An Assessment Tool for Using Videos and Rich Media in Construction Management Curriculum - A Case Study

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Abstract

The use of rich media, especially videos and illustrative examples, in curriculum is becoming increasingly prevalent in certain areas of study due to its potential positive impacts on the learning environment. In the construction management curriculum, videos and rich media have the potential to benefit students and instructors if properly implemented. However, there are few guidelines or examples of how to determine what media is appropriate, how to utilize the media for a particular construction management subject, and how to assess their effectiveness in achieving instructional goals. Instructors are commonly led to believe that they must embrace the technology prior to seeing how to best position it in their classroom. This type of approach can lead to improper utilization of media, instructor frustration, dissatisfaction, and low learner retention of concepts. The use of rich media in the construction management curriculum is discussed and reviewed. An assessment tool is developed for the appropriateness, design, utilization, and refinement of this media in achieving instructional goals, taking inspiration from the prime leaders in the field of Educational Technology and Instructional Design, to allow instructors in construction management to determine the best uses for rich media in their curriculum. The assessment tool was tested as a case study on a construction management course in applied statics. The tool was determined to aid instructors in the proper utilization of media, decrease instructor frustration with rich media, increase overall satisfaction, and optimize time. Future analysis will be carried out on how the use of rich media impacts learning objectives and outcomes in the construction management curriculum.

Keywords: rich media, construction management, curriculum, educational technology

Introduction

The popularity of using rich media and videos has been growing since the 20th century, where the advent and admiration of new technologies such as the motion pictures, radio, television, and now the computer has closely followed their claims of future benefit in educational contexts and delivery of instruction. Each previous advent in technology was thought would revolutionize the field of education, but enthusiasm and interest in each of these technologies faded. This mentality in which the technology or media is the driver of education is referred to as the technology-centered approach, in contrast to the learner-centered approach, and is deemed as less effective in instructional design[17]. If rich media and videos are to be properly utilized in the construction management curriculum, the implementation approach must be more learner-centered than its predecessor technologies and be properly matched to the specific course.

The use of rich media and videos in instruction has benefits for both instructors and learners, especially in the construction management curriculum. Research has illustrated that both students and instructors believe that technologies such as video recordings should be incorporated into construction management and engineering classrooms[18, 19, 21]. Despite the desire and perceived benefits in the construction management curriculum, the use of some of these rich media has largely remained outside of the classroom, while fields such as healthcare and information technology are reaping the benefits[5, 9]. Some of the reasons suggested for this lack of use are the absence of a complete view of the benefits and limitations of the technologies in the construction management curriculum[15] and a lack of resources for instructors to create the media[19]. Further, in the 2012 American Society for Engineering Education report[2], the call for more educational innovation was met by instructors' lack of confidence in the resources to support such innovations. An assessment tool for using videos and rich media in the construction management curriculum would aid instructors in determining if this instructional media aligns with their construction management curriculum and how to optimize its implementation and achievement of benefits.

Definitions

Information richness is defined as the ability of information to change understanding over time, in turn, rich media are communication tools that serve to clarify ambiguities and increase the learning capacity of a communication[6]. Rich communications media allow the transmission of an array of cues, provide immediate feedback, allow communication with both natural language and numbers, and facilitate the personal focus of messages[11]. According to media richness theory, communication media vary in their capacity to process rich information, with those that provide immediate feedback and are able to reduce misunderstandings quickly being mostly desired[6]. In educational technology, rich media takes on the forms of video, animation, and audio. Animation has been found to support learning when it is simple and coupled with narration, taking advantage of the dual coding channels of the brain[14]. Visuals have found to be beneficial when they are coupled with audio narration and mostly aid learners that are novices[17]. Videos have been quite varied in their design and application to learning environments[22]. The design of rich media for classrooms should be carefully planned to optimize the learning process in the construction management curriculum.

Benefits and Limitations

Rich media and videos have the potential, if properly utilized, to optimize both instructors' and students' valuable time and resources. For students, using videos allows them to access the material on-demand, moderate the controls (start, stop, and speed of videos), and can be watched outside of the classroom environment[1]. This type of executive control and autonomous learning has shown to be more impactful than learning where the learner has no ability to moderate[17]. Rich media and videos also frees up the instructor from having to repeat the material multiple times. In the majority of cases, if the students properly utilize the material prior to class (in a flipped classroom environment), these media can also free up time in the classroom for solving practical problems and allowing the teacher to focus on student application of the material. While there are some upfront costs associated with the creation and production of rich media, it has been observed that, over time these costs are diminished in relation to the time savings realized due to a more efficient learning environment.

Instructors are commonly faced with the challenge of embracing new technologies in their classrooms due to mandates from their upper management, resulting in stress, frustration, and lack of student investment. Forty-three percent of the respondents of the State Educational Technology Directors Association's (SETDA) 2012 Report on National Educational Technology Trends[20] indicated increased teacher education technology proficiency as a top priority for their state's grant programs. The National Academies, consisting of the National Academy of Engineering, is also concerned with what current technologies are being used in higher education and how they may transform the curriculum[16]. Instructors may better approach potential implementations of rich media in their classrooms by having a reference case study and a tested assessment tool.

Use in Construction Management Curriculum

The use of videos and recorded media is not new to the construction management curriculum. The intent and learning objectives in using videos have, however, varied over the years. Videos have been used to record construction operations, building systems/components, give tours of buildings, record interviews of construction managers, and beyond[3, 18, 19]. Another common use of video is termed as "lecture capture," wherein the in-class lectures are recorded and made available to the students after that class[1]. Videos have a variety of uses in the construction management curriculum, with few documented case studies.

Methodology

Performed over three separate semesters, this case study created a foundation and background to the assessment tool for the appropriateness, design, utilization, and refinement of rich media in achieving instructional goals to allow instructors in construction management to determine the best uses for rich media in their curriculum. The case study took place in the same applied statics course at a four-year university, in which the professor had taught the applied statics class for over five years. All of the assessment tool levels were developed as a result of the analysis of performance, instructor feedback, and lessons learned.

In the first semester, Levels 1 and 2 of the assessment tool were developed. In the second semester, the rich media was implemented and the students reported positive impacts as part of the evaluation process. Prior to the beginning of the third semester, the university underwent a large re-accreditation effort, resulting in the repositioning of the rich media and development of Levels 3 and 4 of the assessment tool. At the end of the third semester, a formative evaluation will be carried out to determine the impact of the rich media, with attention to any variations in student performance. The data analysis reveals the impacts of the appropriateness, design, utilization, and refinement of rich media in the applied statics course.

Data Analysis

The goal of this study was not to compare the scores or satisfaction of the students in technology rich versus traditional classrooms, as others have accomplished with mixed or no universal findings[4, 10, 12, 16, 17]. These and other studies have revealed that assessment should be linked

more closely to the particular course, ensuring there is an appropriate design, and that the media fits within the overall context and learning objectives of the course. Thus, the goal of this study is to illustrate and provide a framework that supports the idea that the keys to success in use of rich media and videos is making sure their appropriateness, design, utilization, and refinement aid the course and instructor. The assessment tool was divided into fours different levels. The data leading to the development of each level is presented, along with the educational principles that support the structure of that level.

Assessment Tool – Level 1 – Appropriateness

Whether the use of specific instructional media (rich media, videos, etc.) is appropriate largely depends on the content of the lesson and desired learning objectives and must be determined by the instructor or instructional designer. Gagne's Taxonomy classified the five major categories of learning as: verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills, with each of the five requiring different conditions for learning[7]. Media that is truly rich will facilitate learning by communicating the information to be learned in the most effective way, thus reducing any ambiguities[6]. In some cases, for example with more complex learning such as cognitive strategies, rich media and videos may further complicate the material to be learned. On the other hand, learning objectives related to motor skills, visual representations, and any type of repetitive task can greatly benefit from the use of rich media and videos by allowing the skill to be recorded and viewed again by the learners. In the construction management curriculum, this could take on the form of topics that involve math, physics, and use of software.

The instructors taught other courses at the university, which seemed unfit for this particular use of rich media, leading the instructors to believe there must be a level of assessment based on the appropriateness of the course. Upon analysis of the applied statics course's learning objectives and activities (Table 1), it was determined that the category of learning was intellectual and largely math-based and would greatly benefit from repetition and visual representation.

Table 1 – Learning Objectives and Activities

No.	Objective	Activity
1	Identify where unknown reactions occur on beams, rigid bodies, or trusses	Solve similar problems & practice
2	Calculate unknown reactions on beams, rigid bodies, or trusses	Solve similar problems & practice
3	Identify & interpret internal forces acting within members of a truss/frame	Solve similar problems & practice
4	Classify if internal forces are in tension or compression	Solve similar problems & practice
5	Create shear/moment diagrams	Solve similar problems & practice
6	Analyze & interpret shear/moment diagrams	Solve similar problems & practice
7	Calculate the moment of inertia on common shapes in construction industry	Solve similar problems & practice

Assessment Tool – Level 2 – Design

The design of the media must align with current understanding of cognition and how learning occurs. Learning is a process that enables organisms to modify their behavior fairly rapidly in a more or less permanent way, so that the same modification does not have to occur again and again in each new situation[8]. Thus, once the material to be learned is presented, the goal of instruction is to take information from working memory (limited in capacity) to long-term

memory so that learners can more easily access the information. Due to the limited capacity of working memory, it is very important to not overload the system. In addition to the two memory systems, the brain also has separate channels for processing visual/pictorial information and for processing auditory/verbal information, each with its own load limitations[17]. Thus, the design of media should seek to enhance memory transfer and optimize the use of the dual channels of the brain.

The instructors selected to use create videos and publish them on YouTube, allowing learner regulation of content in memory transfer and would make use of both channels of the brain via visual and text (in addition to audio) in the videos. A total of eight videos were recorded, based on the course's structure (Table 2). The instructors recorded videos that introduced the concepts and took the students through a step-by-step approach to solving at least 4 different practice problems, with a maximum duration of 15 minutes per video. Where possible, examples that were relevant to the construction management industry and illustrations were used. This approach represents a more "blended learning" methodology in which an appropriate mix and use of face-to-face instructional methods and various learning technologies are used to support planned learning and foster subsequent learning outcomes[13]. Students were instructed in advance to watch a particular video prior to coming to class on a particular day and class time was devoted less to introductory concepts, material covered in the video, and more to practical problem solving.

Table 2 – Course Structure

No.	Unit	Topics	Videos
1	Moments	Points, Rigid Bodies, Reactions, Distributed Loads, and Couples	1 – Introduction of Concepts 2 – Rigid Bodies and Sample Problems
2	Shear and Moment Diagrams	Point Loads, Distributed Loads, Combined Loads, and Alternate Beams	1 – Introduction and Sample Problems
3	Trusses and Frames	Method of Joints and Method of Sections	1 – Introduction 1 – Method of Joints 1 – Method of Sections
4	Centroids	Simple Shapes	1 – Introduction and Sample Problems
5	Moment of Inertia	Simple Shapes	1 – Introduction and Sample Problems

Assessment Tool – Level 3 – Utilization

In the second semester, the videos were implemented and both students and instructors reported positive impacts as part of the evaluation process. Overall, instructors reported a positive experience with use of the videos. Students also reported watching the videos multiple times and relying less on the instructor for outside assistance. Due to the success of the eight videos, the instructors decided to add three videos to the course. Two videos were related to the course requirements and responsibilities of the students (i.e. how to keep a professional notebook and format their homework). The other video was related to the review of the prerequisite material the students needed to know, since the university had removed a mandatory requirement of a prerequisite class.

In the utilization level, the instructor needs to give guidance to students, especially on first utilization of the rich media. Some students may not have been exposed to certain rich media in the learning environment and are unaware of the role of the media and the expectations of the student. The student needs to be able to understand how the instructor envisions utilizing the media and how this may impact the role of the instructor and the overall classroom environment. Integrating a mechanism that requires the students to use the videos prior to traditional instruction can benefit the student by exposing them to the material prior to coming to class. More research and testing are needed in how this aligns with student motivation.

Assessment Tool – Level 4 – Refinement

Prior to the beginning of the third semester, the university underwent a large re-accreditation effort, resulting in the repositioning of the rich media and development of this assessment. One of the initial goals was a department-wide collaboration on establishing proper learning objectives for each course. The instructors believe that this effort has positively impacted the third semester's use and realization of the value of rich media in this classroom. The results have not yet been disclosed, but will be under evaluation in a subsequent paper. With the information known, certain areas are evaluated. Special attention was paid to developing a proper understanding of both the impacts of the videos on the students as well as determining how to improve the overall utilization of videos in the construction management curriculum.

Learning should be student-centered, which means that the media and approach to the media may need to be refined depending on the students in the course. Some suggested tools for obtaining feedback regarding this are: student surveys, formative and summative evaluation, and data obtained from learning analytics. Lastly, any student assessment regarding the appropriateness or design of the media should directly relate to any learning objectives for the curriculum since the goal of the media is to better facilitate the achievement of learning objectives.

Results

The instructors are very cautious in comparing student performance across three semesters with dynamic variables, such as: student personalities, instructors' personalities and instructional methods, beneficial adjustments made as a result of university student evaluations, tailoring of examinations to fit student capabilities (student-centered approach), and after a large department-wide reaccreditation effort. Best efforts were made to hold these variables constant, but due to their external nature it is challenging to determine their level of consistency. Nevertheless, the instructors wish to provide an overview of the performance factors that were gathered, give an analysis of instructors' feedback via a survey and interviews, and derive lessons learned (including the need to obtain performance factors that can be compared from traditional teaching environments to rich media curriculum).

Performance

Comparing the first semester's (S1) use of the videos versus the second semester (S2), the frequency of video views, estimated minutes watched, average view duration, and average

percentage viewed increased overall (Table 3). Additionally, the instructors recorded an increase in class attendance from S1 to S2. Attendance records were not available prior to S1 to give an indication of attendance in the traditional classroom environment; however, it is recommended that instructors ensure they have a baseline established prior to implementing rich media to see if there are any other impacts. Individual interviews with students that had taken the course prior to S1 and withdrew for personal reasons reported that the course's use of videos had improved and assisted their understanding of the material when taking the class again in S1. Another student that withdrew from the course in S1 and retook in S2 reported an improvement overall in the videos and a greater feeling of autonomy in their learning. The instructors also noticed an improvement in those students' performance as well.

Table 3 – Video Utilization

No.	Criteria	Average % Increase from S1 to S2
1	Views	339%
2	Estimated minutes watched	520%
3	Average view duration (minutes)	20 minutes
4	Average percentage viewed	46%

Instructor Feedback

A survey and interviews were conducted with both of the course's instructors regarding their use of videos in the curriculum. The instructors reported decreased frustration with media, greater perception of fit of the course with media, decreased time spent tutoring students outside of the classroom, slightly increased time spent on new topics, and overall satisfaction with media (Table 4). Initially, the instructors had anticipated to see a dramatic increase in student performance (due to common misconceptions about instructional media previously mentioned), but instead reported an average deviation of three percent either better or worse than the traditional curriculum versus with the use of videos. The instructors reported the reason for this was that the implementation of rich media in the course was still very new to the environment and full benefits were yet to be realized until the utilization was more refined. The development of the assessment tool incorporated these elements into its design as well as lessons learned from these implementations.

Table 4 – Instructor Evaluation

No.	Criteria	Pre-media	Post-media
1	Instructor frustration with media	Medium	Low
2	Instructor perception of fit of course with media	High	High
3	Instructor time spent tutoring students outside of the classroom on an individual basis	High	Low
4	Instructor time spent tutoring students outside of the classroom on a group basis	High	Low
5	Instructor time spent on new topics	Low	Medium
6	Instructor overall satisfaction with media	n/a	High
7	Instructor perception of student performance improvement	n/a	+/-3%

Lessons Learned and Assessment Tool Target Questions

Upon reflection of the past three semesters, the instructors derived lessons learned and areas of potential improvement for subsequent semesters as: the use of learning analytics, refined video design, and creation of course instructional method introductory materials. One of the areas needing further research is how to best compare student performance in traditional versus rich media environments, despite the dynamic nature of instruction in tailoring the approach to the students' needs and content.

In S2, the instructors were first introduced to learning analytics – a way for instructors to gather data regarding student use of the instructional media (i.e. number of views, estimated minutes watched, areas most re-watched, timestamp of when students watched, etc.), but would have been useful in S1. However, with preliminary analytics provided by YouTube, it was observed that students in S1 watched videos at various times (not always prior to class), while a greater percentage of students in S2 watched them prior (meeting the intent of the videos). With this information, the instructors uncovered the value of more sophisticated learning analytics tools and the need for adequate time and resources to review the learning analytics data and tailor the instruction to the students' needs as gathered by the data.

Due to the instructors' constraints of budget and time, they did not seek out the services of an instructional designer, but would like to explore that option in the future refinement of the media. An option the instructors are considering is adding keyword text to the videos to allow more targeted visual response from the students watching the video or looking to re-watch at a certain step. The instructors also wish to explore the variety of free instructional media tools (video recording, editing, animations, etc.) now available online.

The use of certain rich media is not as widespread at this particular university and department, thus the instructors see value in creating a video about how the learning environment will be intended to work (more of blended learning) and what are the students' responsibilities regarding their learning (more autonomous, self-paced, etc.). For example, the instructors learned in the middle of the semester that requiring the students to complete at least one homework problem that was also solved in the video, prior to coming to class, was greatly beneficial. The instructors had assumed that students knew the benefits of watching the videos prior to class, but had not reinforced this. Proper introductory material would communicate the value and use of the rich media to the student and optimize its benefits, in addition to consistent reinforcement by the instructors.

As a result of the testing of the assessment tool, results analyzed, and subsequent lessons learned, target questions were created to aid each level of assessment (Table 5). It is suggested that if any of the criteria in the assessment are not met to return to the previous level for validation.

Table 5 – Assessment Tool – Target Questions

No.	Level	Target Questions
1	Level 1 - Appropriateness	Does the technology align with learning objectives of the course? Is the type of learning associated with the course capable of being presented efficiently via media (won't over complicate the message)?
2	Level 2 – Design	What technology can be used to optimize transfer to long-term memory? How can sensory overload be avoided?
3	Level 3 – Utilization	How is the media being used in the curriculum? How is the student being made aware of the role of the instructor, media, and

		expectations of the student (and potentially motivated to use the media)?
4	Level 4 – Refinement	What does the feedback suggest to improve the media? How can the media be made more effective in the achievement of the learning objectives of the course?

Conclusion

With the use of rich media in curriculum becoming increasingly prevalent in education, it is perceived that the construction management curriculum has much to gain in using rich media. However, there is a low quantity of research regarding a method for optimizing the implementation of rich media in the construction management curriculum. A four-level assessment tool was developed for the appropriateness, design, utilization, and refinement of this media in achieving instructional goals, taking inspiration from the field of Educational Technology and Instructional Design, to allow instructors in construction management to determine the best uses for rich media in their curriculum. The focus of the tool was in ensuring that the communication of the course content to the students was improved with the use of rich media. The assessment tool was tested as a case study on a construction management course in applied statics over two semesters at a large university.

The assessment tool was determined to aid instructors in the proper utilization of media, decrease instructor frustration with rich media, increase overall satisfaction, and optimize time. Some attention was paid to student performance and is suggested to be further analyzed in future research, after which time, more tests will be conducted. Lessons learned from the instructors' use of videos was that the use of rich media and videos in the curriculum should be refined to meet the course's learning objectives, the needs of the students (learner-centered approach), and to better aid the instructor in delivering the instruction (better utilize instructors' time outside and inside of the classroom). Future analysis will also be carried out on how the use of rich media impacts learning objectives and outcomes in the construction management curriculum.

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