Effectiveness Associated With Learning With Video and Multimedia Content in Engineering Students' Classroom Sessions

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Video as an educational tool has evolved in response to the widespread engagement with multimedia content in the modern era. This approach adapts to the widespread access to the internet and online communication, transforming teaching methods in university environments. The inclusion of video in the educational process not only presents concepts in an engaging way but also encourages active student participation and contributes to the construction of knowledge. The versatility of videos enriches understanding by combining visual and auditory elements, promoting better retention of information. Adapting teaching methods to the multimedia era is fundamental in engineering education. Students recognize the value of videos in understanding practical solutions and engineering applications, highlighting their preference for viewing over reading. Clarity in the presentation and description of videos, together with their easy accessibility, is crucial to their effectiveness. The use of video as an academic resource not only allows for improved student performance but also fosters collaboration and independent learning. In this evolving educational environment, adaptability, collaboration, and individual reflection become essential factors in maximizing multimedia and video resources. The integration of artificial intelligence and the creation of digital scientific discourses reflect the ongoing transformation in education. Through visual and auditory elements, videos enhance the learning experience, fostering active participation and facilitating a deeper understanding of concepts. This, in turn, contributes to the educational development of engineering students.

INTRODUCTION

Educational videos as part of multimedia literacy have been the subject of numerous studies and research that evaluate their effectiveness in the development of skills, abilities, and competencies in university students. These studies show that the use of different media to produce videos in educational contexts has significant effects in areas such as oral communication, reading comprehension, analysis, modeling, and computational thinking, among others.

In the field of education, a future in which artificial intelligence (AI) will mediate the use of videos during classroom sessions is envisioned. This perspective, supported by research, suggests that videos are not only useful for groups of students but also allow for the assessment of emotions that arise in relation to the content and academic context (López-Buenache et al., 2022; Quach et al., 2022).

It is important to note that educational videos are not only tools for training in education and culture but also have a presence in advertising and entertainment contexts. Currently, academic materials in video format can be found on various social networks, some of them of shorter duration and designed to reach a wide audience. In addition, emotional regulation interventions have been successfully implemented in the classroom using video recordings of lectures, which influence students' emotions in relation to their work outside the classroom (Ranellucci et al., 2021).

The video format has proven to be successful in fostering multimedia literacy and guiding video selection in future courses. It has been shown that this practice can increase the motivation and engagement of learners, especially those who are digital natives, and facilitate the transformation of information into a conceptual format called multimodal. This approach goes beyond physical modes of learning and allows for the adaptation of content, teaching methods, and learning styles to digital environments (Girón-García and Fortanet-Gómez 2023).

Educational research has explored both verbal and nonverbal aspects using technological media. These studies have provided students with the opportunity to evaluate their own performance through recordings and receive feedback, as well as to practice exercise situations and academic tasks. This dynamic has led teachers to use videos as a tool in the teaching process, thus challenging traditional teaching practices in specific cases. Consequently, an evaluation of teaching methods applicable to the use of video and a clear definition of its role in the relationship between the teaching and learning process are required (Colognesi, Coppe, and Lucchini, 2023).

The transmission of knowledge and the development of skills in university students are achieved through fundamental teaching methods in educational theory. However, in the current era where multimedia content has gained significant popularity, it is necessary to evaluate and review the use of teaching methods that incorporate videos as a resource and medium (More Valencia, 2018).

In an era of widespread internet access and online communication, teaching methods have adapted to incorporate the use of videos in class sessions. The incorporation of video as a highly effective tool in the teaching process implies that teaching methods need to adapt and consider its application in university settings. By presenting concepts in an engaging manner and encouraging active student participation, it is possible to ignite their interest and facilitate the development of knowledge that is suitable for their academic level. This strategy relates to and integrates with other scholarly works that focus on adaptation in a university-level classroom environment (Belton, 2016; Cheng & Li, 2020).

The utility of mass media, social media, and web content for university education lies in their ability to convey information in a highly effective manner. By visualizing complex concepts instead of relying solely on imagination or understanding through text, students can achieve a more comprehensive understanding. The use of videos facilitates the assimilation of knowledge by combining visual and auditory elements, which promotes a deeper understanding and improved retention of information by students (Gelfuso, 2016).

Therefore, the study aims to assess the effectiveness of multimedia tools, particularly videos, in engineering education. It also seeks to understand how students utilize multimedia tools in engineering education and to analyze strategies for enhancing their use in engineering education, as well as to analyze ways to improve the use of multimedia tools in engineering education.

REVIEW OF THE LITERATURE

The incorporation of videos in teaching diversifies didactic resources and enriches the educational process, adapting to the different learning styles of students. Videos are used for instruction, motivation, modeling, and cultural dissemination, and they are not limited to a specific type of teaching or content. This versatility makes them adaptable resources for various educational contexts, including those that cater to students with developmental disabilities (Gelfuso, 2016).

The primary benefit of using videos lies in their capacity to integrate visual and auditory elements, as well as their ability to present content in a captivating and accessible manner. In addition, videos can be accessed online for later reference, and their widespread availability allows for autonomy and flexibility in the teaching process, catering to various learning styles. The effectiveness of videos in the teaching and learning process has been evaluated and documented at the university level, showcasing their successful integration (Krumm et al., 2022).

The impact of various factors on the use of educational videos in social networks has been investigated. These factors include the trustworthiness of the main content-creation agent and the importance of management and institutionalization. These factors promote interdependence between content and users in the field of university education. It is recommended to consider appropriate dimensions and metrics to understand the impact of online video. However, before proposing this type of measurement, it is necessary to analyze the acceptance of video use and teaching methods, as well as categorize the fundamental production of videos in university education (D'Aquila, Wang, and Mattia, 2019; López-Buenache et al., 2022).

The use of videos in teaching sessions should take a holistic approach. The relationship between emotions, learning strategies, and learning behaviors has been studied in a variety of contexts. Using video both inside and outside of the classroom, including the emotional expressions of teachers as instructors, creates a positive atmosphere and fosters a consistent and favorable learning environment. It is valuable to establish clear connections between content and learning activities. Strategies can be employed to remind students of successful classroom activities through video recordings. Frameworks or previous experiences that connect contexts inside and outside the classroom can also be explored (Ranellucci et al., 2021).

Different reflective stimuli have been shown to have effects on cognitive and emotional processes. Videos during teaching practice are a valuable tool as they appear to alleviate boredom and enhance engagement and immersion, in contrast to relying solely on memory or reflection for teaching practice. It may be possible to experiment with teaching methods that utilize videos to address feedback issues and enhance academic performance. Teachers can create videos that effectively communicate learning objectives to students and demonstrate their progress towards achieving them. These videos should include detailed and meaningful feedback that is shared and discussed (Svanbjörnsdóttir, Zophoníasdóttir, and Gísladóttir, 2023).

Reflection on one's own teaching, based on both memory and visual support from videos, seems to lead to a higher level of reasoning grounded in scientific academic knowledge. A practical implication of this is that digital, video-based reflection environments should be highly structured and carefully supported to alleviate teachers' workload and save time (Weber, Prilop, and Kleinknecht, 2023).

The use of videos in simulation contexts plays a crucial role in the teaching and learning process, as they are employed as activities in interprofessional education. This tool is adaptable and flexible, supporting learners in both individual work and collaborative group settings. In areas of study related to health care in university settings, study groups utilizing video have been shown to effectively identify, evaluate, and recommend solutions to medical problems and patient care in areas of study related to healthcare. This contributes to the development of collaborative and interprofessional communication skills (Batteson et al., 2023).

There are extreme cases where students can learn through the use of videos, despite having limitations that may affect their abilities. Videos provide individuals with opportunities for intervention and enable them to engage in activities as independent tasks, with visual stimuli playing a crucial role. Teachers can create content and combine pedagogical methods to facilitate the teaching process (Aldabas, 2023).

In the context of mass learning, there are differences related to language and culture. In these situations, linguistic and semantic variations are observed, and distinctive features are identified among different disciplines. For example, the arts and humanities tend to adopt a more persuasive approach, while the life sciences are characterized by an informative and expository discourse. The discourse in the life sciences is more formal, but not necessarily persuasive or abstract. The physical sciences, by their nature, tend to have a systematic approach and emphasize interaction. In addition, a collaborative and online approach to elaboration is common in the social sciences. Therefore, disciplinary variation is consistent and requires further research to understand learner interaction and the acceptance of different teaching methods in each discipline (Yu, 2022).

Theory has demonstrated the use of predictive models to determine the presentation styles of content in videos. These models experiment with visual styles, verbal styles, or a balanced combination of both. The models utilize supervised learning, and the most efficient results indicate that the verbal style is effective when it is supported by the underlying text. Furthermore, it has been observed that the utilization of a convolutional neural network model to evaluate the engagement and acceptance of the style employed in a video lecture is restricted and imprecise because of the limitations in video quality for analyzing learner participation and engagement. It is necessary to consider other factors, such as interest in the topic or the presentation skills of the speaker, which may have a more direct impact on student engagement (Thomas et al., 2022).

DESIGN OF THE METHODOLOGY

In this study, a quantitative approach has been adopted to investigate the use of videos as academic content for engineering students. Various quantitative methods, including deductive, inductive, statistical, and interpretative approaches, have been employed on 183 engineering students from three universities in Piura, Peru.

The study design was based on a non-experimental, cross-sectional, and correlational approach. This implies that data was collected at a single point in time to examine the relationship between the proposed factors. Questionnaires were used to collect information from university students who were pursuing careers related to information and communication technologies. The initial tests required assessing a factor load and analyzing the responses that engineering students frequently provide (Martínez and Sepúlveda, 2012).

An observation of one's learning was conducted, with a focus on observing teaching methods for university students. The study was based on a deductive approach, starting from previously established theories that provided a framework for the research. In addition, an inductive approach was used to describe and establish the connections between the meanings of the elements involved in the use of multimedia tools, particularly video, as a tool for academic work. The usefulness of sharing, using, and publishing video content was assessed. This assessment includes the publishing and use of video content (PU), the characterization of video content (CV), and the fulfillment of didactic objectives and learning objectives (LO).

In assessing the factor loadings on a test by students in Table 1, three factors related to the publication and use of videos, as well as their didactic objectivity, were identified. The first factor highlights the effectiveness of video viewing today. Although videos may partially address topics covered in class, students have expressed that sharing and utilizing them, either among their peers or in the classroom, creates a sense of immediacy that improves their performance and comprehension of related or interdisciplinary subjects. To achieve this, content needs to be properly referenced when presented on social media or the web.

In the context of engineering, oral explanation or verbal presentation represents an explanatory approach characterized by clear and concise explanations. In addition, the availability of translators on social networks enables the use of subtitles or access to ideas in different languages. Therefore, it is important to understand that videos serve as a didactic tool to support studying, while the practical

application of engineering is typically carried out in laboratories or classrooms (Crawford Camiciottoli, 2021; Expósito et al., 2020).

Video consultations focus on technical rather than theoretical topics, and the concept of immediacy is related to accessibility through devices. The second factor involves the characterization of videos through recommendations and their utilization in social networks among students. The importance of using relevant keywords, titles, and descriptions that align with the video content is also highlighted. Furthermore, the use of videos in social networks is justified in the context of the knowledge society. They can be studied both at home and in the university classroom due to their coherence and continuity in providing information.

The third factor refers to the fulfillment of didactic objectivity, as it is understood that the video's usefulness is primarily technical. Its application is appreciated in individual consultations as well as in group study work, where students must generate solutions and apply them based on the content they have understood. In addition, the use of videos as a feedback tool by teachers to maintain instructional objectivity is highlighted.

TABLE 1
FACTOR ANALYSIS OF THE INSTRUMENT USED IN THE STUDY FOR VIDEO AND MULTIMEDIA USE

Item	**Description of the Specification Observed – Video and multimedia Use**	**Factor**	**F1.**	**F2.**	**F3.**
V1.PU.RecVid	The teacher uses multimedia videos to teach methods and techniques in their field of engineering.	F3*	0.021	0.099	0.478
V1.PU.VidPro	Students use videos for information and academic projects.	F3*	0.013	0.003	0.752
V1.PU.ApVid	Students agree that learning by visualization is more effective than simply reading.	F1*	0.792	0.078	0.019
V1.PU.VidParc	They consult videos that partially address the topics seen in class at university.	F1*	0.476	0.098	0.219
V1.PU.ApoInm	They consider that the use and sharing of video materials provides immediate support.	F1*	0.735	0.046	0.017
V1.PU.AmpClas	They use videos to expand on the topics seen in class and to understand their applicability.	F3*	0.036	0.243	0.372
V1.PU.VidGEst	They have used videos as reference resources for study group work.	F3*	0.153	0.160	0.361
V1.PU.RendVid	The use of videos during the course improves their performance in understanding cross-modular topics.	F1*	0.664	0.014	0.099
V1.PU.FacApr	You would recommend web content on social networks to quickly learn your career.	F2*	0.087	0.250	0.186
V2.CV.RefTex	Textual reference to a video on the web shows its purpose.	F1*	0.627	0.078	0.066
V2.CV.TexApli	Non-speech only textual videos showing tasks and applications, understanding the content.	F3*	0.117	0.073	0.144
V2.CV.HabApli	Videos with speech and presentations execute tasks, understanding the content.	F1*	0.688	0.006	0.004
V2.CV.RecComp	In engineering, files are attached to video explanations (e.g., source code).	F1*	0.736	0.043	0.034
V2.CV.UsoList	You use playlists for engineering video topics.	F1*	0.610	0.085	0.006
V2.CV.BusVid	Find videos by keywords, relevance of title and description.	F2*	0.090	0.339	0.167

Item	Description of the Specification Observed – Video and multimedia Use	Factor	F1.	F2.	F3.
V2.CV.IdioVid	Subtitles in different languages on channels like YouTube are beneficial.	F1*	0.598	0.138	0.029
V2.CV.PlatVid	You would frequent videos on a university platform instead of social media.	F2*	0.040	0.396	0.014
V2.CV.SocCon	Participating in social networks is a justifiable necessity in a knowledge society.	F2*	0.135	0.342	0.034
V2.CV.FueAula	Studying videos at home is better than in a university classroom.	F2*	0.005	0.262	0.002
V3.OD.ApreUni	Videos consulted meet university learning objectives.	F1*	0.099	0.083	0.002
V3.OD.Constr	Differences between studying and applying engineering with video support.	F1*	0.666	0.075	0.032
V3.OD.Aplic	Videos consulted provide immediate help in applying engineering.	F1*	0.654	0.064	0.074
V3.OD.Coher	Videos show applied engineering methods with consistency and continuity.	F2*	0.001	0.334	0.142
V3.OD.Tecni	Videos of engineering content are more technical than theoretical.	F1*	0.595	0.141	0.114
V3.OD.IdeasAcc	Ideas in videos are accessible anywhere via devices.	F1*	0.706	0.010	0.004
V3.OD.ContApren	Level of learning with videos is low in your opinion.	F1*	0.709	0.044	0.109

Source: Own elaboration based on the evaluation of the study in three universities.

The scale used to evaluate teaching methods and the use of multimedia tools is based on an ordinal scale of frequency, with rating levels ranging from 1 to 5. The levels are "Never" (1), "Very Rarely" (2), "Sometimes" (3), "Regularly" (4), and "Always" (5). Descriptive statistics will be used to determine the frequency at which these methods are utilized in the university setting, particularly among engineering students. The effectiveness of multimedia tools, including the use of videos, in courses and classes will also be evaluated.

Statistical and percentage descriptivism will be used to calculate the mean and frequency of each description in the two instruments being utilized. These instruments assess both the teaching methods used in university classrooms and the student's perception of the usefulness of multimedia tools, including video content. The adopted scale follows a formal structure, and the descriptors and percentages will provide information about students' analytical behaviors in relation to teaching methods and the effectiveness of multimedia tools, such as video (Brownstein, Adolfsson, and Ackerman, 2019).

RESULTS

The results in Table 2 show that the students' appreciation of multimedia tools, especially videos, is very high, with a mean above 3.5 (mean > 3.5). It has been observed that students utilize videos on social networks and web content as sources of information for their academic projects. The highest percentages are for the use of videos for consultation and for sharing in study groups (regularly: 42.60% and always: 18.60%). Students recommend publishing content on social networks. They use videos to enhance the content taught in class by their lecturers and highlight the significance of comprehending the practicality of engineering methods and techniques (regularly: 39.30% and always: 13.70%). They also express a desire for universities to utilize digital and multimedia platforms to promote the use of videos and other

multimedia resources, which can be accessed quickly. The survey results show that 33.30% of respondents consult these resources regularly, while 20.80% consult them always.

TABLE 2
DESCRIPTIVE RATINGS BY FREQUENCY OF MULTIMEDIA AND VIDEO USE IN ENGINEERING STUDENTS' CLASSROOM SESSIONS

Item	Description of the Specification Observed – Video and multimedia Use	Media	DsvSstd	1: Never	2: Very.Rarely	3: Sometimes	4: Regularly	5: Always
V1.PU.RecVid	The teacher uses multimedia videos to teach methods and techniques in their field of engineering.	3.459	1.103	3.80%	16.90%	28.40%	31.10%	19.70%
V1.PU.VidPro	Students use videos for information and academic projects.	3.557	1.035	4.90%	7.70%	32.80%	36.10%	18.60%
V1.PU.ApVid	Students agree that learning by visualization is more effective than simply reading.	3.486	1.181	6.60%	15.30%	23.00%	33.30%	21.90%
V1.PU.VidParc	They consult videos that partially address the topics seen in class at university.	3.175	0.927	2.20%	20.80%	42.60%	26.20%	8.20%
V1.PU.ApoInm	They consider that the use and sharing of video materials provides immediate support.	3.470	1.194	7.10%	14.20%	26.20%	29.50%	23.00%
V1.PU.AmpClas	They use videos to expand on the topics seen in class and to understand their applicability.	3.617	0.899	1.10%	8.70%	33.90%	39.90%	16.40%

V1.PU.VidGEst	They have used videos as reference resources for study group work.	3.689	0.924	2.20%	6.60%	30.10%	42.60%	18.60%
V1.PU.RendVid	The use of videos during the course improves their performance in understanding cross-modular topics.	3.361	1.168	7.70%	15.80%	26.80%	32.20%	17.50%
V1.PU.FacApr	You would recommend web content on social networks to quickly learn your career.	3.689	0.992	1.60%	10.40%	28.40%	36.60%	23.00%
V2.CV.RefTex	Textual reference to a video on the web shows its purpose.	3.115	0.933	2.70%	23.00%	41.50%	25.70%	7.10%
V2.CV.TexApli	Non-speech only textual videos showing tasks and applications, understanding the content.	3.120	0.982	6.00%	18.00%	40.40%	29.00%	6.60%
V2.CV.HabApli	Videos with speech and presentations execute tasks, understanding the content.	3.393	1.109	5.50%	14.80%	32.80%	29.00%	18.00%
V2.CV.RecComp	In engineering, files are attached to video explanations (e.g., source code).	3.470	1.226	7.10%	16.90%	21.90%	30.10%	24.00%
V2.CV.UsoList	You use playlists for engineering video topics.	3.377	1.040	3.30%	16.40%	35.50%	29.00%	15.80%
V2.CV.BusVid	Find videos by keywords, relevance of title and description.	3.678	1.079	3.80%	10.90%	23.50%	37.20%	24.60%
V2.CV.IdioVid	Subtitles in different languages on channels like YouTube are beneficial.	3.333	1.116	6.60%	15.30%	32.20%	30.10%	15.80%
V2.CV.PlatVid	You would frequent videos on a university platform instead of social media.	3.563	1.056	3.80%	10.90%	31.10%	33.30%	20.80%
V2.CV.SocCon	Participating in social networks is a justifiable necessity in a knowledge society.	3.497	0.960	2.20%	12.60%	32.80%	38.30%	14.20%
V2.CV.FueAula	Studying videos at home is better than in a university classroom.	3.486	0.954	2.20%	10.40%	39.90%	31.70%	15.80%
V3.OD.ApreUni	Videos consulted meet university learning objectives.	3.301	1.075	5.50%	16.40%	35.00%	29.00%	14.20%

V3.OD.Constr	Differences between studying and applying engineering with video support.	3.333	1.081	6.00%	16.40%	28.40%	36.60%	12.60%
V3.OD.Aplic	Videos consulted provide immediate help in applying engineering.	3.552	0.881	1.10%	9.30%	36.60%	39.30%	13.70%
V3.OD.Coher	Videos show applied engineering methods with consistency and continuity.	3.213	0.968	3.30%	19.10%	39.90%	28.40%	9.30%
V3.OD.Tecni	Videos of engineering content are more technical than theoretical.	3.317	1.113	6.00%	19.10%	25.70%	35.50%	13.70%
V3.OD.IdeasAcc	Ideas in videos are accessible anywhere via devices.	3.410	1.044	2.70%	19.10%	27.30%	36.10%	14.80%
V3.OD.ContApren	Level of learning with videos is low in your opinion.	2.814	1.068	10.90%	27.90%	37.20%	16.90%	7.10%

Source: Own elaboration based on the evaluation of the study in three universities.

In contrast, students' perception of support for a low level of learning with videos is infrequent. Most students understand that learning is more closely related to the visibility and application of engineering in academic contexts. The percentage of students who never perceive support for learning with videos is 10.90%, while the percentage of students who perceive it as very rarely is 27.90%. Using videos to support group assignments and watching cases in class allows students to gain a deeper understanding of engineering solutions, rather than relying solely on memorizing data, results, or formulas. This approach is preferred by 36.60% of students sometimes and by 39.30% of students regularly.

The high frequency of video posting demonstrates the students' recurring search for techniques and methods. For many people, visualization is more effective than reading, and they place a high value on the ability to immediately understand and apply concepts. This is reflected in the survey results, with 33.30% of respondents reporting that they regularly find visualization more effective, and 29.10% stating that they always do. Videos and multimedia resources help students improve their performance, particularly in understanding the sequentially and modularity of their courses. This includes the appropriate dosage of content for experimentation and learning. They would recommend and share the content they find on the web with others.

It is important for students that the presentation and description of videos be clear and concise. Additionally, they must include attachments, such as programming codes or PDF documents, which provide explanations and academic support. According to students' responses, 30.10% of students reported receiving attachments regularly, while 24.00% reported receiving them always. They value keywords to facilitate the searching and sharing of material. The percentage of respondents who reported using keywords regularly was 37.20%, while 24.60% reported using keywords always. In summary, the utilization of multimedia and videos in applied engineering offers coherence and continuity, enabling a vivid and clear comprehension of the concepts.

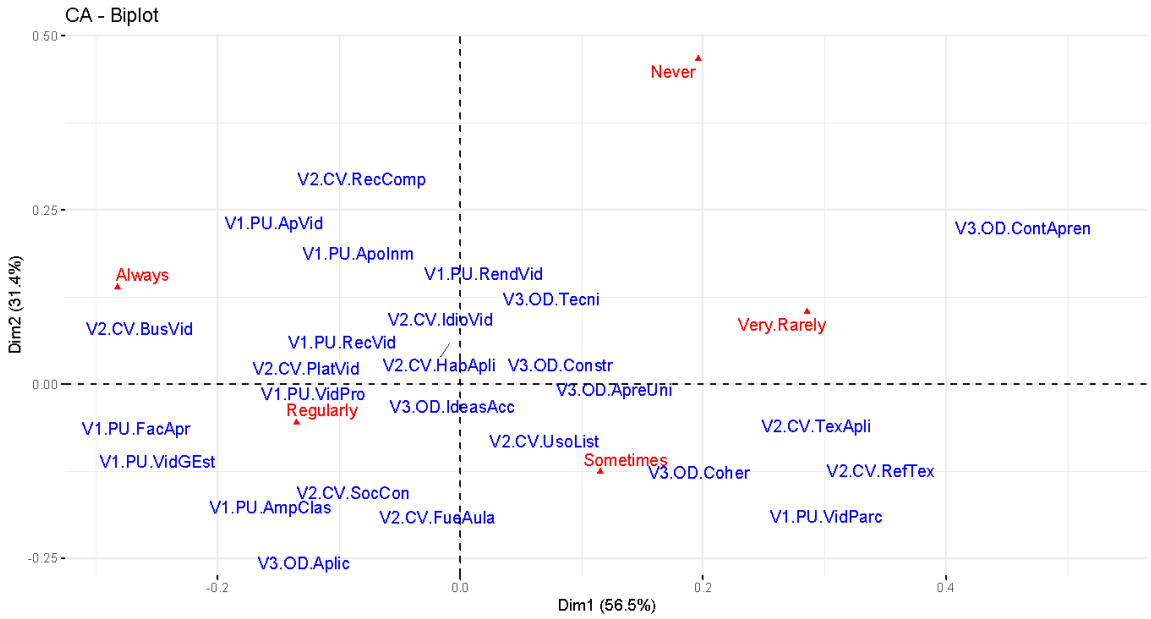
The factor loading analysis for components explains 87.9% of the data, as shown in Figure 1. At the frequency level, it is always associated with the following: the results indicate that students consider the use of videos with immediate support as a fundamental feature of multimedia tools. They are also interested in videos being accompanied by additional materials, such as mathematical models, programming code, spreadsheets, mind maps, and reference links.

Teachers can also use videos and multimedia to teach methods and techniques within each field of engineering. The idea of using these methods as a teaching approach requires some study. The teacher can choose to use a deductive, inductive, analogical, or reality-checked method, depending on their preferred way of conducting the class. When discussing teaching techniques, we are referring to the effectiveness of technological tools within the field of engineering. Students are also open to the idea of videos coming from sources other than social networks. They are willing to utilize a university platform that provides them with access to a wide range of videos, including those created by their professors as well as those available on the vast expanse of the internet.

Students are also interested in being able to easily find the videos they need. Remember that young people are surrounded by video content, so it is important that videos used in the academic environment are easily recognizable and accessible. To achieve this goal, videos should be properly titled, including relevant keywords and an objective description. The description should also include timestamps so that viewers can easily locate specific references within the video.

Students regularly use multimedia and videos for academic projects. This is because videos are accessible on mid-range mobile devices and are often recommended on social media. Students also use videos in study groups, where they select and share them for their projects. Students justify the use of videos in the knowledge society, which is composed of both text and video. Students can share and evaluate videos to enhance their understanding of class topics and explore real-world engineering applications. They can also access videos outside of the classroom, which gives them more flexibility in their study time.

FIGURE 1
CORRESPONDENCE ANALYSIS BETWEEN FREQUENCY OF USE AND ITEMS RATED FOR VIDEO AND MULTIMEDIA USE



Source: Own elaboration based on the evaluation of the study in three universities.

On occasion, students have resorted to watching videos hosted on playlists that are specific to the field of engineering. This resource, which includes material from various universities, professors, and related academic institutions, has been used to a lesser extent. Although this practice is sporadic, some of these videos demonstrate remarkable coherence and continuity in the presentation of engineering methods.

Coherence and sequentially are most evident in videos that are labeled and organized under a predefined title or list. This approach also connects the video content to the topics covered in the course. Sometimes,

these audiovisual materials effectively complement university learning. It is noted that some videos lack narration and instead focus on demonstrating manual protocols or textual procedures. This manual orientation is particularly evident in practical applications, such as coding and circuit-related experiments.

The inclusion of textual references in the videos is crucial. The inclusion of metadata in the video presentation, including a synthesis that can guide the learner in understanding the content and sequence of the exposition, is a fundamental aspect. In addition, it is proposed that this textual reference should include time stamps in the video, thus allowing for easy navigation and uninterrupted study.

In some cases, students have identified videos that do not fully cover the topics discussed in class, presenting only partial segments. However, these fragments still provide valuable support for their learning. Students rarely question the effectiveness of this video learning approach, and their feedback generally indicates an improvement in the quality of their understanding.

DISCUSSION AND CONCLUSIONS

The structured, orderly, and sequential design of technological platforms, which incorporate academic and multimedia content, as well as each university's own videos, has not yet become widespread. Although some teachers apply it, it lacks regulation and organization that allows emotion to be a participating factor in the learning process. The authors cited in this article highlight the relevance of emotions in the interaction with students, and video formats not only promote literacy, but also generate motivation and engagement in students.

To achieve this, formats, searches, and filters in visual media need to be adapted to the content and engineering techniques learned at university. Adaptation, however, requires appropriate teaching styles and methods. In conclusion, it is vital to incorporate elements that enable this type of learning and teaching style in a digital environment. This implies a shift in traditional educational dynamics towards one that takes advantage of the opportunities presented by the digital age (Krumm et al., 2022; Thomas et al., 2022).

The focus is on the student processing information in digital formats, such as videos, and the teacher filtering and regulating the content. This shift challenges the traditional practice of knowledge transmission in universities. Knowledge is now accessible online and undergoes more agile iterations, enriched by interactions on social networks (Stefanidis et al., 2018; Weber, Prilop, and Kleinknecht, 2023; D'Aquila, Wang, and Mattia, 2019).

Table 3 is presented, which allows us to summarize in the form of conclusions the ideas discussed, in addition to the support and effectiveness that can be achieved as learning by using multimedia content and video:

TABLE 3
DESCRIPTIVE RATINGS BY FREQUENCY OF MULTIMEDIA AND VIDEO USE IN ENGINEERING STUDENTS' CLASSROOM SESSIONS

IDEA STUDIED	STUDY SUPPORT	LEARNING EFFECTIVENESS
Use of videos as a source of information	Students use videos on social media and web content for academic projects.	Teachers can provide guidance on the selection and critical evaluation of videos. Students should learn to identify relevant and reliable content.
Consultation and sharing in study groups	The highest values relate to the use of videos for consultation and in study groups.	Teachers can encourage the integration of videos into group discussions. Students should learn to communicate and discuss the information obtained from the videos.
Expansion of content taught in class	Students use videos to supplement material taught in class.	Teachers should provide guidance on how to relate videos to the topics covered. Students should understand how videos extend the content presented in class.

IDEA STUDIED	STUDY SUPPORT	LEARNING EFFECTIVENESS
Applicability of engineering methods and techniques	Students emphasize the importance of understanding the applicability of engineering techniques.	Teachers should contextualize the videos and show how the methods and techniques are applied in real situations. Students should reflect on the usefulness and limitations of the techniques presented in the videos.
Use of digital and multimedia platforms	Students want university platforms to promote the use of videos and multimedia resources.	Teachers can encourage the creation and sharing of videos on academic platforms. Students should explore and take advantage of the multimedia resources offered by the institution.
Learning related to visibility and applicability	Most students associate learning with understanding and applying engineering in academic contexts.	Teachers should provide concrete examples of how the concepts are applied in real engineering. Students should look for connections between the theoretical content and its practical application in the videos.
Effective use of multimedia and videos	Students value visualization for understanding concepts, especially in the sequencing of courses.	Teachers can recommend strategies to improve comprehension when watching videos. Students should take notes and ask questions while watching the videos to maintain an active focus.
Clear presentation and description of videos	Students consider a concise presentation of videos with attachments and keywords important.	Teachers can instruct on how to structure the description of the videos. Students should select videos with complete and relevant information.
Complementarity of models and resources	Students seek videos accompanied by additional materials such as mathematical models and reference links.	Teachers can link additional resources to the videos they share. Students should take advantage of these resources to deepen their understanding and broaden their knowledge.
Value of immediacy in understanding	Students find viewing more effective than reading and value immediacy in comprehension.	Teachers can highlight how videos allow for quicker comprehension. Students should develop skills to visually analyze information critically and efficiently.

Source: Own elaboration based on the evaluation of the study.

Video integration does not seek to eliminate the textual content needed in many careers, but rather to diversify learning tools. The use of visual and auditory senses is valued to make engineering methods more engaging, by combining technical content with emotion. Learner autonomy and flexibility are encouraged, as accessibility on university platforms can be assessed and organized.

The mediation of multimedia content and videos opens up a perspective to evaluate their effectiveness on an individual student basis. This not only constitutes a cognitive proposal in the sequence of work of each engineering course but also infuses emotion through this sequential relationship. The decrease in the use of text and its relative ineffectiveness in conveying content and explanations highlight the significance of coherent explanations that can be seamlessly integrated into the student-content relationship (López-Buenache et al., 2022).

Adaptation involves not only technology but also the incorporation of comprehensive metrics to assess the teacher's production of content, including the conveyed emotions. It is proposed to reduce distractions in videos to encourage student reflection. Techniques such as digital reflection with the use of prompts, such as organized forms of requesting consequent antecedents of ideas and questions to an AI (artificial intelligence), are employed to structure web content (Aldabas, 2023).

Adaptability, collaboration, and a personal thought process that combines visual and auditory elements are therefore required. The use of technologies such as artificial intelligence and the creation of digital

scientific discourses are integral parts of the new educational environment. Interdisciplinary interaction, collaboration, and individual reflection are essential for generating meaningful learning that fully utilizes multimedia and video resources.

The use of videos and multimedia in interprofessional education is crucial for fostering collaboration and problem-solving skills. This practice is particularly important in fields like medicine, which can serve as a valuable reference for engineering students to apply in their careers. Videos enable active intervention, promoting effective learning through visual stimuli. Disciplinary differences impact how concepts are taught through video. For example, the social sciences often utilize online collaborative approaches. There is even a reference to the use of artificial intelligence, where predictive models for video styles demonstrate the effectiveness of combining visual and verbal styles.

ACKNOWLEDGEMENT

Translated & edited by American Publishing Services (https://americanpublishingservices.com/).

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