weeks across the two case study sites. During the initial stage, meetings were held with school administrators and participating teachers to obtain institutional approval, explain the study procedures and coordinate the implementation schedule. Consent and assent procedures were also completed at this stage. Preliminary support was provided to teachers in relation to the selected digital tools, including platforms such as Ed puzzle, Cap Cut and Canva Video, in order to ensure that the classroom activities could be implemented as planned.

During the implementation phase, the Science teacher conducted five lessons using interactive videos that incorporated narration, embedded questions, animations and visual prompts. In the Visual Arts case, students participated in a structured video documentation activity in which they recorded and edited aspects of their creative process using mobile editing applications. Throughout this period, the researcher conducted non-participant classroom observations and recorded field notes focusing on student engagement, classroom interaction and the pedagogical use of the video materials. By the end of the implementation stage, relevant teaching materials, student video artefacts and observation records had been collected. In the final phase, teacher interviews, student focus group discussions and student reflective responses were conducted and compiled. Member checking was subsequently carried out to verify selected interpretations and enhance the trustworthiness of the findings. All data were transcribed, organised, anonymised and stored securely for analysis.

Data Analysis and Analytical Techniques

The qualitative data were analysed using thematic analysis, guided by the six-phase framework proposed by Braun and Clarke (2006). This analytic approach was selected because it allowed for the systematic identification, organisation and interpretation of recurring patterns across multiple qualitative data sources. The analysis began with repeated reading of interview transcripts, focus group responses, reflective texts, observation notes and relevant documents in order to develop familiarity with the dataset. Initial codes were then generated to capture meaningful features related to student engagement, motivation, conceptual understanding, creativity, teacher practice and implementation challenges.

Following the initial coding stage, related codes were reviewed and grouped into broader themes that reflected patterns within and across the two cases. The coding process was supported by NVivo 12, which facilitated data organisation and retrieval. The thematic analysis was informed both inductively, through patterns emerging from the data and deductively, through sensitising concepts derived from the conceptual framework and selected 21st-century learning constructs. This allowed the analysis to remain grounded in participant perspectives

while also attending to theoretically relevant dimensions such as multimedia learning, learner-centred pedagogy and metacognitive development. A cross-case analysis was then conducted to identify commonalities and differences between the Science and Visual Arts contexts. This process enabled the researcher to generate a more nuanced interpretation of how interactive video editing functioned across different disciplinary and pedagogical settings.

Data Triangulation and Trustworthiness

To enhance the credibility and trustworthiness of the study, methodological triangulation was employed through the use of multiple data sources, including teacher interviews, student focus group discussions, classroom observations, student reflections, document analysis and performance assessment records. Each source provided a different perspective on the phenomenon under investigation. Teacher interviews offered insight into instructional planning and pedagogical intention, student discussions and reflections revealed learner experiences and perceptions, classroom observations captured behavioural and interactional evidence and artefacts provided documentation of actual classroom outputs. The convergence of these sources enabled the researcher to confirm recurring themes, identify discrepancies and develop a more robust interpretation of the findings (Lavarda & Bellucci, 2022).

Several additional strategies were also used to strengthen trustworthiness. Member checking was conducted by sharing selected findings or interpretations with participants for verification. Peer debriefing was used during the analysis process to review the coding and thematic development. The researcher also maintained reflective memos to document analytic decisions, emerging interpretations and possible sources of bias throughout the study. These procedures contributed to the overall dependability, credibility and confirmability of the analysis.

Ethical Considerations

This study adhered to established ethical procedures to protect the rights, dignity and wellbeing of all participants. Ethical approval was obtained from the relevant university research ethics committee, together with formal permission from the Ministry of Education Malaysia and the relevant educational authorities. Because the study involved school students, informed consent was obtained from teachers and parents or guardians, while student assent was also secured to ensure voluntary participation. Participants were provided with clear and age-appropriate explanations of the study purpose, procedures and their right to withdraw at any point without penalty.

To preserve confidentiality, pseudonyms were assigned to schools, teachers and students in all transcripts, notes and reports. All data, including interview recordings, classroom observation records, student reflections and video artefacts, were anonymised and stored securely. Access to raw data was restricted to the researcher and supervisory team. Where classroom recordings were involved, additional care was taken to ensure that students' privacy and dignity were protected throughout the data collection and reporting process. Digital tools used during the study were selected with attention to data protection and child privacy considerations. These procedures were implemented to ensure that the research was conducted responsibly and ethically within a digitally mediated classroom context involving minors (Yanto, 2023).

Findings

This study explored how interactive video editing supported student engagement, conceptual understanding, creativity and reflective learning among secondary school students in rural educational contexts. The findings are organised according to the two case studies examined in this research, namely Science and Visual Arts. Across both cases, thematic analysis of teacher interviews, student focus group discussions, classroom observations, reflective responses and performance-related artefacts generated several recurring themes. These themes highlight how interactive video editing functioned not only as a technological tool, but also as a pedagogical strategy that shaped student participation, teacher practice and classroom learning processes. The findings from each case are presented below.

Case Study 1: Enhancing Science Learning through Interactive Videos

The first case study focused on a rural secondary school Science classroom in which interactive video editing was implemented over five weeks as part of instructional delivery. The teacher designed and used videos containing embedded quizzes, AI-generated narration, green screen simulations, animations and on-screen annotations to support the teaching of chemical reactions and Newtonian physics. Analysis of the data produced five main themes: (1) student engagement and active learning behaviours, (2) visualisation of abstract scientific concepts, (3) teacher instructional adaptation, (4) student confidence and emerging autonomy and (5) implementation challenges in a low-resource setting.

Student Engagement and Active Learning Behaviors

A key finding from the Science case was the increase in observable student engagement following the integration of interactive videos into classroom instruction. Classroom observations showed that students were more attentive during lessons and interacted with the learning materials more actively than during conventional teacher-led delivery. They paused videos to write notes, replayed sections to clarify understanding and discussed quiz questions with peers during the lesson. These behaviours suggested a shift from passive reception of content to more active participation in the learning process.

Students also appeared more willing to revisit difficult content independently, especially when videos were segmented into shorter and more manageable parts. This structure enabled students to focus on one concept at a time and appeared particularly helpful for learners who required additional support. Focus group data further indicated that students appreciated the opportunity to learn at their own pace, as the interactive format reduced pressure and allowed repeated viewing when needed (Gambari, Yaki, Gana, & Ughovwa, 2014). Overall, interactive video emerged as a powerful tool for enhancing student focus, participation and ownership of learning, particularly in rural secondary school contexts (Figure 1).

Student Behavioral Aspect	Before (Traditional Method)	After (Interactive Video Integration)
Level of Focus and Attention	Low (drowsy, passive behavior)	High (focused attention, responsive behavior)
Note-Taking Habits	Minimal or none	Actively taking notes while the video plays
Student Interaction	Limited peer interaction	Actively helping each other with in-video quiz questions
Content Repetition/Replaying	Rarely or never revisited content	Frequently replayed difficult sections for better understanding
Self-Directed Learning	Low motivation and autonomy	Increased autonomy, self-paced learning, and personal initiative

Figure 1: Comparison of Student Behaviors Before and After Integration of Interactive Videos

Visualization of Abstract Scientific Concepts

Another major finding concerned the role of interactive video in supporting students' understanding of abstract scientific concepts. The teacher used green screen overlays, animated diagrams and visual simulations to explain content that was otherwise difficult to demonstrate through conventional methods, particularly in a rural school context with limited laboratory access. These visual elements helped students observe processes such as chemical reactions and motion in more concrete and accessible ways.

Interview data from the teacher indicated that students responded more positively to visual explanations than to text-based teaching alone. Students were able to observe representations of invisible or complex phenomena, which appeared to strengthen their understanding of scientific processes and relationships. The inclusion of AI-generated voiceovers and subtitles also supported learners with different levels of reading proficiency and language ability. This suggests that interactive video served as an important instructional scaffold by making complex scientific content more understandable and inclusive.

The teacher reflected:

"...The green screen made my lesson come alive. My students were so engaged; they kept asking to replay the reaction animation..."

(ST1/W3/12/10/2025)

Moreover, the use of AI-generated voiceovers and automated subtitles ensured that students of varying reading proficiency and learning styles could follow along confidently. This inclusive design was particularly beneficial to lower-performing students and English as Second Language (ESL) learners who often struggle with textbook-heavy instruction. The visualization strategies helped scaffold their understanding while reducing reliance on rote memorization. In essence, interactive video not only supplemented content delivery but functioned as a surrogate lab making high-level scientific content more accessible, engaging and meaningful for learners in a low-resource environment (Figure 2).

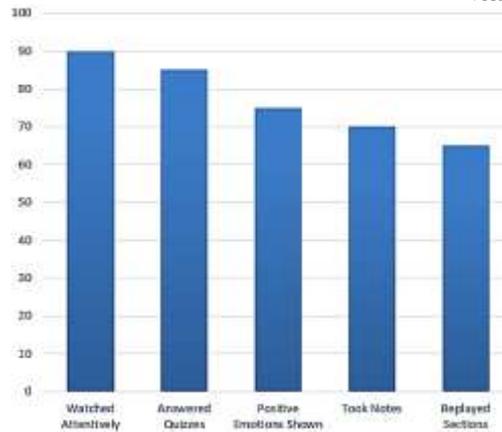


Figure 2: Student Engagement Levels During Interactive Science Video Lessons

Teacher's Experience and Instructional Adaptation

The findings also revealed that the use of interactive video editing influenced the teacher's instructional planning and classroom practice. The teacher reported that creating the videos initially required more preparation time than conventional teaching materials. However, this additional effort was viewed as worthwhile because it allowed lessons to be designed more deliberately and aligned more closely with specific learning objectives. The teacher had greater control over pacing, sequencing, visual explanation and the placement of formative questions within the lesson. Embedded quizzes were particularly useful because they enabled the teacher to monitor student understanding during the lesson and identify misconceptions more quickly. The teacher also noted that the visual and interactive features of the videos improved confidence in explaining difficult concepts. Over time, the teacher became more comfortable with the technology and expressed interest in using interactive videos more regularly in future teaching.

The teacher reflected:

"...At first it took time, but once I saw how students responded, I wanted to use it more..."

"...Using visuals helped me explain things like Newton's laws better than just talking..."

"...Quizzes inside the videos helped me know if they were following or not..."

(ST2/W3/12/10/2025)

This enabled more responsive teaching, as misconceptions could be addressed during or immediately after the video session. The teacher also reported feeling more confident in explaining complex topics with the support of visual cues and simulations. Interestingly, video editing also prompted the teacher to reflect more deeply on pedagogical strategies, leading to better sequencing of content and clearer explanations. Although initial technical training was required, the process became easier over time and the teacher expressed interest in integrating such methods more regularly. Overall, the case reveals how interactive video tools can empower teachers as instructional designers, capable of crafting customized, student-centered learning experiences even within infrastructural limitations. Table 1 below shows the summary of teacher insights on instructional adaptation using interactive videos.

Table 1: Summary of Teacher Insights on Instructional Adaptation Using Interactive Videos

Theme	Description / Teacher Insight
Increased Planning Effort	Creating videos required more initial time and technical effort than slides or worksheets.
Greater Pedagogical Control	Able to customize pacing, visuals and narration to align with lesson objectives.
Embedded Assessment Benefits	In-video quizzes helped gauge student understanding and correct misconceptions in real time.
Improved Concept Explanation	Visuals, animations and narration made it easier to teach complex concepts.
Reflection on Teaching Practice	Video planning led to better content sequencing and deeper thinking about pedagogy.
Professional Growth	Teachers gained confidence over time and expressed interest to continue using videos regularly.

Student Voice, Confidence and Emerging Autonomy

The Science case also demonstrated that interactive video supported the development of student confidence and autonomy. Focus group discussions showed that students found the lessons more engaging and easier to follow than conventional note-based instruction. Several students explained that being able to pause and replay the videos allowed them to understand content privately before contributing in class. This appeared especially beneficial for students who were usually less confident during live classroom interaction.

Evidence of emerging autonomy was also observed when some students independently used mobile editing applications to create their own revision videos and recorded summaries. Although this was not a formal requirement of the lesson, it indicated that students were beginning to transfer the video-based learning approach into their own study practices. This suggests that interactive video may support not only classroom engagement, but also students' sense of ownership over their learning.

Students commented:

"...I feel more confident when I can rewatch the video before I speak in class...."

"...It's not boring like notes. It's like watching something real..."

"...I made a video of my own to help me revise. I even put voiceover like in class..."

(S2/W6/28/10/2025)

Further reinforcing this shift, several students independently explored mobile video editing apps, creating their own revision videos and content summaries using screen recordings and voice narration. This unprompted behavior reflects a growing sense of student agency and creativity key competencies in 21st-century learning. By engaging in content creation, students moved beyond passive consumption, taking ownership of their learning process and

constructing knowledge through multimodal expression, combining visuals, spoken language and text.

These practices are particularly significant in educational settings where pedagogy has traditionally cast students as passive recipients rather than active producers of knowledge. By giving learners the opportunity to design and narrate their own learning artifacts, they became more deeply engaged with the subject matter, reinforcing their understanding while also cultivating essential digital literacy skills. As highlighted by Stanković, Maksimović and Osmanović (2018), this shift marks a redefinition of the learner's role from a passive observer to a confident, creative participant in a digital learning environment. This transformation was clearly reflected in students' feedback and behaviors during the study. Table 2 summarizes the key themes that emerged from classroom observations and focus group discussions, capturing how interactive video integration supported students' confidence, autonomy and evolving learner identity.

Table 2. Summary of Key Student Themes and Observations from Interactive Video Integration

Theme	Student Feedback / Observations
Increased Confidence	Students felt more prepared for discussions after watching videos privately.
Self-Paced Learning Benefits	Students preferred being able to pause and replay content as needed.
Safe Learning Environment	Video format reduced anxiety in asking questions during live sessions.
Emergent Creativity	Some students created their own video summaries and screen recordings.
Ownership of Learning	Students expressed that they “felt like teachers” while narrating their own revision videos.
Shift in Student Identity	Learners began to view themselves as content creators, not just consumers.

Limitations and Challenges Observed

Despite the positive outcomes, several implementation challenges were identified. Unequal access to personal devices limited some students' ability to review the videos outside school hours. In addition, unstable internet connectivity occasionally disrupted access to video materials, particularly in situations where downloading or streaming was required. A small number of students also required support in using video controls and responding to embedded activities, indicating variation in digital literacy levels. From the teacher's perspective, the production of interactive videos required additional time, technical skills and planning. This may present a challenge for wider implementation if schools do not provide sufficient professional development or institutional support. Some students also reported fatigue when videos were too long, highlighting the need for careful attention to pacing and duration. These findings suggest that while interactive video has strong pedagogical potential, its successful use depends on adequate infrastructure, digital support and thoughtful instructional design. Table 3 presents a summary of the main challenges encountered during the implementation process.

Table 3: Summary of Challenges Encountered During Implementation of Interactive Video in Rural Classrooms

Theme / Challenge	Observation / Description	Proposed Solution
Access to Devices	Not all students had personal devices; some relied on shared school computers.	Provide loan devices or increase access to digital labs.
Internet Connectivity	Unstable connections hindered video streaming, especially high-res files.	Pre-download content or use compressed formats.
Digital Literacy Gaps	Some students struggled with video navigation and quizzes.	Include digital skills training as part of onboarding.
Teacher Time & Technical Demands	Teachers needed extra time and skills to produce videos.	Offer professional development & admin support.
Cognitive Fatigue	A few students reported long videos felt tiring.	Keep videos concise; apply chunking and pausing techniques.

Case Study 2: Promoting Creativity and Reflection in Visual Arts through Interactive Video

The second case study examined the use of interactive video editing in a secondary school Visual Arts classroom. In this case, students used applications such as CapCut, Canva Video and InShot to document and present their artistic processes through structured video projects. The activity was aligned with the ARTSCreaSTEAM approach and emphasised creativity, reflection and multimodal communication. Analysis of the data generated five themes: (1) creative expression through video storytelling, (2) metacognitive development through reflective practice, (3) student motivation and collaboration, (4) the teacher's facilitative role and (5) implementation challenges.

Encouraging Creative Expression through Video Storytelling

A major finding from the Visual Arts case was that video editing functioned as a medium for creative expression and personal storytelling. Students were required to produce short videos documenting their artistic process from idea development to final artwork, while including reflections, narration, music and transitions. This enabled them to represent not only the final product but also the thinking and decision-making behind their work. Classroom observations showed that students were highly engaged in selecting clips, arranging sequences, adding audio and refining how their ideas were communicated. The multimodal nature of the task appeared to provide an alternative avenue of expression, particularly for students who were less comfortable communicating through writing or speaking alone. Through the combination of visuals, audio, timing and narrative structure, students were able to communicate their ideas in more personal and imaginative ways. This finding suggests that interactive video can extend the expressive possibilities of Visual Arts learning beyond traditional forms of documentation.

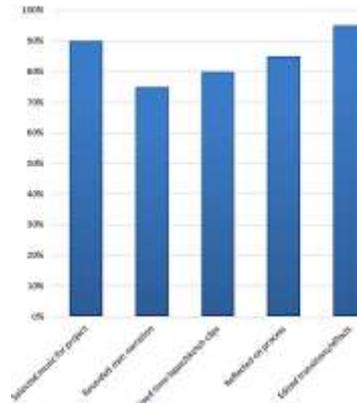


Figure 3: Participation in Creative Video Project

Figure 3 illustrates student participation in the creative video project, where learners were encouraged to use mobile-friendly editing apps such as CapCut, Canva Video and InShot. These tools provided an accessible and intuitive platform for creative expression, enabling students to independently explore video editing techniques. Classroom observations showed that students were deeply engaged in the process selecting background music, sequencing video clips and narrating their thoughts with evident enthusiasm and care. Unlike traditional Visual Arts projects that focus primarily on the final artwork, this video-based approach emphasized the creative journey, allowing students to express the intentions and reflections behind each artistic decision.

The process encouraged self-expression, critical thinking and personal storytelling, making learning more meaningful and student-centered (Buruntong et al., 2025). This method offered an alternative communication channel, particularly beneficial for students who found it difficult to express ideas verbally. Through the multimodal format of video combining visuals, audio, pacing and design students were able to articulate meaning in a more personal and imaginative way. The experience transformed learners into designers of their own learning journey, promoting ownership originality and deeper engagement. Table 4 presents a summary of the creative tools and processes used during this project.

Table 4: Creative Processes and Tools Used

Aspect of Creative Process	Observation / Student Action	Tools Used
Brainstorming & Idea Generation	Students recorded video logs explaining concepts and inspirations	Smartphone camera, CapCut
Visual Composition & Sketching	Time-lapse clips of sketching process were included	InShot, Canva Video
Audio & Music Integration	Students selected background music to enhance mood and tone	CapCut, royalty-free music
Reflection & Verbal Narration	Embedded voiceovers to explain choices and artistic intention	Voice recording tools
Editing & Storyboarding	Students sequenced clips to show process from start to finish	CapCut, Canva
Presentation & Sharing	Final videos presented to class; peer feedback gathered	YouTube (unlisted), Google Drive

Developing Metacognition through Reflective Video Practice

Another important finding was the role of video production in supporting metacognitive development. Students were required to explain their choices of materials, colour, technique and design development while editing and narrating their videos. This process encouraged them to reflect more carefully on their own artistic decisions and on how their work changed over time. Rather than simply describing what they produced, students were prompted to articulate why certain decisions were made and how their ideas evolved. Several students reported that narrating their process helped them notice weaknesses in their planning and identify ways to improve their work. The teacher similarly observed that students became better able to explain their artistic intention when using video than through conventional written reflections. This suggests that reflective video practice may serve as a useful pedagogical tool for making artistic thinking more visible and assessable.

A student explained:

“...When I explained my ideas on camera, I realized I didn’t plan some things well. So I changed it and improved my design...”

“...Talking through the process helped me notice things I didn’t think about before....”

“...I never wrote reflections this well, but speaking while editing felt easier...”

(S8/W4/18/10/2025)

These moments of self-correction and intentional planning demonstrated students' engagement in higher-order thinking skills, such as analysis, evaluation and reflection core components of 21st-century learning. The teacher observed a marked improvement in students' ability to articulate their artistic intentions, a skill that had previously been difficult to assess through conventional means like written reflections or static visual displays. The integration of voiceovers and subtitles further empowered students with varying language proficiencies to express their ideas more confidently, allowing for inclusive participation. Rather than serving merely as a final product, the video functioned as a dynamic learning tool enabling self-assessment, critical reflection and deeper metacognitive engagement. As noted by Cavanagh and Kiersch (2022), this approach effectively bridges the gap between process and product, enriching learning in Visual Arts through multimodal representation and learner agency.

Student Motivation and Collaboration in the Creative Process

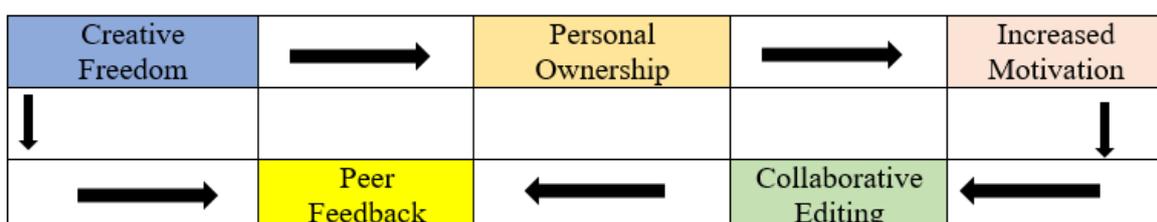


Figure 4: Motivation and Collaboration Cycle

Figure 4 illustrates the Motivation and Collaboration Cycle that emerged during the interactive video assignment. The Visual Arts project also appeared to strengthen student motivation and collaboration. Focus group data indicated that students enjoyed the opportunity to personalise their videos through music, visual style and presentation choices. Many described the project as different from ordinary classroom tasks and appreciated the opportunity to communicate their identity and ideas through digital media. This sense of personal investment appeared to increase effort, attention to detail and commitment to the task. Classroom observations also showed that students frequently supported one another during the editing process. They worked in informal pairs or small groups to solve technical problems, review each other's voiceovers and suggest improvements to sequencing or design. In some cases, students who were usually quiet in class took on leadership roles by helping peers use the editing applications. These patterns suggest that interactive video editing may encourage both intrinsic motivation and collaborative learning, particularly in creative subject areas.

Observation data indicated:

"...Several students who were typically quiet took the lead in helping their peers use the editing apps..."

"...Students were seen laughing and replaying their own videos, proud of how their ideas came to life through music and narration..."

(OB8/W4/18/10/2025)

Moreover, the use of interactive video editing fostered a more collaborative classroom environment, where students frequently worked in informal pairs or groups to assist one another with editing software, provide feedback on voiceovers and troubleshoot technical issues. This peer learning dynamic not only enhanced students' technical skills but also strengthened social interaction and classroom relationships (Bland, Guo, & Dousay, 2024). The teacher observed that students who were typically quiet or disengaged became more active participants, with some even stepping into leadership roles by guiding their peers through the creative process. The task of producing a final video product added a sense of real-world purpose and authenticity to the assignment, which in turn increased students' motivation to revise, refine and take ownership of their work (Buruntong & Kindoyop, 2024). These observations suggest that interactive video editing can be a powerful catalyst for promoting both intrinsic motivation and collaborative learning, particularly in creative disciplines such as Visual Arts.

Teacher's Role in Facilitating Digital Art Integration

The teacher's role in this case was facilitative rather than directive. After becoming familiar with basic editing tools, the teacher structured the project around storyboarding, reflection prompts and creative guidance rather than step-by-step technical control. This created space for students to make decisions independently while still receiving support when required. The teacher reported that the project made student thinking more visible and provided a fuller understanding of how students developed their ideas over time. The teacher also noted that this approach prompted a reconsideration of assessment practices in Visual Arts. Rather than evaluating only the final artwork, the inclusion of video documentation made it possible to assess reflection, process, communication and creative intention more meaningfully. Although the teacher acknowledged that the project required additional support and preparation, the pedagogical value was considered significant.

The teacher stated:

“...I could finally see how students think, not just what they produce. The videos revealed their decision-making process clearly.”

“At first, learning the tools was challenging, but the way students responded made it worth the effort...”

“...This project changed how I think about assessment in art. Reflection matters as much as the final artwork...”

(IVS10/W4/18/10/2025)

During interviews, she emphasized that this project allowed her to see students' thought processes more clearly than traditional sketchbooks or essays ever had. She also noted the challenge of balancing curriculum demands with the flexibility required by project-based learning but acknowledged that the benefits in terms of student engagement and skill development outweighed the time investment. The project encouraged her to rethink how digital media could be incorporated into assessment, feedback and creative expression. Overall, the teacher's role evolved to become more adaptive, reflective and technologically responsive, demonstrating how professional growth can emerge when teachers embrace new tools aligned with pedagogical goals (Mayer, 2024).

Limitations and Challenges Observed

While the project was largely successful, several challenges were identified that need to be addressed to support the sustainable integration of interactive video in Visual Arts education. One major issue concerned device availability, as not all students had access to smartphones with sufficient storage capacity or battery life for video editing. As a result, some students had to rely on a limited number of shared tablets provided by the school during classroom sessions. Inconsistent internet access also affected students' ability to upload, preview or revise their work outside the classroom. In addition, although many students were familiar with mobile applications, several required explicit guidance in basic editing functions such as trimming clips, adding transitions and adjusting audio.

The implementation of interactive video projects also required considerable time and sustained teacher support, particularly during the planning and facilitation stages. Another key challenge involved assessment, as evaluation extended beyond the final artwork to include storytelling clarity, depth of reflection and technical execution. To address this, the teacher developed a rubric with clear criteria related to creativity, communication and effort in order to support a more holistic and transparent assessment process. Despite these challenges, feedback from both students and the teacher remained strongly positive, particularly in relation to the meaningful and engaging nature of the learning experience. These findings highlight the importance of institutional support, equitable access to digital devices and ongoing digital literacy development in sustaining interactive video-based practices across diverse school settings (Guckian et al., 2024). Table 5 summarises the key insights and practical implications derived from this case for future classroom implementation.

Table 5. Key Insights and Implications for Sustainable Implementation of Interactive Video Projects

Key Insight	Implication
Structural issues (devices/internet)	Require institutional resource support
Student readiness varies	Need for differentiated digital skills training
Project-based evaluation needs clarity	Rubrics and formative assessment models should be co-developed
Teacher support is critical	Time, training and flexibility needed for successful scaling

Cross-Case Summary of Findings

Across both case studies, several common patterns emerged. First, interactive video editing appeared to increase student engagement by making learning more active, visual and participatory. Second, it supported different forms of understanding depending on the subject context: in Science, it strengthened conceptual clarity through visualisation and guided explanation, while in Visual Arts, it supported creativity and reflective meaning-making. Third, both cases indicated that interactive video could foster student confidence, autonomy and learner participation when students were given opportunities to interact with or produce digital content. Finally, both contexts highlighted practical barriers related to infrastructure, digital access and teacher preparedness. These shared findings suggest that interactive video editing has strong pedagogical potential in secondary education, but its effectiveness depends on thoughtful design, contextual support and alignment with subject-specific learning goals.

Discussion

This section interprets the findings from the two case studies in relation to the research objectives and the conceptual framework underpinning the study. The discussion focuses on how interactive video editing functioned as a pedagogical strategy in supporting student engagement, conceptual understanding, creativity and reflective learning in secondary school classrooms. It also considers how these outcomes relate to Mayer's Cognitive Theory of Multimedia Learning, learner-centred pedagogy and the practical realities of implementation in under-resourced rural contexts. Although the Science and Visual Arts cases differed in disciplinary orientation, both demonstrated that interactive video editing could support more active, participatory and meaningful learning when implemented with clear pedagogical intent. At the same time, the discussion highlights the contextual constraints that shape the sustainability and wider adoption of such practices.

Interactive Video Editing and Student Engagement

One of the most consistent findings across the two cases was the role of interactive video editing in supporting student engagement. In the Science classroom, students demonstrated more active learning behaviours, including replaying content, responding to embedded questions and discussing ideas with peers. In the Visual Arts classroom, students were actively involved in planning, editing, narrating and revising their own creative documentation. These findings suggest that interactive video editing may support a shift from passive reception of information towards more active participation in the learning process (Buruntong et al., 2025).

This pattern is consistent with learner-centred pedagogical perspectives, which emphasise participation, autonomy and meaningful interaction with content. It also aligns with studies that have found interactivity to be an important factor in sustaining learner attention and encouraging active response during digital learning activities (Anderson, 2021). In this study, engagement did not appear to arise from technology alone, but from the way video was structured to require participation, reflection and repeated interaction. This indicates that the pedagogical value of interactive video lies not merely in its digital format, but in its capacity to create conditions for active learning.

Conceptual Understanding through Multimedia and Visualisation

The findings also suggest that interactive video editing supported conceptual understanding, particularly in the Science case, where students engaged with visual simulations, narration and segmented explanations of abstract concepts. This is closely aligned with Mayer's Cognitive Theory of Multimedia Learning, which proposes that learners understand content more effectively when verbal and visual information are presented in a well-structured and cognitively manageable way. In the present study, visual overlays, animations, subtitles and guided pacing appeared to help students process complex scientific ideas more clearly (Sareya et al., 2025).

The Visual Arts case extended this discussion in a different direction. Rather than supporting understanding of abstract scientific concepts, video editing enabled students to make sense of their own creative processes through multimodal reflection and narration. In both cases, video functioned as more than a delivery medium. It served as a cognitive support mechanism that enabled learners to organise information, interpret meaning and revisit ideas at their own pace. These findings support earlier research suggesting that multimedia learning is most effective when instructional design is carefully aligned with pedagogical goals rather than driven by technology alone (Bland, Guo, & Dousay, 2024).

Metacognition, Reflection and Student Agency

Another important contribution of the study concerns the role of interactive video editing in supporting metacognitive awareness, reflection and student agency. In the Visual Arts case, students used video narration and documentation to explain decisions, evaluate their progress and revise their thinking. In the Science case, students' repeated engagement with instructional videos, including replaying difficult sections and independently producing revision materials, suggested the emergence of self-monitoring and more autonomous learning behaviours. These patterns indicate that interactive video may support not only content engagement, but also students' awareness of how they learn (Pitler et al., 2012).

This finding is significant because it positions students not only as recipients of instructional content, but also as participants in knowledge construction. Such a shift is consistent with constructivist views of learning, in which understanding is developed through active meaning-making, reflection and interaction. It also reinforces the argument that digital pedagogies should create opportunities for student voice and ownership rather than merely increase exposure to content. In the Malaysian secondary school context, where teacher-directed approaches may still be common, this suggests that interactive video editing can provide an alternative pedagogical pathway for fostering confidence, expression and learner agency.

Teacher Adaptation and Learner-Centred Pedagogy

From the teachers' perspective, the findings suggest that interactive video editing prompted meaningful changes in instructional practice. In the Science case, the teacher used video editing to control pacing, embed formative assessment and improve explanation of complex concepts. In the Visual Arts case, the teacher shifted from a primarily product-oriented approach towards a process-oriented model that emphasised reflection, creative development and student voice. These changes indicate that interactive video editing may support a broader pedagogical transition from content transmission towards learning design.

This finding is important because it suggests that technology integration is most meaningful when it reshapes pedagogical thinking rather than simply digitises existing practice. The findings also reflect the relevance of the TPACK perspective, which emphasises that effective technology use depends on the interaction between content knowledge, pedagogical knowledge and technological understanding. However, the study also showed that such pedagogical adaptation requires time, confidence and institutional support. Teachers' willingness to continue using video editing appeared to depend not only on positive student outcomes, but also on whether they could access the resources and professional learning necessary to sustain the practice.

Equity, Infrastructure and Implementation Constraints

Although the findings point to substantial pedagogical value, both case studies also revealed significant implementation constraints. Issues related to device access, internet instability, uneven digital literacy and the time demands of video production were evident across both contexts. These challenges are consistent with previous research on digital inequality in rural educational settings, particularly in relation to infrastructure and teacher readiness (Azizan & Hashim, 2021; Alias & Rahman, 2021). The study therefore reinforces the view that the success of digital pedagogies depends not only on innovation at the classroom level, but also on broader structural support.

These challenges also have implications for equity. If interactive video editing is to function as an inclusive pedagogical strategy, schools must ensure that students have sufficient access to devices, connectivity and support in using digital tools. At the same time, teachers require more than technical exposure; they need pedagogically focused professional development that helps them design interactive video in ways that are instructionally purposeful and contextually feasible. The findings therefore suggest that the broader implementation of interactive video editing should be approached not simply as a technological initiative, but as a systemic educational effort requiring coordination across pedagogy, infrastructure and policy support.

Implications of the Study

The findings of this study have several implications for teaching, school leadership and educational policy. At the classroom level, the study suggests that interactive video editing can support more learner-centred and multimodal teaching practices, particularly in subjects that require either conceptual visualisation or reflective expression. Teachers may use interactive video not only to present content, but also to encourage participation, formative assessment and student reflection. This indicates that interactive video editing should be considered a pedagogical practice rather than merely a technical skill.

At the institutional level, the study highlights the importance of sustained support for digital pedagogy. Schools need not only devices and internet access, but also time, training and collaborative spaces that enable teachers to experiment with and refine video-based practices. The findings further suggest that assessment practices may need to be broadened to accommodate multimodal forms of learning, especially where student reflection, process documentation and creative communication are central. At the policy level, the study contributes to discussions on digital inclusion and 21st-century pedagogy by showing that interactive video editing has potential value even in under-resourced settings, provided that implementation is pedagogically guided and structurally supported. This has implications for professional development frameworks, curriculum innovation and rural digital education planning.

Recommendations

Based on the findings of the study, several recommendations can be proposed. First, teachers should be supported through continuous professional development that addresses both technical competence and pedagogical design in the use of interactive video. Second, schools, particularly those in rural areas, should strengthen access to digital infrastructure, including devices, connectivity and technical support. Third, curriculum planners and educational leaders should consider integrating interactive video-based tasks more systematically into teaching and assessment, especially in areas where visualisation, creativity and student reflection are important. Finally, future research should examine the longer-term effects of student-created and teacher-designed interactive videos across a wider range of subjects and school contexts.

Conclusion

This study examined how interactive video editing was implemented in Science and Visual Arts classrooms and how it influenced student engagement, conceptual understanding, creativity and reflective learning in rural secondary school settings. The findings indicate that interactive video editing can function as a meaningful pedagogical strategy when it is designed in ways that support participation, visual understanding, learner autonomy and reflective practice. In the Science case, interactive video strengthened the explanation of abstract concepts and encouraged active engagement with content. In the Visual Arts case, it supported creative expression, metacognitive reflection and student voice through multimodal documentation.

The study also showed that the pedagogical potential of interactive video editing is closely tied to teacher adaptation, contextual feasibility and access to adequate support. While the findings demonstrate promising educational value, they also reveal the importance of infrastructure, digital literacy and professional development in sustaining such practices. Overall, this study contributes to educational technology research by showing that structured interactive video editing is not merely a technical enhancement, but a learner-centred pedagogical approach that may support more inclusive, engaging and meaningful learning in secondary education.

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