

Development and Evaluation of Interactive Video: An Instructional Material for Teaching Plumbing System

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ABSTRACT

In the era of an ICT-driven educational landscape, engaging students in technical-vocational subjects remains a challenge, particularly in the plumbing trade, where there is a shortage of skilled practitioners and qualified trainers. This study aimed to develop and evaluate the acceptability of an interactive instructional video on the plumbing system to address both engagement and skill development needs. A developmental research method, guided by the ADDIE Model, was employed in designing videos, emphasizing content design, media design, visual design, assessment items, feedback mechanisms, and navigation. These features are intended to capture students' interest, promote active engagement, and enhance appreciation of plumbing as both an academic subject and a viable trade. Purposive sampling was used to select 30 respondents: three (3) plumbing instructors, two (2) educational technology teachers, and twenty-five (25) third-year students majoring in Industrial Arts. The data were gathered using a modified survey questionnaire with a 5-point Likert scale and analyzed through descriptive statistics (frequency distribution, mean, standard deviation) and a Welch's Independent T-test to compare teacher and student evaluations. Results indicated that respondents rated the video as excellent overall, with navigation receiving the highest scores, followed by assessment. Group comparisons showed that students gave consistently higher ratings than teachers. Despite differences in experience, the consistently high ratings from both groups suggest that the developed interactive video holds strong potential as an instructional material for teaching the plumbing system, addressing classroom engagement challenges, and contributing to the development of skills in the plumbing industry.

Keywords: Interactive Video, Instructional Materials, Plumbing Systems, ADDIE Model, ICT Tools

INTRODUCTION

Education carries both immediate and long-term value for society. It not only provides learners with the knowledge and skills to participate in the economy but also shapes their values, attitudes, and behaviors in line with cultural and social expectations. With the advent of the Fourth Industrial Revolution, commonly referred to as Industry 4.0, education faces new demands (Lase, 2019). Automation, data-driven decision making, and emerging technologies are reshaping how people live and work, giving rise to what is now called Education 4.0. This paradigm encourages the use of artificial intelligence, digital platforms, and interactive tools to improve instruction and better prepare students for modern workplaces (Rara et al., 2024).

However, many teachers continue to struggle with sustaining students' attention in class (McDermott et al., 2018; Dumadag et al., 2023). The challenge is particularly evident in technical vocational education, where plumbing has become one of the most undersubscribed but essential trades. In the Philippines, plumbing is offered under the Technical-Vocational-Livelihood (TVL) track in senior high school and through Technical and Vocational Education and Training (TVET) programs supervised by TESDA. The sector continues to face a shortage

of qualified practitioners and certified trainers, despite the demand for safe and reliable water systems in both urban and rural communities.

Despite its importance, plumbing instruction often relies heavily on lecture-based teaching and limited laboratory demonstrations. While these approaches deliver basic knowledge, they fall short of simulating real-world working conditions. Consequently, students tend to show reduced motivation, weaker skill retention, and a lack of appreciation for the trade. The situation is worsened by outdated, text-dominated modules and the scarcity of modern training facilities (Mohlabi-Tlaka et al., 2017; Ramos, 2021). This issue is not unique to plumbing; similar constraints have been reported across other TVET disciplines, especially where access to high-quality digital learning resources remains limited (Swisscontact, 2025).

A growing body of research highlights the benefits of integrating interactive and multimedia-based resources into technical education. Interactive videos that incorporate animations, practice exercises, and immediate feedback have been shown to transform passive instruction into active learning, thereby improving comprehension and skill mastery (Wachtler et al., 2016; Qaddumi et al., 2020; Lassoff, 2023). Moreover, flexible delivery modes such as the Hybrid and Flexible (HyFlex) model have demonstrated positive effects on pre-service teachers' academic performance and engagement when compared with traditional teaching strategies (Amirova et al., 2023).

Despite these developments, relatively few studies have explored the use of interactive video resources tailored for plumbing instruction. Most available research either addresses general digital learning tools or focuses on other trades, leaving a clear gap in the literature and practice. This study attempts to bridge that gap by developing and evaluating an interactive instructional video designed for plumbing systems. The material integrates short video demonstrations, embedded assessments, feedback mechanisms, and easy-to-use navigation features. Through this design, the study aims to enhance student engagement, strengthen skill retention, and ultimately contribute to addressing the shortage of competent plumbers and trainers in the Philippine context.

METHODS OF RESEARCH

Research Design

This study used developmental research and descriptive research methods. It used a developmental method to develop an interactive video of plumbing systems and a descriptive method to describe the evaluation criteria that the respondents would answer. Development research is an inquiry unique to the instructional design and technology fields that focuses on creating new knowledge and validating existing practice (Ravana et al., 2023). It evolved through the usage of quantitative data, which is a method commonly used in descriptive research.

Sampling Method

The study employed purposive sampling to select participants directly involved in BTLED-Industrial Arts programs, specifically students and teachers/trainers in plumbing and educational technology. This technique was chosen to ensure that respondents possessed relevant experience and could provide informed feedback on the interactive video. A total of 30 participants participated, deemed sufficient for research purposes (Vasileiou et al., 2018), comprising 5 teachers/trainers,

three (3) plumbing instructors, two (2) educational technology teachers, and 25 BTLED–Industrial Arts students. The student participants were enrolled in IAE 101 – Civil Technology 1, which covers plumbing content. Inclusion criteria required respondents to have prior exposure to Industrial Arts topics and access to a digital device to interact with the learning module.

Instrumentation

The primary data collection instrument was a modified survey questionnaire, adapted from Lewis et al. (2020). The questionnaire assessed six key dimensions: Content Design, Media Design, Visual Design, Assessment Items, Feedback Mechanism, and Navigation. Modifications were made to align the items with the specific context of the interactive video developed for the Plumbing System module. Prior to full implementation, the instrument underwent pilot testing with a small group of participants who were not part of the actual sample to ensure clarity, relevance, and reliability. This process verified that the questionnaire effectively captured the instructional design properties and interactivity of the module.

Product Development

The development of Interactive Video on Plumbing Systems follows the ADDIE Model (Figure 1). The ADDIE model is a process of instructional system design that consists of five components: Analysis, Design, Development, Implementation, and Evaluation (Adeoye et al., 2024).

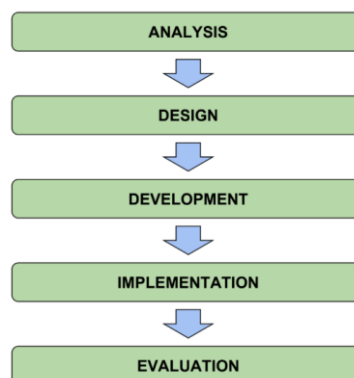


Figure 1 ADDIE Design Stages

Analysis Stage

In the analysis stage, the researchers were able to analyze the problems, and the following are the things that they were able to come up with: They first analyzed the possible end user. The possible target users are the teachers teaching plumbing systems, as the developed interactive video will serve as instructional material that can explain and assess students simultaneously. Another possible user is students with a plumbing system as part of their subject, with the developed interactive video, they can assess and enhance their knowledge of the basic plumbing system. The topics of the interactive video are about the basic concept of a residential plumbing system. It discusses water supply, the drain-waste system, and the vent system.

Design Stage

The interactive video was developed in the Design stage because the existing materials had several problems, such as outdated information, a lack of practical exercises, and poor-quality illustrations and diagrams. So, the developed interactive videos serve as instructional material in the plumbing system. Below is the proposed design with its features, namely, Content Design, Media Design, Visual Design, Assessment Items, Feedback Mechanism, and Navigation, as well as the application program used to develop the interactive elements in the videos in the plumbing system.

The interactive video starts with an objective, followed by a short discussion about the chosen topic. While the students are watching and listening, pop-up questions appear that they need to answer, with a feedback mechanism that explains the correct answer. The bookmarks feature helps the students track the video's progress or the part they want to focus on, which helps them navigate the video better.

Table 1 Design Components of the Developed Interactive Video

Features	Description
Content Design	Short, accurate explanations aligned with learning objectives.
Media Design	Animations, diagrams, and real-life video clips are integrated for clarity.
Visual Design	Appealing graphics, consistent formatting, and color-coded highlights.
Assessment Items	Pop-up questions, drag-and-drop exercises, and end-of-topic quizzes.
Feedback Mechanism	Immediate, informative feedback for answers to reinforce learning.
Navigation	Bookmarks, progress bar, and a clickable table of contents for ease of use.
Application Program	SketchUp Software, Cap Cut Video Editor, H5P Application

Development Stage

In developing the interactive video, the researcher utilized SketchUp software to design the plumbing system, specifically the water supply, drainage, and ventilation system. It was also used to create clips for the actual animation video of the plumbing systems. Cap Cut Video Editor was used to compile all the animated clips of the plumbing systems. Also, it was used to integrate subtitle captioning and apply the voice-over for the videos. The H5P application incorporated interactive elements into the video, such as pop-up questioning, bookmarks, and feedback mechanisms.



Figure 2 Introduction



Figure 3 Introduction of Objectives



Figure 4 Discussion

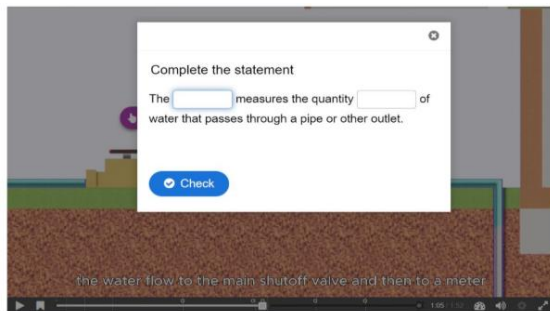


Figure 5 Pop-up Questions

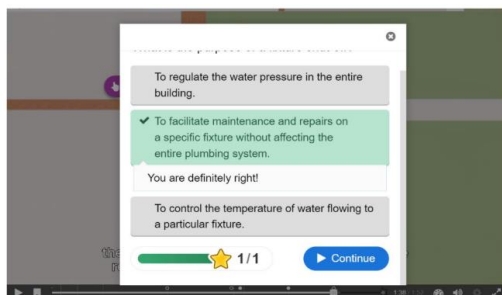


Figure 6 Pop-up Questions



Figure 7 Closing Part

Implementation Stage

In the Implementation Stage, the developed interactive videos were pilot-tested with BTLED–Industrial Arts students and teachers/trainers in plumbing and educational technology. Participants accessed the videos via a link provided on their mobile devices, ensuring accessibility and inclusiveness. They explored key features such as Content Design, Media Design, Visual Design, Assessment Items, Feedback Mechanism, and Navigation, allowing the researchers to collect initial feedback on usability and instructional effectiveness.

Evaluation Stage

After exploring the developed interactive video, participants answered a modified survey adapted from Lewis et al. (2020). The questionnaire assessed Content Design, Media Design, Visual Design, Assessment Items, Feedback Mechanism, and Navigation, reflecting the module's instructional design properties and interactivity, consistent with Ercikan et al. (2020). Data was collected online via digital platforms to ensure accessibility and efficiency. According to Faisal et al. (2022), understanding a product's functionality, what it is designed to achieve, and how it should perform are essential for an effective development process.

Statistical Treatment

The data collected from the questionnaire were analyzed using descriptive and inferential statistics. Descriptive statistics, including Frequency and Percentage Distributions, Mean, and Standard Deviation, summarized respondents' feedback and measured the acceptability of the interactive video across the six evaluation criteria.

For inferential analysis, Welch's Independent T-test was employed to compare perceptions between students and teachers. This test was chosen because it is robust to unequal group sizes and

variances, making it suitable for comparing the larger student group (n=25) with the smaller teacher group (n=5). This approach allows for a valid evaluation of differences in perceptions regarding the module's instructional effectiveness. Nominal scales ranging from ten (excellent) to one (poor), following Mishra et al. (2018) and Sánchez et al. (2021), were used to present data. Effect sizes were also reported to supplement p-values and indicate practical significance..

Ethical Consideration

The study respected the rights, needs, and beliefs of all participants. Participating was voluntary, and participants were fully informed about the study's procedures, objectives, and potential risks through a letter of permission and direct explanation from the researchers, ensuring informed consent.

RESULTS AND DISCUSSION

The study assessed the efficacy of the developed Interactive Video on Plumbing Systems, focusing on its acceptability and effectiveness across various dimensions. The research seeks answers to specific questions, primarily addressing the level of acceptability of the interactive video concerning Content Design, Assessment Items, Feedback Mechanism, Media Design, Visual Design, and Navigation. Each of these components plays a crucial role in determining the overall effectiveness of the interactive video.

Level of acceptance of the Interactive Video developed about Plumbing Systems

Table 2 Descriptive Statistics for Content Design of Interactive Videos for Plumbing Systems (N = 30)

Content Design	Mean	SD	Descriptive Interpretation
The level of the content presented is appropriate and relevant to the target audience (e.g., industrial arts students, plumbers, plumbing teachers, and trainers).	4.67	0.48	Excellent
The information is "scaffolded" well to guide learners to complete the sections within the interactive videos.	4.47	0.57	Excellent
The content is stimulating, engaging, motivating, and relevant to the targeted learners.	4.57	0.50	Excellent
The content is informative and promotes deeper learning.	4.63	0.49	Excellent
The video uses multiple interactive teaching strategies, such as problem-based learning, discovery, and critical thinking.	4.50	0.68	Excellent
The vocabulary and terminology used in the interactive video are precise and supported by references or glossaries.	4.53	0.73	Excellent
The content presented in the interactive video uses visuals such as a 3-dimensional model of the plumbing system.	4.60	0.67	Excellent
The interactive video summarizes the information presented at the beginning of the video.	4.53	0.57	Excellent
The interactive video summarizes the information at the end of the video.	4.47	0.78	Excellent
Overall Mean	4.55	0.46	Excellent

Note: N = number of participants; SD = Standard Deviation

Table 2 presents the descriptive statistics on the content design criteria of the interactive videos, which were consistently rated as Excellent across all aspects. The highest rating was given to appropriateness and relevance to the target audience (M = 4.67, SD = 0.48), followed by informative content that supports deeper learning (M = 4.63, SD = 0.49) and the integration of visuals such as a

3D plumbing model ($M = 4.60$, $SD = 0.67$). These findings confirm that the material was contextually suitable and effective in supporting learners' comprehension of technical concepts.

Slightly lower scores were observed in scaffolding ($M = 4.47$, $SD = 0.57$) and end-of-video summarization ($M = 4.47$, $SD = 0.78$), suggesting areas for refinement in guiding learners through content progression and consolidating knowledge at the conclusion of lessons. Nevertheless, the overall mean of 4.55 ($SD = 0.46$) reflects strong instructional quality and learner satisfaction.

These results align with prior research indicating that well-designed multimedia materials can significantly enhance student motivation, engagement, and knowledge retention (Mayer, 2021; Qaddumi et al., 2020). Furthermore, the use of H5P as an authoring tool for interactive videos is supported by studies demonstrating its effectiveness in producing engaging, student-centered content that fosters active learning (Jacob & Centofanti, 2023). Thus, the positive evaluation of the video affirms not only its immediate instructional value but also its contribution to the broader body of evidence highlighting interactive multimedia as a powerful approach in technical and vocational education.

Table 3 Descriptive Statistics for Assessment Criteria for
Interactive Videos for Plumbing Systems ($N = 30$)

Assessment Items	Mean	SD	Descriptive Interpretation
The interactive video includes an assessment.	4.53	0.63	Excellent
The assessment questions within the interactive video are aligned with the interactive video's content and objectives.	4.70	0.53	Excellent
Assessment items allow repeated or multiple attempts when appropriate.	4.57	0.63	Excellent
Knowledge assessment questions incorporate interactive videos related to the core concept of the plumbing systems.	4.70	0.60	Excellent
The interactive video uses true-false, multiple-choice, multiple answers, fill-in-the-blanks, matching, interactive graphs, or drag/drop items, and quick check questions.	4.70	0.47	Excellent
Assessment items have an appropriate level of rigor and demonstrate a progression of cognitive complexity to measure a range of learners' thinking and understanding.	4.57	0.57	Excellent
Assessment items intend to measure critical content elements embedded in the interactive video.	4.60	0.56	Excellent
Overall Mean	4.62	0.48	Excellent

Note: N = number of participants, SD = Standard Deviation

Table 3 presents the evaluation of assessment items in the interactive plumbing videos. The overall mean of 4.62 ($SD = 0.48$) indicates an Excellent rating across all indicators. Respondents particularly highlighted the strong alignment of assessment questions with content and objectives ($M = 4.70$, $SD = 0.53$) and the integration of varied formats such as True-False, multiple choice, and drag-and-drop ($M = 4.70$, $SD = 0.47$). They also valued the provision for repeated attempts ($M = 4.57$, $SD = 0.63$) and the inclusion of appropriate rigor and progression of cognitive complexity ($M = 4.57$, $SD = 0.57$). These results suggest that the assessments were well-structured, engaging, and effective in measuring key learning outcomes.

This positive feedback is consistent with studies emphasizing that assessments embedded in multimedia environments enhance learner motivation, engagement, and comprehension by

seamlessly integrating evaluation into the learning process (Mayer, 2021; Qaddumi et al., 2020). The use of H5P as the authoring tool further strengthened these outcomes, as it enabled the creation of interactive quizzes with immediate feedback and active participation. Prior research confirms that H5P fosters student-centered learning and sustains engagement by transforming static videos into dynamic, interactive resources (Mir et al., 2022; Mutawa et al., 2023).

Taken together, these findings underscore the significance of integrating interactive assessments within digital learning materials. In the context of plumbing education, such features not only validate the instructional quality of the video but also contribute to broader efforts in technical and vocational education to adopt innovative tools that promote deeper learning and skill mastery.

Table 4 Descriptive Statistics for Feedback Mechanism of Interactive Videos
for Plumbing Systems (N = 30)

Feedback Mechanism	Mean	SD	Descriptive Interpretation
The interactive video provides immediate feedback after answering, including correct and incorrect responses.	4.60	0.56	Excellent
Assessment questions provide immediate explanatory feedback as the selected answer is true or false.	4.47	0.82	Excellent
The interactive video encourages learners to find the correct answer by listening to the discussion again.	4.60	0.62	Excellent
The interactive video provides unique explanations for each wrong answer as feedback.	4.33	0.84	Excellent
Overall, the feedback mechanism is interactive and efficient, and guides learners toward understanding the content knowledge through questions.	4.47	0.68	Excellent
Overall Mean	4.49	0.55	Excellent

Note: N = number of participants; SD = Standard Deviation

Table 4 shows the evaluation of the feedback mechanisms embedded in the interactive plumbing videos, which were rated Excellent overall (M = 4.49, SD = 0.55). Respondents particularly valued the provision of immediate feedback after answering (M = 4.60, SD = 0.56) and explanatory feedback that encouraged revisiting the discussion to find the correct answer (M = 4.60, SD = 0.62). The interactive video's ability to deliver corrective explanations tailored to learner responses was also highlighted. However, this item received a slightly lower score (M = 4.33, SD = 0.84), suggesting potential improvement in the depth or variety of explanations provided for incorrect answers.

These findings underscore the critical role of timely and meaningful feedback in digital learning environments. Timely feedback is critical in distance learning, as it helps sustain learner motivation and supports knowledge retention (Jurs & Špehte, 2021). By encouraging learners to re-engage with the discussion after an incorrect response, the interactive video reflects formative assessment principles that foster persistence, mastery, and self-regulated learning.

Moreover, the results affirm the importance of product functionality in the design of instructional tools. The interactive and efficient feedback mechanisms embedded in the videos guided learners toward a deeper understanding of content knowledge, demonstrating their effectiveness in clarifying misconceptions and reinforcing learning. As Faisal et al. (2022) emphasize, product functionality is an essential element of effective development processes. In this study, the

feedback system exemplifies that principle by ensuring interactivity, efficiency, and meaningful guidance for learners in plumbing education.

Table 5 Descriptive Statistics for Media Design of Interactive Videos for Plumbing Systems (N = 30)

Media Design	Mean	SD	Descriptive Interpretation
The interactive video includes narrated presentations during the content delivery (if applicable).	4.60	0.62	Excellent
The narrator introduces the topic and explains it by giving a brief introduction, including the subsections.	4.50	0.63	Excellent
The instructions or directions the narrator gives are clear and straightforward.	4.60	0.62	Excellent
The images, text, and audio are well-synchronized (sound and written text/ video properly overlap) in the interactive video.	4.60	0.67	Excellent
The learner has complete control of the narrator's audio and the videos (e.g., stop and start, rewind to a specific segment, or pause on a specific frame).	4.60	0.56	Excellent
The audiovisual of the interactive video works properly.	4.53	0.63	Excellent
Overall, media design elements are integrated into a multimodal presentation that explains the plumbing system's core concepts.	4.63	0.56	Excellent
Overall Mean	4.58	0.50	Excellent

Note: N = number of participants; SD = Standard Deviation

Table 5 presents the evaluation of the media design features of the interactive videos, which received an overall mean of 4.58 (SD = 0.50), interpreted as Excellent. High ratings were consistently given across indicators, including narrated presentations (M = 4.60, SD = 0.62), synchronization of images, text, and audio (M = 4.60, SD = 0.67), and learner control over playback functions (M = 4.60, SD = 0.56). Respondents also rated positively the clarity of narration (M = 4.60, SD = 0.62) and the audiovisual quality (M = 4.53, SD = 0.63). The slightly highest score was observed in the integration of multimodal elements to explain plumbing concepts (M = 4.63, SD = 0.56), underscoring the strength of the video's overall design.

The interactive videos delivered narrated presentations with well-organized subsections, ensuring clarity and coherence in content delivery. Images, text, and audio were effectively synchronized, while learners retained complete control over playback functions such as pausing, rewinding, and replaying. This combination of features reflects the growing use of instructional videos as versatile and engaging educational tools. Grounded in Mayer's Cognitive Theory of Multimedia Learning, the design highlights the effectiveness of combining verbal and visual elements to enhance comprehension and long-term retention (Mayer, 2024). Furthermore, the integration of systematic instructional design principles, such as those embedded in the ADDIE model, into the video development process ensures that the materials are pedagogically sound and learner-centered (Artman, 2020).

These results also support prior research showing that well-designed multimedia resources must be intentionally structured to provide learners and teachers with an experience that justifies their investment of time, attention, and effort (Abdulrahman et al., 2020). By ensuring both clarity

and interactivity, the media design of the videos contributes not only to effective content delivery but also to sustaining student interest and active participation in plumbing education.

Table 6 Descriptive Statistics for Visual Design of Interactive Videos for Plumbing Systems (N = 30)

Visual Design	Mean	SD	Descriptive Interpretation
Each topic of the interactive video has consistent color coding regarding the title, the body of the text, and assessment activities.	4.60	.56	Excellent
The interactive video has a consistent font size, color, and text format, which is easy to read.	4.43	.68	Excellent
The interactive video uses captioning and bold, italic, and underscored text to highlight organization or important information.	4.43	.82	Excellent
The interactive video design shows an appealing visual organization (not crowded and text-heavy).	4.53	.685	Excellent
Text and audiovisual materials are well-balanced with appropriate whitespace (e.g., presented aesthetically).	4.57	.57	Excellent
The positions of audiovisual materials on the screen are easy to follow and appealing to learners.	4.60	.50	Excellent
The screen titles, symbols, or icons represent the corresponding message.	4.63	.56	Excellent
The interactive video is free of grammar, capitalization, punctuation, and spelling errors.	4.53	.68	Excellent
Consistent language is used throughout the entire interactive video.	4.63	.61	Excellent
Overall Mean	4.55	.45	Excellent

Note: N = number of participants; SD = Standard Deviation

Table 6 provides the evaluation of the visual design of the interactive videos, which achieved an overall mean of 4.55 (SD = 0.45), interpreted as Excellent. Respondents highlighted strengths in the consistent use of screen titles, symbols, and icons to represent messages (M = 4.63, SD = 0.56) and the use of consistent language throughout the video (M = 4.63, SD = 0.61). They also valued the clear organization of materials (M = 4.53, SD = 0.685) and the balance between text, images, and whitespace (M = 4.57, SD = 0.57). Slightly lower, though still excellent, ratings were observed in text readability (M = 4.43, SD = 0.68) and the use of captions and formatting to emphasize key points (M = 4.43, SD = 0.82), suggesting areas for minor improvement.

These findings affirm that the interactive videos excel in applying principles of visual consistency and organization, which are critical in guiding attention and improving comprehension. According to Mayer's (2021) Multimedia Learning Theory, well-integrated verbal and visual elements help learners process and retain information more effectively, while poor design can overload working memory. This aligns with Cognitive Load Theory, which emphasizes the need to balance text and visuals to avoid overwhelming learners' limited cognitive capacity. Furthermore, the systematic design of the visual elements reflects instructional design frameworks, such as ADDIE, ensuring clarity, readability, and pedagogical soundness (Artman, 2020).

Overall, the strong evaluation of visual design underscores its role not only as an aesthetic feature but as a pedagogical strategy that enhances comprehension, prevents cognitive overload, and sustains learner engagement in plumbing education.

Table 7 Descriptive Statistics for Navigation of Interactive Videos for Plumbing Systems (N = 30)

Navigation	Mean	SD	Descriptive Interpretation
The function of the interactive video's navigation control is easily determined immediately.	4.73	0.52	Excellent
The interactive video's user interface allows learners to identify their learning path quickly.	4.63	0.56	Excellent
The interactive navigation is consistent, logical, and accessible for a learner with little or no experience using technology/ computers.	4.60	0.56	Excellent
The interactive video provides narrated navigational directions and visual indicators (if applicable).	4.67	0.55	Excellent
Learners can control their learning progress by navigating between the subsections using the bookmark section.	4.63	0.56	Excellent
The interactive video interface allows users to find information and sections quickly.	4.67	0.55	Excellent
Overall Mean	4.65	0.47	Excellent

Note: N = number of participants; SD = Standard Deviation

Table 7 provides the evaluation of navigation features in the interactive plumbing videos, which obtained an overall mean of 4.65 (SD = 0.47), interpreted as Excellent. Respondents highlighted the ease of determining navigation controls (M = 4.73, SD = 0.52) and the efficiency of locating information quickly through the interface (M = 4.67, SD = 0.55). Narrated directions with visual indicators (M = 4.67, SD = 0.55) and the bookmark function (M = 4.63, SD = 0.56) further enhanced accessibility and learner control. Importantly, the navigation system was rated logical and user-friendly even for learners with limited technological experience (M = 4.60, SD = 0.56), underscoring its inclusivity.

These findings affirm that intuitive navigation is essential in interactive learning environments, as it reduces cognitive barriers and ensures a seamless user experience. According to Nielsen's (1994) usability heuristics, consistent and straightforward navigation allows learners to focus on content rather than interface complexity. Similarly, Mayer's (2021) Multimedia Learning Theory stresses that minimizing extraneous cognitive load, such as navigation difficulties, frees up working memory for meaningful learning.

Furthermore, the emphasis on usability and learner control reflects the significance of product functionality in instructional design. As Faisal et al. (2022) argue, functionality provides clarity of purpose and performance in practical educational tools. In this study, features such as narrated directions, logical sequencing, and bookmark navigation demonstrate how functionality and pedagogy can work together to support autonomy, accessibility, and learner engagement in technical education.

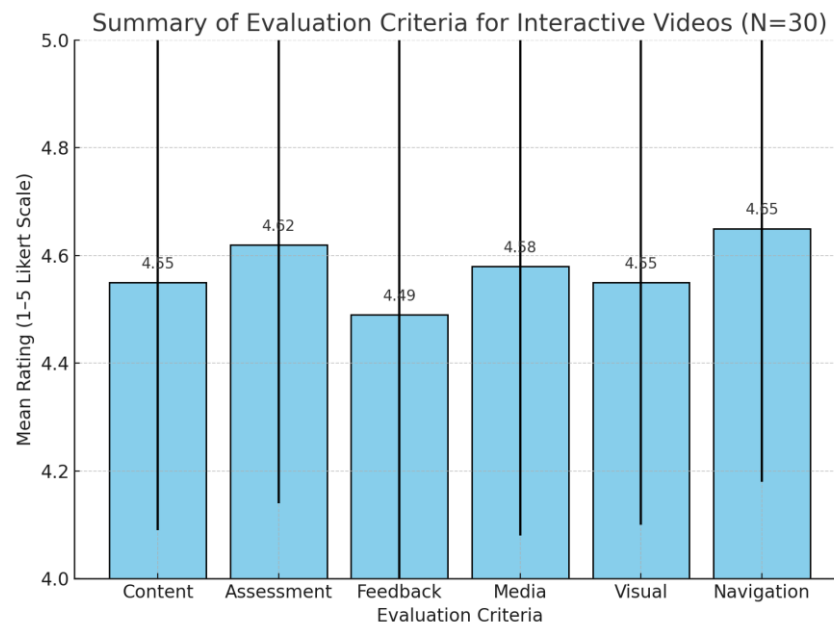


Figure 8 Summary result of the evaluation criteria

Across all six dimensions, the interactive videos were rated Excellent, with overall means ranging from 4.49 to 4.65. The consistently high evaluations affirm that the videos were effective in integrating multimedia principles, interactivity, and pedagogical design, thereby enhancing engagement, comprehension, and motivation in plumbing education. These findings contribute to the growing body of evidence that interactive videos, particularly when designed with tools like H5P and grounded in instructional design models, are valuable innovations for technical and vocational education.

Differences in Student and Teacher Evaluations

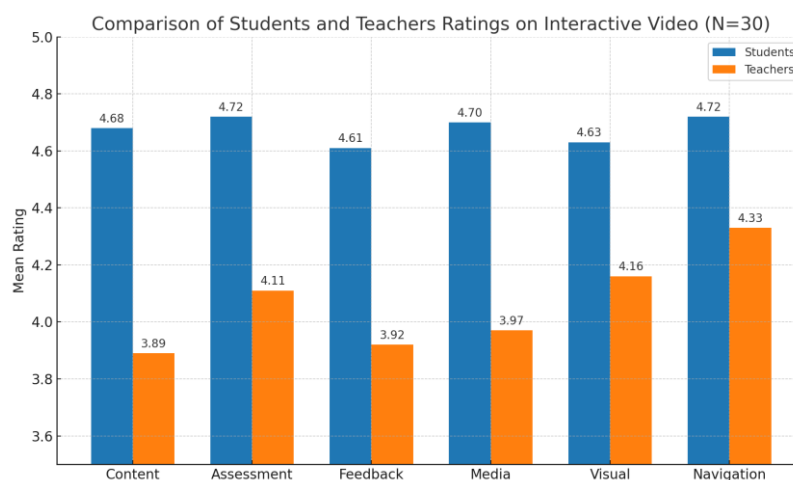


Figure 9 Summary of Teacher and Student Ratings

Table 8 Welch's Independent Samples t-test Results Comparing Students and Teachers

Criterion	t	df	p	Interpretation
Content Design	4.72	5.83	.004*	Significant
Assessment Items	1.66	4.27	.168	N.S.
Feedback Mechanism	1.69	4.29	.163	N.S.
Media Design	2.33	4.49	.073	N.S. (trend)
Visual Design	1.50	4.49	.200	N.S.
Navigation	1.74	~4.5+	.150	N.S.

*Note. Note. N.S.= not significant; * = significant at $p < .05$. + df approximated using Welch's formula.*

Table 8 presents Welch's independent samples t-test results comparing student and teacher evaluations of the interactive videos. The analysis showed that students generally rated the videos more positively than teachers across all criteria. However, a statistically significant difference was found only for Content Design, $t(5.83) = 4.72$, $p = .004$, with students assigning higher ratings than teachers. For the other criteria, Assessment, Feedback, Media, and Visual Design, the differences did not reach significance, although Media Design approached trend level ($p = .073$). Both groups rated Navigation equally high, and no significant difference was observed.

Overall, only Content Design showed a significant difference, suggesting that while students consistently rated all aspects of the interactive videos as excellent, teachers tended to give lower ratings for content-related quality.

The significant difference in Content Design ratings indicates that students and teachers perceived the quality of the interactive video differently. Students consistently rated the content highly, likely valuing its clarity, accessibility, and engaging presentation. Teachers, however, applied a more critical lens, informed by their professional and pedagogical standards (Nelms & Segura-Totten, 2019). Their lower ratings may reflect concerns about the depth of the material, alignment with curriculum objectives, or its adequacy in preparing learners for real-world technical applications. This gap underscores the need for instructional materials to balance learner-centered design with educator expectations for rigor and curriculum alignment.

In contrast, both students and teachers rated the Navigation of the interactive videos equally high. This suggests that the platform's user-friendly interface and logical structure were effective in supporting both groups. Regardless of role, participants were able to interact with the content easily and intuitively, which highlights the strength of the video's design in enhancing usability. This convergence implies that while content refinement may be necessary to address teacher expectations, the navigational aspects already meet the needs of both learners and educators.

CONCLUSIONS

This study set out to evaluate the acceptability of a developed interactive video on Plumbing Systems by examining six design criteria, content, assessment, feedback, media, visual design, and navigation, from the perspectives of both students and teachers. The findings demonstrated that interactive videos continue to be valuable instructional materials, evolving into versatile tools that support teaching and learning in the era of rapid technological advancement. Both groups consistently rated the interactive video highly, with navigation emerging as a shared strength, underscoring the importance of user-friendly design in promoting engagement and accessibility. The results fulfilled the objectives of the study by confirming that interactive videos were rated as acceptable instructional materials, with the potential to enhance students' learning and provide

pedagogical value for teachers. However, differences between students and teachers in evaluating content design suggest that while learners value clarity and engagement, educators demand greater rigor, depth, and curriculum alignment. This highlights the need for developers to balance learner-centered design with professional pedagogical expectations. The study contributes to the growing body of evidence affirming interactive videos as practical digital learning tools. By demonstrating how they can be applied in both synchronous and asynchronous settings, this research supports their role in reducing academic boredom and fostering active participation. Moreover, the integration of available ICT tools and emerging technologies, such as generative AI, presents opportunities for creating even more dynamic and personalized learning resources. For future research, it is recommended that the effectiveness of interactive videos be examined in actual classroom settings, across varied learner demographics, and within diverse delivery modes to establish broader generalizability. Larger and more diverse participant groups may also provide deeper insights into how teachers and students perceive these tools. Ultimately, this study affirms that embracing interactive video technology is a meaningful step toward enhancing instructional delivery and ensuring that education keeps pace with the evolving needs of 21st-century learners.

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