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What makes educational videos useful? Design patterns and student perceptions in the Peruvian higher education context

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Abstract

Educational videos have become essential in higher education; however, understanding which design attributes improve their usefulness remains unclear, particularly in Latin American contexts. This study examines how specific design attributes influence Peruvian undergraduate students' perception of the usefulness of this type of digital content. Using Activity Theory as a framework, this study tested a PLS-SEM model organizing eight design attributes into three second-order dimensions: Learning Control (playback speed, video design, duration), Learning Communication (instructor credibility, depth of explanation, clarity), and Learning Context (study-environment suitability, advertising distraction). The study analyzed data from 128 undergraduates who evaluated a randomly assigned video. Results show that Learning Communication and Learning Control significantly predict perceived usefulness, jointly explaining 51.9% of variance, while Learning Context shows no significant effect. Component-level analysis reveals that instructor credibility and explanatory depth are the strongest drivers within communication, while video design and duration dominate control effects. These findings indicate that instructor-related attributes and learner-control features are the primary determinants of educational video usefulness, suggesting that in resource-constrained settings investments in communication quality and navigation affordances yield greater returns than contextual enhancements.

Keywords: Educational videos, perceived usefulness, activity theory, video design attributes, higher education

Introduction

In Peru, higher education quality has become a national priority because, although university enrollment has grown in recent decades, academic learning outcomes have not improved (Organization for Economic Co-operation and Development [OECD], 2016). From an operational perspective, this country defines university quality as the extent to which institutions meet basic quality conditions (“condiciones básicas de calidad”, CBC). This licensing process establishes enforceable standards outlined in the University Law for the authorization and supervision of higher education services (Ministerio de Justicia y Derechos Humanos, 2023). Beyond licensing, academic program accreditation—understood as external evaluation aimed at continuous improvement—represents a higher level of educational quality evaluation, given that accredited programs are associated with improvements in academic quality, student learning, and graduate employability (Srijampana et al., 2025).

This reform of the Peruvian higher education system has consolidated institutions that successfully passed these processes while removing those that did not meet the CBC. As of June 2025, 100 universities held valid institutional licenses (Superintendencia Nacional de Educación Superior Universitaria [SUNEDU], 2025), while 44 universities and two graduate schools had been denied their licenses (SUNEDU, 2024). Figures for the accreditation process are lower: the official National System

for the Evaluation, Accreditation, and Certification of Educational Quality (SINEACE, its acronym in Spanish) currently lists 91 programs with active accreditation across all higher education institutions (SINEACE, 2025). This accreditation gap coexists with low national investment in research and development—0.16% of GDP in 2022 (World Bank, 2025)—and significant shortcomings in the capacity of teaching staff at public universities (Ministerio de Educación [MINEDU], 2023). These factors limit the quality and innovation of universities. Public perception reflects this situation: in 2024, 53% of the population rated the Peruvian national education system as "poor," and 37% of respondents identified inadequate infrastructure as a top challenge (IPSOS, 2024).

Educational quality is a significant component of a country's human capital and is associated with greater productivity and economic growth (Hanushek & Woessmann, 2021). At the macroeconomic level, substantially improving population skills is associated with growth in GDP per capita in the long run (Hanushek & Woessmann, 2021). At the microeconomic level, education generates tangible economic returns such as higher incomes (Psacharopoulos & Patrinos, 2018). For Peru specifically, recent evidence confirms a positive relationship between education and income, although the strength varies by economic sector (Chacaltana & Moreno, 2025). Despite its importance, significant educational quality gaps exist, and to mitigate this problem, a potential strategy for integrating information technologies (ITs) into learning processes might improve learning achievement when implementation aligns with sound instructional design principles (Tamim et al., 2011). For example, intelligent and adaptive tutoring systems positively impact student evaluations (Kulik & Fletcher, 2016). Similarly, courses with active learning practices supported by ITs have achieved superior outcomes than traditional classes (Freeman et al., 2014).

Within technology-enhanced higher education practices, multiple digital modalities, including social-media video, massive open online courses (MOOCs), and Artificial Intelligence (AI) applications, are concurrently studied and implemented to support the learning process (Zawacki-Richter, 2025). Evidence indicates that well-designed videos that apply multimedia principles, such as signaling, segmentation, and coherence, can improve learning outcomes in higher education, and that microlearning formats may reinforce specific concepts (Noetel et al., 2021). In addition, prior studies show that students prefer pre-recorded videos as a learning format and tend to rate reading-centered courses as less effective (Watson et al., 2023).

Based on the above discussion, the objective of this study is to analyze which of the following video design attributes—playback speed, overall video design, duration, in-video advertising distraction, instructor credibility, depth of explanation, instructor clarity, and study-environment suitability—are associated with higher perceived usefulness among Peruvian undergraduates. The findings of this study aim to provide design guidelines for educators, universities, and creators of educational content.

Literature Review

Educational videos have become a central component of higher education pedagogy. A comprehensive meta-analysis of 389 studies found that video improves learning outcomes, with larger effects when it supports rather than replaces existing teaching methods (Noetel et al., 2021). This review focuses on the design attributes that shape these learning outcomes. Research on multimedia learning has identified several principles that consistently improve results. Segmentation—breaking content into learner-paced units—produces small to medium effects on retention and transfer while reducing cognitive load (Rey et al., 2019). Similarly, signaling through visual or auditory cues has demonstrated reliable benefits (Schneider et al., 2018). For example, eye-tracking studies confirmed that signaling led to concentrated attention on relevant information, reducing off-target fixations (Deng et al., 2023). Captions provide another robust pathway, supporting comprehension, attention, and memory across diverse populations (Alotaibi, 2023; Gernsbacher, 2015).

Beyond these structural features, video length and playback speed represent critical design decisions. Observational research on MOOCs found that engagement drops sharply beyond 6 minutes (Guo et al., 2014). In addition, experimental evidence indicates that viewing speeds up to 2X can maintain comprehension when videos include strong visual support (Chen et al., 2024). Similarly, options such as the presence of the instructor in the video have received considerable attention, although with non-conclusive results (Kühl et al., 2025; Polat et al., 2023; Schneider et al., 2024).

Converting passive viewing into active learning often involves interactive elements and learner control. Embedded questions without feedback have been shown to improve the learning process (van der Meij & Böckmann, 2021), while questions in pre-class videos have increased student engagement (Deng et al., 2023). In addition, platform features that enable control might support self-regulated behaviors that correlate with better outcomes. Research has found that video-viewing patterns such as pauses, rewinds, and selective rewatching relate to motivational dynamics and performance, with distinct learner profiles emerging from the data (Liao & Wu, 2023). Students tend to pause at points of conceptual transition and perceived difficulty, adaptively managing cognitive load (Akçapnar et al., 2024).

While the abovementioned design attributes influence learning through cognitive and attentional mechanisms, video adoption also depends on user perceptions. The Technology Acceptance Model (TAM) identifies perceived usefulness (PU) and perceived ease of use (PEOU) as primary predictors of behavioral intention and use (Davis, 1989). Recent studies have extended TAM to video platforms and MOOCs; for example, Indian educators' adoption of these platforms was influenced by perceived usefulness, ease of use, social context, and content quality (Virani et al., 2023). However, most adoption studies measure perceived usefulness at the platform level rather than the individual video or design attribute level (Alharbi, 2023; Virani et al., 2023; Wang et al., 2024).

Despite the contributions of prior studies, two gaps remain. First, prior studies have assessed perceived usefulness at the platform or course level without examining how specific video design attributes—namely, duration, caption quality, playback speed, depth of explanation, clarity, instructor credibility, or presence of advertising distractions—relate to a video's usefulness. Second, research on video acceptance in Latin America relies primarily on open-ended surveys documenting general perceptions of utility (Arroyo-Barrigüete et al., 2019; Velarde Alvarado et al., 2020), with few studies employing standardized acceptance models to examine relationships between fine-grained design attributes and perceived usefulness. This study addresses these gaps by investigating which video design attributes are associated with higher perceptions of video usefulness among Peruvian undergraduate students.

Theoretical Framework

Activity Theory (AT)

AT conceptualizes learning as an object-oriented activity in which a subject acts on an object through mediating artifacts, within a sociocultural system of rules, community, and division of labor. The activity system—rather than the individual or the tool in isolation—is the unit of analysis; artifacts are not neutral because their design shapes attention, pacing, and coordination costs; whereas contradictions among system elements explain variability in outcomes (Engeström, 2001; Kaptelinin & Nardi, 2006).

In higher education virtual environments, this general formulation is commonly operationalized into three analytic blocks that make social and organizational mediation observable in practice: learning control, learning context, and learning communication (Liaw et al., 2010; Libaque-Saenz & Armijos, 2025). Figure 1 visualizes this adapted AT system: the classic Subject–Object–Tools triangle rests on a base representing the three aforementioned analytic blocks. This conceptualization makes explicit that organizational conditions and communicative design guide and constrain how students use these tools.

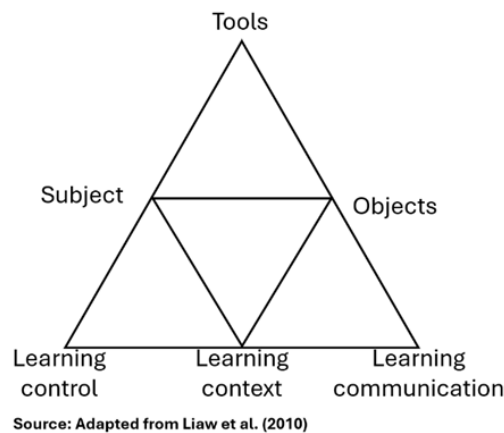


Figure 1. Virtual Learning Analysis Framework

In this study, the student is the subject, the educational video is the object, and the mobile phone, tablet, or laptop is the mediating tool through which the student acts on the object. These lenses shift the question from whether video "works" to how and when it works, as a function of the fit between artifact design, pedagogical guidance, and concrete use conditions. Figure 2 shows the Subject–Tools–Object map for this study's context (student → mobile → video), which anchors the research model.

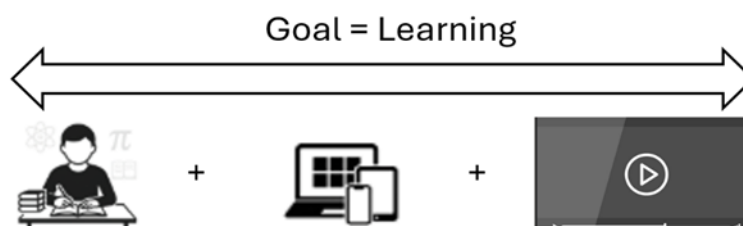


Figure 2. Student–Mobile–Video (Subject–Tool–Object)

Within this applied AT framework, the three analytic blocks clarify how activity unfolds when Peruvian undergraduates study with educational videos. Learning communication concerns how the material addresses the learner (verbal–visual alignment, signaling, captions/transcripts, guided instructor presence). Learning context refers to viewing conditions that constrain what design can achieve (e.g., whether viewing is uninterrupted and where students study). Learning control comprises design and behavioral affordances that give students command over focus and pace (breaking content into manageable chunks, keeping videos brief, pausing and rewinding, and adjustable playback speed). In short, communication, context, and control are the channels through which design and local conditions shape how students use educational videos to pursue their academic objectives and, in turn, determine their perception of the videos' usefulness.

Potential Dimensions of Learning Control, Context, and Communication

Within this framework, perceived usefulness (PU) functions as the dependent construct. Following Davis (1989), PU is defined as the degree to which a person believes that using a particular system would enhance their performance. In the present study, PU refers to students' belief that a given educational video improves their learning process and academic outcomes, capturing the extent to which the mediating artifact successfully supports the pursuit of the learning objective as shaped by the three analytic blocks.

Prior work suggests that beliefs about educational videos may vary across contexts. As a preliminary step, this study conducted an open-ended salient-belief elicitation following established procedures (Ajzen, 2002). The elicitation was conducted with a convenience sample of 43 Peruvian undergraduate students from a large university in Peru, recruited in class during the first stage of data collection. This sample was independent from the main study sample of 128 participants. Responses were collected via a short questionnaire administered in Spanish and thematically coded to identify the most frequently mentioned beliefs, which were subsequently operationalized as the eight design attributes (V1–V8) examined in this study. Themes mentioned by a small minority of respondents or that conceptually overlapped with constructs already in the model—including interactivity and multimedia richness, both highlighted in prior literature—were not retained as separate first-order variables; these could be examined independently in future research.

Building on this open-ended elicitation process, this study found a set of eight variables. Variables from V1 to V3 capture learning control (design affordances that let students command focus and pace), because they enable students to regulate viewing pace and manage how content is structured and presented. Variables from V4 to V6 capture learning communication (how content is presented and explained) because they determine how effectively instructional messages are delivered to learners. Finally, V7 and V8 summarize the learning context (boundary conditions for what design can achieve) because they reflect environmental conditions that enable or constrain effective video use. Table 1 gives the standardized labels and operational definitions of each variable.

Table 1. Variables and Operational Definitions

Code	Variable (Label)	Operational definition
V1	Playback speed	Ability to adjust playback rate to match comprehension and task demands during educational-video study
V2	Video design	Structural and interface features (layout, segmentation, basic controls) that support navigation and sustained focus
V3	Video duration	Length is bound to a coherent unit that can be completed in one sitting without overloading attention
V4	Instructor credibility	Perceived expertise and trustworthiness of the presenter as signaled by delivery, references, and presentation
V5	Depth of explanation	Inclusion of worked steps and justifications that move beyond surface description to enable application
V6	Instructor clarity	Lucid, well-paced exposition that reduces ambiguity and aligns spoken content with what is shown
V7	Study-environment suitability	Absence of external distractors (ambient noise, mind wandering, social media interruptions)
V8	In-video advertising distraction	Presence of ads/overlays/notifications that interrupt or compete with attention while viewing

Based on the above categorization, this study conceptualized Learning Control, Learning Communication, and Learning Context as formative higher-order constructs. This formative specification is justified because each first-order variable captures a distinct aspect of its higher-order construct rather than reflecting a common underlying factor. Consider Learning Control: playback speed (V1) addresses temporal regulation, video design (V2) concerns visual organization, and duration (V3) relates to content segmentation—three conceptually distinct design features that jointly define learner control. Removing any one of these would substantively alter what Learning Control represents (MacKenzie et al., 2011). A well-designed video (V2) can coexist with poor playback speed options (V1) or excessive duration (V3), illustrating that these dimensions contribute independently to the overall construct. Similar reasoning applies to Learning Communication, where instructor credibility, depth, and clarity represent complementary but distinct communicative elements, and to Learning Context, where study-environment suitability and advertising distraction capture different contextual constraints. This pattern supports the formative specification of these variables.

Research Model

This section presents directional hypotheses linking three Activity-Theory-based dimensions of educational videos to PU among Peruvian undergraduate students. Within the structural model, these three blocks—Learning Control, Learning Communication, and Learning Context—function as formative second-order constructs, each reflected by its corresponding observed variables (i.e., first-order variables). Based on Figure 4, this study presents three directional hypotheses.

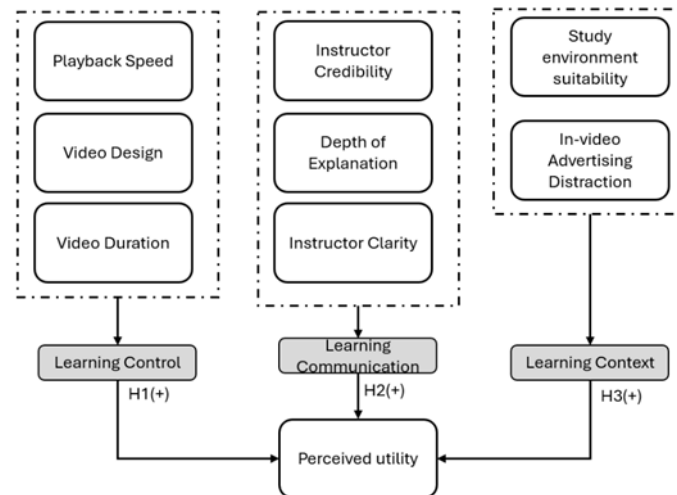


Figure 4. Proposed Research Model and Hypotheses

AT conceptualizes learning as a goal-directed activity mediated by tools within sociocultural systems (Jonassen & Rohrer-Murphy, 1999). In video-based learning, moderate playback speed adjustments can maintain or improve efficiency when visual support is strong, and students regulate pace thoughtfully, helping them extract key ideas without losing comprehension (Chen et al., 2024; Huang et al., 2025). Applying multimedia design principles such as segmentation and signaling helps manage cognitive load and is consistently associated with better learning outcomes (Rey et al., 2019; Schneider et al., 2018). Large-scale MOOC evidence also shows that shorter, purposeful videos are linked to sustained engagement and higher evaluations of course materials (Guo et al., 2014; Zhu et al., 2022). Hence:

H1: Learning Control is positively associated with the video's PU

AT emphasizes that learning activities are mediated by communicative processes within the activity system, rather than solely by individual cognition (Engeström, 2001). Empirical studies show that instructor credibility—qualities that convey expertise and trustworthiness—shapes learners' judgments about whether a resource is worth their time and effort, thereby supporting more favorable evaluations of instructional materials (Gray et al., 2011; Polat et al., 2023). Evidence from Ibero-American contexts indicates that students view videos as useful when explanations address their learning needs with sufficient detail for exam preparation and review, and when design features support understanding (Arroyo-Barrigüete et al., 2019; Velarde Alvarado et al., 2020). Clear, well-structured delivery, with signaling and attentional guidance, makes content easier to process and connect with, which typically improves students' perceptions of instructional value (Schneider et al., 2018). Hence:

H2: Learning Communication is positively associated with the video's PU

Within AT, tools operate within material and social conditions that can enable or constrain their effects on learning (Liaw et al., 2010; Libaque-Saenz & Armijos, 2025). In higher education, contextual factors such as noise, interruptions, and competing tasks are salient issues. Peruvian research on task-distractor

effects underscores the relevance of environmental and attentional demands to university students' academic activities (Mamani-Benito et al., 2023). Study-environment suitability shapes the extent to which design features can realize their intended benefits. In contrast, in-video advertising distraction can intrude on the flow of content, divert attention, and reduce judgments regarding value in short-video environments (Zhao & Wang, 2020). Hence:

H3: Learning Context is positively associated with the video's PU.

Research Methodology

Measurement Instrument

An online questionnaire (in Spanish) with 5-point Likert scales (1 = Completely disagree; 5 = Completely agree) was used. Respondents answered immediately after viewing the randomly assigned video and rated all statements about it. The dependent variable was PU. Each construct was measured with 2 or 3 items adapted from prior literature, as summarized in Table 2. (The complete list of items can be accessed at <https://tinyurl.com/bdftp6ke>, as additional material).

Table 2. Measurement Items

Variable	Items	Likert	Adapted from
Playback speed	2	5-point	Chen (2008)
Video design	3	5-point	Miao et al. (2021); Teo et al. (2025)
Video duration	2	5-point	Zhu et al. (2022)
Instructor credibility	3	5-point	Gray et al. (2011)
Depth of explanation	3	5-point	Shah (2024)
Instructor clarity	2	5-point	Bolkan (2017)
Study-environment suitability	3	5-point	Li et al. (2021); Mamani-Benito et al. (2023)
In-video advertising distraction	2	5-point	Derryberry and Reed (2002)
Perceived Usefulness	3	5-point	Chen (2008); Cheon et al. (2012)

It is important to note that the three second-order variables were measured using a two-step approach. The first step is to repeat the items of their first-order variables in the second order. The second step then involved using the latent scores from the first step to run the structural model. This process applies to Learning Control, Learning Communication, and Learning Context.

Data Collection

This study targeted Peruvian undergraduate students who had utilized educational videos to complement their university coursework within the preceding three months. Data were collected through a self-administered, voluntary online questionnaire distributed via Google Forms. A multi-channel recruitment strategy was implemented, encompassing in-class distribution of QR codes, university email campaigns, and social media dissemination. Additionally, snowball sampling was employed to extend the reach within the target population.

Participants were randomly assigned to one of three educational videos in Spanish, each approximately 3 minutes long, selected from publicly available YouTube content. All three videos contained a single mid-roll advertisement of similar duration that could not be skipped. The first video covered Spanish adverbs (51 respondents, 39.8%), the second addressed geometric figures in the Cartesian plane (39 respondents, 30.5%), and the third covered cell biology (38 respondents, 29.7%). Random assignments were applied in order to minimize topic-driven selection bias across groups.

Data Analysis

This study employed structural equation modeling (SEM) to evaluate the research model, as the hypotheses propose causal relationships among latent constructs. In this study, nine first-order variables—playback speed, video design, video duration, instructor credibility, depth of explanation, instructor clarity, study-environment suitability, in-video advertising distraction, and perceived usefulness—were modeled as reflective latent variables. Additionally, the three second-order latent variables—Learning Control, Learning Communication, and Learning Context—were modeled as formative. The structural model tested paths from these three higher-order constructs to PU (H1–H3). The analysis was conducted using SmartPLS 4.0.

Sample

Data were collected in October and November 2025, and 128 valid responses were retained for analysis. Following the recommendation of Cohen (1992) on sample size, and considering that there are three independent variables in the research model (Learning Control, Learning Communication, and Learning Context), a minimum of 36 observations would be necessary to detect an R^2 value of at least 0.25 to achieve a statistical power of 0.8 at a significance level of 0.05 (Hair et al., 2017). The sample size of 128 in this study met this requirement.

The sample comprised 69 females (53.9%) and 59 males (46.1%) participants. Regarding age distribution, 75 respondents (58.6%) were between 21 and 23 years old, 44 (34.4%) were between 18 and 20 years old, 7 (5.5%) were between 24 and 26 years old, and 2 (1.6%) were over 26 years old. Academic level varied across the sample, with the highest concentrations in the eighth and tenth semesters (28 respondents, 21.9%; and (28 respondents, 21.9%, respectively), while other semesters ranged from 1 to 18 participants. The sample included students from multiple academic programs, predominantly Business Engineering and Information Engineering, followed by Economics, Administration, and various other disciplines, including Medicine, Law, Psychology, Design, and Architecture.

Results

Analysis of Reliability and Validity for First-order Variables

The measurement model for the nine first-order constructs was assessed through three key assessments: construct reliability, convergent validity, and discriminant validity. Regarding construct reliability, composite reliability (CR) values were used. Following established thresholds (Nunnally, 1978), all CR values exceeded the minimum acceptable value of 0.70 across the multi-item first-order constructs, as is shown in Table 3.

Convergent validity was assessed through two criteria: indicator loadings and average variance extracted (AVE). Two indicators, IVD2 and SES2, had loadings below 0.70 and were therefore removed from the model. Following Barclay et al. (1995), this study verified that, in the final measurement model, all remaining indicator loadings exceeded 0.70, confirming that each item contributes adequately to its respective construct. Additionally, AVE values for the first-order constructs ranged from 0.678 to 0.888, all surpassing the 0.50 threshold recommended by Hu et al. (2004). Table 3 presents the complete results for composite reliability coefficients and AVE values.

Table 3. Reliability and Convergent Validity

Construct	CR	AVE
Playback speed	0.912	0.839
Video design	0.919	0.790

Video duration	0.941	0.888
Instructor credibility	0.913	0.778
Depth of explanation	0.938	0.834
Instructor clarity	0.913	0.840
Study-environment suitability	0.808	0.678
Perceived Usefulness	0.918	0.789

Note: In-video advertising distraction was measured with a single item, thus, CR and AVE values were not calculated.

Discriminant validity was assessed using the heterotrait-monotrait ratio (HTMT). According to Kline (2011), HTMT values should remain below 0.85 for conceptually distinct constructs. As shown in Table 4, HTMT values ranged from 0.022 (VDU–IVD) to 0.739 (IC–ICla), all of which fell below the 0.85 threshold, indicating adequate discriminant validity.

Table 4. Heterotrait-monotrait Ratio (HTMT)

Construct	PS	VDe	VDu	IC	DE	ICla	SE	IVD	PU
PS									
VDe	0.523								
VDu	0.354	0.689							
IC	0.264	0.440	0.550						
DE	0.510	0.615	0.588	0.553					
ICla	0.317	0.513	0.657	0.739	0.648				
SES	0.221	0.422	0.591	0.464	0.425	0.701			
IVD	0.314	0.196	0.022	0.143	0.173	0.108	0.244		
PU	0.384	0.560	0.645	0.720	0.544	0.540	0.465	0.102	

Note: PS = Playback speed, VDe = Video design, VDu = Video duration, IC = Instructor credibility, DE = Depth of explanation, ICla = Instructor clarity, SES = Study-environment suitability, IVD = In-video advertising distraction, PU = Perceived usefulness

Analysis of Reliability and Validity for Higher-Order Variables

Because the higher-order constructs are specified as formative, the first step was to examine potential multicollinearity among their components. Variance inflation factor (VIF) values were computed for the first-order dimensions that act as formative inputs to the three higher-order constructs. In the case of Learning Control, VIF values range from 1.237 to 1.775 across its components. For Learning Communication, the values ranged from 1.519 to 1.880, while the VIF values for the Learning Context components were all 1.032. All values are well below the recommended threshold of 5 for formative indicators (Hair et al., 2017), indicating that multicollinearity is not a concern and that the components can be interpreted jointly when evaluating the higher-order constructs.

After establishing that collinearity values were acceptable, the formative weights and component loadings were evaluated. In this hierarchical specification, the path from each first-order dimension to its corresponding higher-order construct represents the formative weights and indicates the relative contribution of each component. Following recommendations for reflective–formative models (MacKenzie et al., 2011), these paths were examined for magnitude and statistical significance using

the bootstrapping procedure implemented in SmartPLS. Table 5 summarizes the estimated weights, loadings, and R^2 values for the components of the three higher-order constructs.

Table 5. Formative Weights and Loadings of Higher-Order Variables

Relationship	Weight	Loading	R^2
Learning Control			
Playback speed	0.195	0.535*	99.7%
Video design	0.312*	0.812*	
Video duration	0.687*	0.934*	
Learning Communication			
Instructor credibility	0.747*	0.948*	99.6%
Depth of explanation	0.345*	0.738*	
Instructor clarity	0.053	0.707*	
Learning Context			
Study-environment suitability	0.981*	0.905*	100%
In-video advertising distraction	-0.432	-0.260	

Note: * $p < 0.05$

The paths from the first-order dimensions to their respective higher-order constructs were analyzed. These paths represent the weights of the components; therefore, they should be significant (MacKenzie et al., 2011). Table 5 shows that the proposed model met this criterion for most components. For Learning Control, video duration and video design exhibited significant weights. Playback speed did not show a significant weight; however, its loading was larger than 0.5, suggesting that while it might not have significant relative importance, its absolute importance for explaining Learning Control is sufficient to retain it in the model. The three components explained 99.7% of the variance in Learning Control, with video duration being the strongest component, followed by video design and playback speed. For Learning Communication, instructor credibility and depth of explanation showed significant weights. Instructor clarity did not exhibit a significant weight, but its loading exceeded 0.5, indicating adequate absolute importance and warranting its retention in the construct. Similarly, the three components explained 99.6% of the variance in Learning Communication, with instructor credibility as the strongest component, followed by depth of explanation and instructor clarity.

For Learning Context, a different pattern emerged. Although the collinearity statistics for both components were acceptable, only study-environment suitability exhibited a significant weight and a strong loading. By contrast, in-video advertising distraction displayed neither a significant weight nor a loading above 0.5. In line with recommendations for formative measurement (Hair et al., 2017), a component that does not meaningfully contribute may be removed to improve parsimony and measurement quality. Consequently, in-video advertising distraction was removed from the final specification. In the refined model, Learning Context is represented solely by study-environment suitability, which explained 100% of the variance in this construct.

Structural model

To assess the explanatory power of the proposed structural model, this study examined the R^2 values of all latent constructs and the paths corresponding to the three hypotheses. The structural model accounts for 51.9% of the variance in perceived usefulness ($R^2 = 0.519$), representing moderate explanatory power for an exploratory study in this context. This suggests that the three AT dimensions capture a

substantial portion of the factors influencing students' perceptions of usefulness, though other variables not included in the model, such as prior knowledge, motivation, or subject matter, may also contribute.

The path analysis reveals that two of the three higher-order constructs significantly predict perceived usefulness. Learning Communication exerts the strongest influence ($H2, \beta = 0.435, t = 5.238, p < 0.001$), indicating that instructor credibility, depth of explanation, and clarity are central to students' judgments of video usefulness. At the component level, instructor credibility (weight = 0.747) emerges as the most important driver within Learning Communication, contributing more than twice as much as depth of explanation (weight = 0.345). In contrast, instructor clarity exhibits a negligible formative weight (weight = 0.053).

Learning Control also exerts a significant positive effect ($H1, \beta = 0.313, t = 3.442, p = 0.001$), suggesting that features enabling control over pacing and structure contribute meaningfully to perceived usefulness. Within Learning Control, video duration (weight = 0.687) constitutes the dominant component, with a contribution more than double that of video design (weight = 0.312), while playback speed shows minimal formative weight (weight = 0.195). In contrast, Learning Context does not significantly affect perceived usefulness ($H3, \beta = 0.091, t = 1.024, p = 0.306$). This non-significant result suggests that environmental factors, as represented by study-environment suitability, may be perceived as less central to the video's inherent value, or that students distinguish between content quality and viewing conditions when evaluating usefulness.

Discussion and Implications

This study examined how design attributes of educational videos relate to perceived usefulness among Peruvian undergraduate students. Eight first-order constructs were organized into three formative higher-order variables: Learning Control (playback speed, video design, video duration), Learning Communication (instructor credibility, depth of explanation, instructor clarity), and Learning Context (study-environment suitability, in-video advertising distraction). The findings reveal that Learning Communication and Learning Control significantly predict perceived usefulness, whereas Learning Context does not.

Component-level analysis reveals important patterns in how first-order attributes form the higher-order constructs. For Learning Control, video duration emerged as the most influential component, followed by video design, while playback speed contributed minimally. These results suggest students' sense of control stems primarily from having appropriately sized video segments rather than from technical playback features. For Learning Communication, instructor credibility was the dominant driver, with depth of explanation playing a secondary role, while instructor clarity showed a negligible unique contribution. This hierarchy indicates that students prioritize whether they trust the instructor over how clearly information is presented, assuming a baseline level of clarity. For Learning Context, study-environment suitability almost entirely captured the construct, while in-video advertising distraction showed no contribution and was removed from the final model.

The non-significant Learning Context effect has two plausible explanations. First, because the survey was self-administered online, participants likely completed it in settings they had already judged adequate for focused viewing, which may have compressed variance in perceived study-environment suitability. Second, students accustomed to consuming educational content across diverse settings may find environmental factors less salient in their usefulness judgments.

Theoretical Implications

The study validates a higher-order PLS-SEM model grounded in Activity Theory, in which video attributes are organized into three second-order constructs that predict perceived usefulness. The findings demonstrate that utility evaluations depend more on communication delivery and learner

control than on contextual factors. The component-level results refine design theories in significant ways. The dominance of video duration in Learning Control extends prior research by showing that temporal structuring outweighs technical affordances in shaping perceptions of learner control. The primacy of instructor credibility in Learning Communication adds nuance to instructional design literature by revealing that trust in the instructor matters more than presentation clarity, suggesting these are distinct dimensions rather than interchangeable aspects of communication quality. The near-complete capture of Learning Context by study-environment suitability indicates that contextual influences operate mainly through general concentration-enabling conditions, rather than through incidental disruptions such as in-video advertising.

Practical Implications

For instructors and course designers, the priorities below follow directly from the significant predictors. Regarding Learning Communication, instructor credibility was the strongest driver of perceived usefulness; instructors should establish their expertise early in the video and connect concepts to real-world professional experience. Depth of explanation, the second most relevant component, can be strengthened through worked examples and explicit links to previously covered material.

Regarding Learning Control, video duration was the dominant factor: videos should focus on a single, coherent learning objective rather than covering broad topics in one extended recording, splitting content into separate videos when needed. Video design, the second most relevant component, benefits from clear visual organization and segmentation markers for navigation. Universities can support these priorities by training instructors on credibility-building and modular content design, and by ensuring learning platforms support flexible playback and clear content organization.

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