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Exploring the relationship between video lecture usage patterns and students' attitudes

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Abstract
Videos have enhanced the value of teaching and learning, particularly in tertiary education. Recent studies have investigated students' attitudes toward video lectures for educational purposes; however, the relationship between students' attitudes and different usage patterns such as platforms used, video duration, watching period and students' experience, is yet to be explored. To investigate potential attitudinal differences among the diverse video lectures usage patterns, the present study incorporates responses from 40 students who participated in a video-assisted software engineering course. Our results suggest that usage patterns affect students' attitudes to video lectures as a learning tool. The overall outcomes are expected to promote theoretical development of students' attitudes, video-platform design principles, and better and more efficient use of video lectures.

Introduction

Across the globe, many preeminent universities (eg, Stanford, Oxford, MIT, EPFL and Harvard) offer video lectures in most subjects. An increasing number of educators in tertiary education and training organizations are implementing videos in a variety of ways, such as on-demand or live video lectures, capturing and broadcasting face-to-face meetings for review purposes, and assigning videos before class to flip (invert) class time for hands-on activities and critical discussions (Maag, 2006).

Furthermore, there are many video platforms where people can find video lectures (eg, teachertube.com, khan academy, mylearningtube.com). During recent years, an increased interest on educational videos has been observed (Giannakos, 2013). Many universities offer lectures on iTunesU, making course material accessible on a range of devices, like smart phones and tablets. In addition, the number of for-profit organizations who use training or advertising videos is increasing rapidly. Currently, Massive Open Online Courses (MOOCs) are a widely discussed phenomenon in education.

Practitioner Notes

What is already known about this topic

- Many instructors in higher education and training organizations are implementing video lectures in a variety of ways.
- There is a wide variety of video lecture usage patterns (eg, platforms used, video duration, watching period and students' experience).
- Studies have shown that students' usage patterns might have an impact on their intention to adopt some e-learning mediums (eg, web-course).

What this paper adds

- The present study incorporates responses from students who participated in a video-assisted course.
- This research identifies video lectures usage patterns and measures the attitudes of the students who use video lectures in their studying.
- Empirical validation found whether and how certain usage patterns affect students' attitudes.

Implications for practice and/or policy

- Instructors should focus on incorporating video lectures into freshmen syllabi to engage them with the benefits of video lectures early in their education.
- Instructors should also use strategies to encourage students to use the full lecture (instead of parts of it).
- Video lectures are ideal for reviewing and scanning through content; however, watching the full videos increases students' decision to adopt and incorporate this medium in their learning.
- Students' perceive video lectures posted into their institutions to be more useful, even when the videos are exactly the same.

Traditional lectures may no longer primarily serve the purpose of disseminating information, which can be easily found in many online video lecture repositories at any time. In this paper, we use the term video-based learning to refer to the systematic use of video resources for the purpose of achieving defined competences.

Hence, video-based learning might be defined as:

"The learning process of acquiring defined knowledge, competence, and skills with the systematic use of video resources."

Learners have described video lectures as enjoyable, satisfying, motivating and effective with respect to improving their learning (Traphagan, Kucsera & Kishi, 2010). Current research specifies that the analysis with empirical data obtained from students reveals several different usage patterns for video lectures (Walls *et al*, 2010) and highlights the importance of these patterns (von Konsky, Ivins & Gribble, 2009).

Tangible evidence for the field of engineering has already highlighted the importance of usage patterns on the success of web-based courses (Steif & Dollár, 2009). Given the different video lecture usage patterns (eg, platforms used, video duration, watching period and students' experience) and the importance of students' attitudes regarding video lectures, in this study we attempt to understand the impact of usage patterns on students' attitudes.

The purpose of this research is twofold: *first, to map the usage patterns and measure the attitudes of students who use video lectures in their studies; and second, to empirically evaluate whether and how certain usage patterns are related to students' attitudes*. To achieve this, we designed and implemented a video-assisted course at the Norwegian University of Science and Technology (NTNU), extending an existing Software Engineering (SE) course, which targets students who attend the second year (fourth semester) of the undergraduate degree in Computer Science. The research included questionnaires incorporating factors regarding students' attitudes and their usage patterns, in addition to investigating log files from the video platforms. After students used video lectures to assist their studying during the full semester, they were asked to complete the questionnaire based on their intensive experience.

The first step of this research is to investigate the diverse usage patterns of the students who use video lectures. This guides us to the main question of our research.

RQ: What is the relationship between students' usage patterns and their attitudes regarding video lectures?

The paper is organized as follows. The next section outlines the related work and hypotheses development. The third section presents the methodology employed in this study to investigate potential attitudinal differences among diverse video lecture usage patterns. The fourth section presents the empirical research findings of our study. The fifth section of the paper discusses the results, the limitations and the implication of the study.

Related work and hypotheses development

Related work

During recent years, an increasing number of instructors have advocated the use of video lectures for learning (Giannakos, 2013). Video lectures can assist students with taking better notes and studying before tests and exams (Deal, 2007). Van Zanten, Somogyi and Curro (2012) indicated that video lectures are used extensively by students for review purposes, particularly during exam periods. Harris and Park (2008) indicate that video lectures can also be used for various reasons, including dissemination, supplementation and marketing materials. Hence, we can argue that video lectures can provide an easy means for everyone to study.

On the other hand, Weatherly, Grabe and Arthur (2003) have argued against the use of video lectures, based on the assumption that the accessibility of the video lectures could potentially lead to an increase in student absences from class. This is in contrast to the work of Traphagan *et al* (2010) and Brotherton and Abowd (2004), who proved that the attendance of students who are using video lectures is not changing significantly; Traphagan *et al* (2010) also indicated that availability of other digital materials such as presentations has a greater negative impact on students' attendance. Similarly, Malan (2007) found that students of a video-recorded computer science course at Harvard valued video lectures more as a medium for review (45%) than as an alternative to a physical lecture (18%).

Students' use of an e-learning medium is considered an important predictor of successful learning. Hence, research is needed to better understand how instructors and students can be engaged in learning technologies (Liao & Lu, 2008; Liaw, 2008). Past research has investigated several issues concerning the ease of use, acceptance and usefulness of various e-learning mediums such as Moodle (Sánchez & Huero, 2010) and other systems (Ngai, Poon & Chan, 2007). At present, empirical analysis of the usefulness of video lectures and acceptance by different user types are lacking.

Several frameworks have been employed to address many aspects of learning technologies and to identify the importance of usefulness and acceptance of learning systems. The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis & Davis, 2003) and other TAM-related theories are the most widely applied and accepted models in the context of learning

technologies' adoption and acceptance. UTAUT has successfully examined several attitudinal aspects of different learning systems (Giannakos, 2013), and constructs such as intention to use (IU) (known as behavioral intention) and usefulness (USE) (known as performance expectancy) have been identified as key attitudes in the area of e-learning.

Students have indicated (Evans, 2008) that they benefit from the availability of video lectures. Another beneficial characteristic of video lectures is students' ability to control them (Dale & Pymm, 2009) by quickly reviewing content, rewinding and skipping material as they desire. Video lectures are particularly useful before tests and exams for reviewing content and decreasing students' anxiety (Maag, 2006). Moreover, repetitive review and the ability to skip through the lecture content are particularly helpful practices for the students (Maag, 2006). Despite the different usage patterns of students and the importance and great potential of video lectures in teaching and learning, the relationship between students' USE and IU and the different usage patterns such as platforms used, video duration, watching period and students' experience, has yet to be explored.

Hypotheses development

Learners' perceptions change over time. The predictors of continued IU for e-learning technologies would not be the same for all learners; this is particularly clear in learners with different experiences (Giannakos & Vlamos, 2013). The level of website experience influences the students' IU websites for studying (Liao & Lu, 2008); the same applies in the context of video lectures (Giannakos & Vlamos, 2013). Hence, it is reasonable to expect that experience is a significant determinant of students' attitudes, specifically in the USE they perceive and their IU.

USE can be defined as the degree to which students perceive that video lectures improve their knowledge, and IU is the intention to use video lectures for studying. Because the continuing use of video lectures is expected to be positively related to both USE and IU, it is hypothesized that:

H1a: *Students' previous experience (with video lectures) is significantly related to their USE regarding video lectures.*

H1b: *Students' previous experience (with video lectures) is significantly related to their IU video lectures.*

Although videos have been employed in higher education for many years (Giannakos, 2013), several factors regarding students' engagement with and use of videos have changed. For example, students can interact with the content in various ways, video repositories have advanced (eg, iTunes, YouTube) and other interactive video-based systems have appeared (Interactive TV). As such, various technological tools with diverse functions and design patterns have emerged. Advanced tools like Opencast Matterhorn provide an easy way for anyone to study using videos by providing personalized services and sophisticated functions (eg, advanced navigation).

Today, advanced video repository systems have seen enormous growth (eg, Videolectures.net, Khan Academy). Most of the 2.0 e-learning tools such as wikis, blogs and other social media have added video lectures. It is notable that sometimes the same video lectures are posted on two different platforms (eg, Khan Academy: www.khanacademy.org/; YouTube EDU: www.youtube.com/education) but the majority of students use only one. With the widespread adoption of all these different video learning platforms, new research from the design perspective is emerging. Therefore, we want our research to make a first step in this direction by examining whether the video platform affects students' USE and IU. Hence, it is hypothesized that:

H2a: *The video platform (public or organizational) is significantly related to students' USE of video lectures.*

H2b: *The video platform (public or organizational) is significantly related to students' IU video lectures.*

Numerous comments have been made in the past regarding the different watching styles. Evans (2008) claims that videos are more efficient reviewing tools than traditional learning

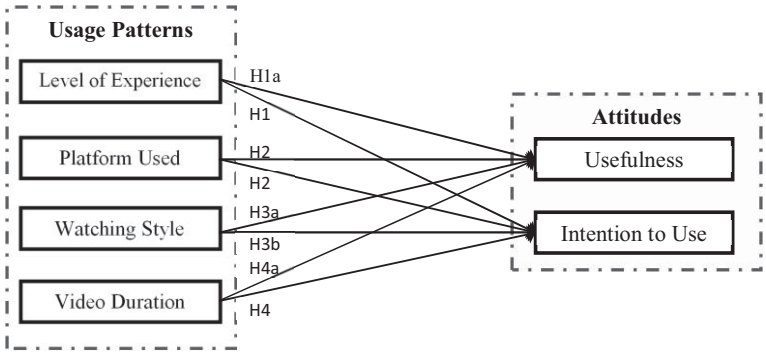

Figure 1: Visualization of the research hypotheses

materials (eg, books, PDFs) or even a student's own notes. In addition, positive student responses (Dale & Pymm, 2009) have indicated the importance of rewinding, skipping and other similar functionalities to navigate video content. Although research has mentioned several different watching styles, the differences between the two main watching categories, students who watch the full video and those who watch only parts of it, are yet to be explored. Hence, in our research we want to examine whether the watching style affects students USE and IU.

H3a: *The watching style is significantly related to the USE of video lectures.*

H3b: *The watching style is significantly related to the IU video lectures.*

Another important aspect is the video lecture's duration, as some students prefer watching a whole lecture while others prefer watching short video lectures, or only the highlights or a summary of a lecture. Although the duration of the videos is fundamental to both the design of the syllabus and the students' adoption of video-assisted learning, this factor is yet to be explored. For instance, organizations like TEDx and Khan Academy provide short videos while other organizations like Udacity and EdX provide longer videos, mostly of the same duration as traditional lectures. Therefore, we want to examine whether video duration affects students' USE of and IU video lectures.

H4a: *Video lecture duration significantly affects students' USE of video lectures.*

H4b: *Video lecture significantly affects students' IU video lectures.*

Figure 1 presents a visual summary of the research hypotheses.

Methodology

Context

The NTNU has been one of the first Nordic universities (together with the University of Stavanger in 2009) to post lectures and talks on iTunesU for free download. NTNU has posted hundreds of video lectures under the name NTNU Open Courseware (http://itunes.ntnu.no/ny/). The lectures range from popular presentations to formal course lectures, in both Norwegian and English, from highly recognized researchers and educators.

For our experiment, we used the introductory SE course (fourth semester). During the course, students obtained knowledge about software engineering concepts such as software processes models, methods and techniques for architectural design, testing, planning, configuration management, and software quality management (based on Sommerville, 2006). It was also expected that students would acquire knowledge to plan and manage small software engineering projects and participate as designers/programmers/testers on larger software projects. In addition, students learned how to understand the reasons behind complex software engineering projects and

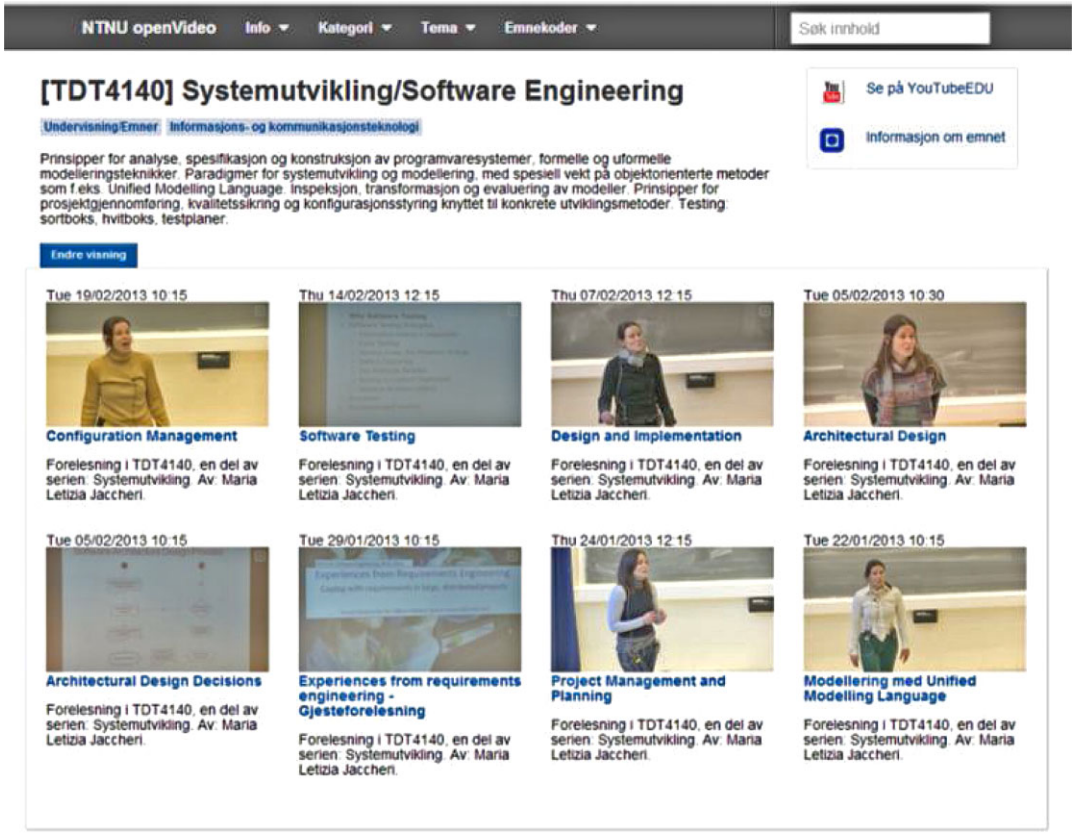

Figure 2: The SE Video collection at NTNU's Open Video platform

the associated technical and organizational issues. Traditionally, this course has been based on the following pillars: lectures by the teachers, exercises, a compulsory development project and lectures by industry.

In the SE course in the spring semester of 2013, we incorporated 12 video lectures into the students' curriculum based on traditional lectures. In addition to the traditional reading materials for the course (Sommerville, 2006), students were able to alternatively or additionally go through the 12 video lectures. For the distribution of video lectures, we used two different platforms, one institutional and one commercial. In particular, we used NTNU's video platform called NTNU Open Video (http://video.adm.ntnu.no/openVideo/). We refer to this platform with the term Institutional, and for NTNU's YouTube channel (http://www.youtube.com/user/ntnuinfo) as Commercial. In the screenshot (Figure 2), we can see the video collection for the SE course.

The following 12 video lectures were included in the syllabus.

1 Modeling with Unified Modelling Language (UML)—Duration: 43 minutes
2 Project Management and Planning (PM)—Duration: 45 minutes
3 Experiences from requirements engineering (REQ)—Duration: 40 minutes
4 Architectural Design (ARC)—Duration: 42 minutes
5 Design and Implementation (DES)—Duration: 49 minutes
6 Testing (TES)—Duration: 46 minutes
7 Configuration Management (CM)—Duration: 47 minutes

8 Agile Development (AG)—Duration: 50 minutes
9 MySQL Release Management (MSQ)—Duration: 43 minutes
10 Experiences with the establishment of a service-oriented architecture (SOA)—Duration: 50 minutes
11 Introduction to Software Engineering (ISE)—Duration: 44 minutes
12 Testing in Practice (TeP)—Duration: 44 minutes

Sampling

The methodology comprised a questionnaire conducted at the end of the 12-week video-assisted learning experience. The responses were captured from June to July 2013 and it was clear that participation was voluntary. Forty students who had completed the whole course responded. Although 40 respondents can be considered a small sample size; Galtung (1969) states that with 40 responses you can gain meaningful results, especially when the respondent experience is intense and longitudinal.

Of the respondents, 87.5% were men and 12.5% were women, and all were aged between 20 and 23 years ($M = 21.7$, standard deviation [SD] = 1.12), with the exception of one 25-year-old student. The sample consisted of experienced IT users (they were sophomore in a Computer Science degree) with experience using video lectures on their syllabus (only two had no experience of video lectures). In the clarification letter accompanying the survey, after describing the purpose of our study, respondents were asked to answer the questions based on their use of video lectures usage and experience with the software engineering video lectures. Respondents watched an average of 4.03 videos (out of 12), with the median value being four video lectures and an SD of 3.45. In addition, four students' (10%) did not watch a complete video lecture, four watched only one video lecture (10%) and three (7.5%) watched all 12 video lectures.

Measures

The questionnaire consisted of two parts: (1) questions concerning the demographics of the sample and the use of video lectures (eg, age, gender, video experience), and (2) measures of USE of video lectures and the students' IU video lectures in future courses. Table 1 lists the operational definitions and the items of the constructs and the source studies of the constructs. We used a 7-point Likert scale anchored from 1, "*completely disagree*," to 7, "*completely agree*." The questionnaire used in the study is presented in the Appendix.

Data collected from the individual items using a Likert scale are strictly speaking ordinal, not interval. Using these numbers for comparative statistics should be done carefully. In our case, to

Table 1: Construct definition and instrument development

Construct	*Operational definition*	*Items*	*Source adopted*
Usefulness (USE)	Measuring how useful it is for students to use video lectures	SE video lectures were very useful to me (USE1). SE video lectures help me to improve my learning performance (USE2). SE video lectures make it easier for me to study (USE3).	Sanchez-Franco, 2010
Intention to use (IU)	Measuring the intention students have to use video lectures in future courses	I plan to use video lectures for studying in the future (IU1). I think video lectures should be incorporated in the courses' future syllabus (IU2). I intend to continue using video lectures in the future (IU3)	Lee *et al.*, 2009

address this issue we followed Allen and Seaman's (2007) proposed guidelines. Hence, multiple Likert items can be combined to form a scale, and parametric procedures can be used in the statistical analysis of the data as long as the scales pass Cronbach's alpha test of intercorrelation and validity (Allen & Seaman, 2007).

Statistical analysis

To analyze the data, first we performed descriptive statistics for students' responses and logged data of the systems to illustrate the students' use of the video lectures. Afterwards, we assessed the validity and reliability of our measures by following the three-step procedure of Fornell and Larcker (1981). We first carried out an analysis of composite reliability of each construct and dimensionality to check the validity of the scale used in the survey. To do this, Cronbach's alpha indicator was applied and we applied inter-item correlations statistics for the items of the construct. The results of the tests revealed acceptable indices (>0.7) of internal consistency in all the factors (see Table 2). Following this, we evaluated the reliability of the measure. The reliability of an item was assessed by measuring its factor loading onto the underlying construct. In particular, factorial analysis with principal components and varimax rotation for the items of each variable was applied. The factor analysis identified two distinct factors (based on Hair, Anderson, Tatham & Black, 1998, factor loading > 0.6): (1) USE and (2) IU (Table 2). The last step was to test the average variance explained (AVE); the AVE was found to be adequate because it exceeds 0.50.

We then investigated any potential relationships between the usage patterns and students' attitudes to video lectures. To explore the effect of different usage patterns on USE and IU, we used independent samples *t*-test as this method allowed us to extract reliable results in a normally distributed and particularly small population (Nam & Smith-Jackson, 2007). Hence, we applied Levene's test to evaluate the homogeneity of variance and the Shapiro–Wilk test to evaluate the normality criterion (Conover, 1998; Shapiro & Wilk, 1965). Both results revealed a nonsignificant outcome ($p > .05$), suggesting that the samples had homogenous variances and normal distribution of data. The exact numbers can be found in Tables 4–7.

Research findings

Descriptive analyses of our measures

Analyzing the experience of the respondents, only 2 out of 40 had no experience with video lectures in their syllabus. In addition, all of them had used videos to attain knowledge (eg, cooking and how-to videos from YouTube) in the past 6 months. During the last 6 months, the respondents had watched 31.48 videos as an average value with *SD* of 41.50. Figure 3 presents the number of views for each video lecture; those numbers are based on students' responses.

Regarding the duration of the video lectures, students' responses varied from 15 minutes to 100 minutes, with an average value at 37.41 minutes and *SD* at 20.01. Therefore, we can assume that

Table 2: Summary of measurement scales

Factors	*Items*	Mean	SD	*CR*	*Loadings*	*AVE*
USE	USE1	4.15	1.51	0.916	0.966	**0.83**
	USE2	4.30	1.51		0.949	
	USE3	4.78	1.39		0.811	
IU	IU1	6.00	1.33	0.733	0.915	**0.72**
	IU2	4.48	2.23		0.650	
	IU3	5.98	1.27		0.941	

AVE, average variance explained; CR, Cronbach's alpha; IU, intention to use; SD, standard deviation; USE, usefulness.

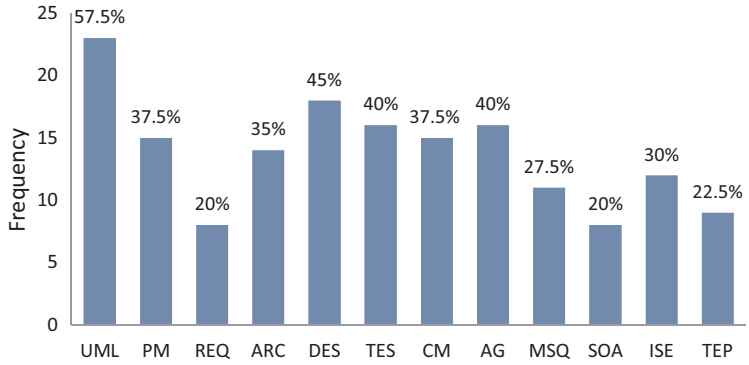

Figure 3: Frequency of students who watched each respective video lecture

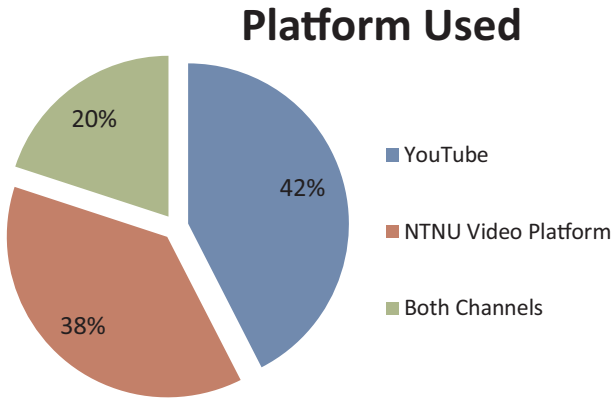

Figure 4: Distribution of the watching platforms used by the students

the students' preferred duration of a video lecture is close to the traditional lecture duration (45 minutes). Regarding the devices used for the video lectures, only one student out of 40 used a tablet/PDA; the rest of the students used their PC. On the other hand, students' selection of video platforms was varied; the number of students viewing videos on YouTube was nearly equal to the number of students viewing on the University's video platform, with a significant number of students using both platforms. Figure 4 shows the students' video platform selection.

Seventy percent of the students mentioned that video lectures should be connected to a Facebook group. In addition, 17.5% claimed that using Twitter to distribute and advertise video lectures would be helpful. Students also endorsed Google Plus+ (10%), LinkedIn (10%), Blogs (5%) and Digg (2.5%). Figure 5 shows the responses of the students regarding the potential of social media to assist video lectures.

To investigate the video lecture users' watching profiles, we asked students to describe how and in what period of the course they were using the video lectures. Over half the students (60%) were watching the full video lecture, while the remainders (40%) were watching specific parts of the video. Regarding the watching period for the videos, most students used them before exams (75%), some after lectures (15%) and even fewer during the semester. Figure 6 summarizes the results of the watching behavior in our study.

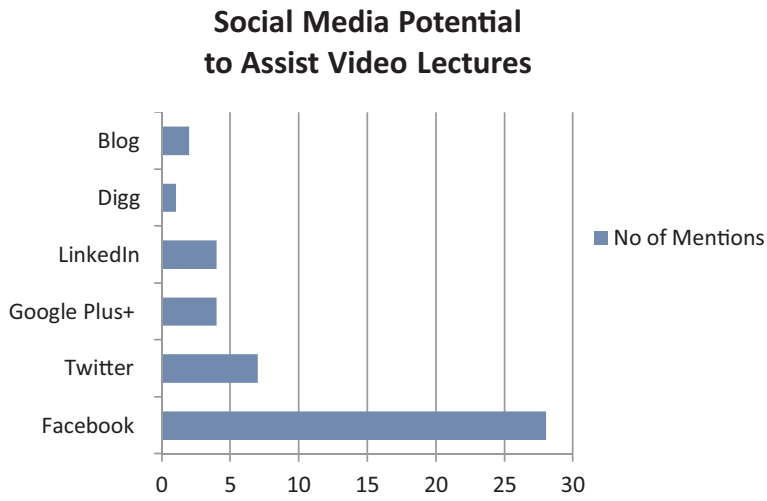

Figure 5: Number of students' mentions regarding the potential of social media to assist video lectures

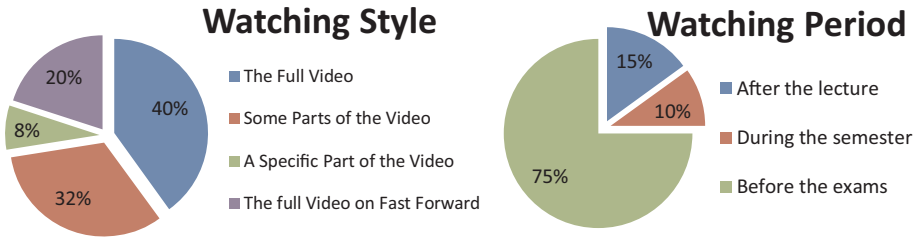

Figure 6: Distribution of the watching styles and the watching period for the SE video lectures

Table 3: The most popular video lectures and their views on each platform

	*Video views**			
Video Lectures	*Institutional platform*	*YouTube*	*Total*	*Ratio*
Unified Modelling Language (UML)	253	500	753	1.98
Project Management and Planning	164	193	357	1.18
Architectural Design	128	159	287	1.24
Design and Implementation	147	149	296	1.01
Testing	114	242	356	2.12
Configuration Management	100	357	457	3.57
Total	906	1600	2506	1.77

*Video views is different from page views; with one page view/visit, the student might watch the video many times.

Presentation of the analytics obtained from the video platforms

Besides the data collected via surveys, we obtained some basic analytics from the video platforms. One of the most basic but also important measures is the number of views for each video. Looking at Table 3, we can clearly see that YouTube videos have more views than Institutional ones for every video, and the ratio among the views on YouTube and the Institutional platform

ranges from 1.01 to 3.57, with a mean ratio of 1.77. One more remark is that we can see major discrepancies among the total views of videos; for instance, there are videos that have 2.6 times more views than others.

Identifying differences in video lectures among different video lectures usage groups

The respondents had enough experience of video usage for knowledge acquisition (5.10 videos/month) and for knowledge acquisition based on SE videos in particular (4.03 videos out of 12), with the median value being four video lectures. In addition, four students (10%) did not watch a complete video lecture and three students (7.5%) watched all 12 video lectures. Students' expressed IU video lectures in the future (IU = 5.49/7) but their positive feelings regarding USE were not at such a high level (USE=4.41/7).

To examine the hypotheses H1a and H1b, *t*-tests were conducted between the students with low (watched up to three videos) and high (watched more than three videos) experience with the SE video lectures (three videos was the median). The results shown in Table 4 show a statistically significant difference in USE and nonsignificant difference in IU. This demonstrates a significant relationship between students' experiences with USE and a nonsignificant relationship with their IU; therefore, hypothesis H1a is accepted and H1b is rejected.

To examine hypotheses H2a and H2b, *t*-tests were conducted between the students who used YouTube and those who used the Institutional video platform. The results exhibited in Table 5 show a statistically significant difference on students' USE and nonsignificant difference on their IU. This demonstrates a significant relationship between the platform used and students' USE, and a nonsignificant relationship with their IU; therefore, hypothesis H2a is accepted and the H2b is rejected.

To examine the hypotheses H3a and H3b, *t*-tests were conducted between the students who watched the full video lectures and those who watched only parts. The results exhibited in Table 6 show a nonsignificant difference in students' USE and significant difference in their IU. This

Table 4: Testing the effect of experience on students attitudes using t*-tests*

	Experience with the SE videos Mean *(SD) [Shapiro–Wilk Sig]*					
	Up to three videos (n = *19*)	*More than three* (n = *21*)	*T*	*Sig.*	*Levene's* p	*Hypotheses*
USE	3.72 (1.64) [0.259]	4.97 (0.99) [0.467]	**2.95**	**0.005***	0.167	H1a (accepted)
IU	5.19 (1.56) [0.231]	5.73 (1.12) [0.106]	1.27	0.213	0.458	H1b (rejected)

**$p < .01$; *$p < .05$. IU, intention to use; USE, usefulness.

Table 5: Testing the effect of platform used on students' attitudes using t*-tests*

	Platform used Mean *(SD) [Shapiro–Wilk Sig]*					
	YouTube (n = *17*)	*Institutional* (n = *15*)	*T*	*Sig.*	*Levene's* p	*Hypotheses*
USE	3.77 (1.31) [0.090]	4.92 (1.29) [0.72]	**2.31**	**0.029***	0.838	H2a (accepted)
IU	5.16 (1.42) [0.069]	5.77 (1.05) [0.103]	1.25	0.221	0.830	H2b (rejected)

**$p < .01$; *$p < .05$. IU, intention to use; USE, usefulness.

Table 6: Testing the effect of watching style on students' attitudes using t*-tests*

	Watching style Mean *(SD) [Shapiro–Wilk Sig]*					
	The full video (n = *24)*	*Parts of the video* (n = *16)*	*T*	*Sig.*	*Levene's* p	*Hypotheses*
USE	4.65 (1.06) [0.481]	4.04 (1.69) [0.288]	1.29	0.207	0.090	H3a (rejected)
IU	5.85 (1.18) [0.159]	4.94 (1.43) [0.063]	**2.11**	**0.041***	0.801	H3b (accepted)

**p* < .01; **p* < .05. IU, intention to use; USE, usefulness.

Table 7: Testing the effect of duration on students' attitudes using t*-tests*

	Duration Mean *(SD) [Shapiro–Wilk Sig]*					
	Up to 25 mins (n = *20)*	*More than 25 mins* (n = *20)*	*T*	*Sig.*	*Levene's* p	*Hypotheses*
USE	3.94 (1.72) [0.120]	4.71 (1.21) [0.197]	1.64	0.110	0.275	H4a (rejected)
IU	4.39 (1.29) [0.075]	5.92 (1.03) [0.068]	**4.14**	**0.000****	0.576	H4b (accepted)

**p* < .01; **p* < .05. IU, intention to use; USE, usefulness.

demonstrates a nonsignificant relationship between the two different watching styles and students' USE, and a significant relationship with their IU; therefore, hypothesis H3a is rejected and H3b is accepted.

To examine hypotheses H4a and H4b, *t*-tests were conducted among the students who are used to watching short video lectures (up to 25 minutes) and those who are used to watching long video lectures (more than 25 minutes). The results exhibited in Table 7 show a nonsignificant difference for students' USE and a significant difference for their IU. This demonstrates that there is a nonsignificant relationship between video duration and students' USE, and a significant relationship with their IU; therefore, hypothesis H4a is rejected and H4b is accepted.

Regarding the watching period of the video lectures, we could not perform any statistical test as the distribution of students was very imbalanced (75% of students watched video lectures before the exams). However, we deeply analyzed the descriptive statistics in an attempt to understand the potential differences among the different watching period types. The students who watched video lectures "After the lecture" had moderate averages in both USE ($M = 4.17$, $SD = 1.35$) and IU ($M = 5.67$, $SD = 1.26$). The students who watched video lectures "During the Semester" had the lowest USE ($M = 3.75$, $SD = 0.88$) and the highest IU ($M = 6.08$, $SD = 1.07$). The majority of students watched the video lectures "Before the Exams"; this group of students has the highest USE ($M = 4.54$, $SD = 1.41$) and the lowest IU ($M = 5.37$, $SD = 1.40$). Potential explanation of these results might be that the third category of the students (use before the exams) is using video lectures because they perceived them as very useful; however, they do not intend to include them in their traditional studying material.

It would also be interesting to observe any potential differences among students who used their PC to watch a video and those who used tablets and PDAs. However, as only one student out of 40 used a tablet/PDA, we were unable to investigate any potential differences in this area.

Qualitative insights

In the open-ended questions, students supported that the continuation of video lectures is very important, which aligns with Tynan and Colbran's (2006) findings. Additionally, they mention

that video lectures are not helpful for some students, but remain a very important part of study for others. Students also mentioned other courses where video lectures are advanced in terms of graphics and functions, and they are using them routinely. We present some original responses from students to ground our insights.

"People should just be able to watch them if they feel like it helps. Continue as it is now. Not all learn from watching videos but some do."

"Video lectures are a great tool, in many courses there are amazing video lectures with many functions for culling through the content."

"In other courses with a tradition of using video lectures, like Advanced Mathematics, video lectures have been a central part of my learning, and the same might be the case for later courses—I am very positive towards the idea of video courses in general."

Another important insight arising from the students' responses is that they are using video lectures mostly when they cannot attend the course. One student responded: "Mostly, I use the videos when I haven't had the chance to attend a class." This said, we must not blame video lectures for low attendance, as we know (Traphagan *et al*, 2010) that when video lectures are available, students use them without greatly decreasing their attendance. Another indication of the positive intentions of students toward video lectures is that they mentioned the possibility of connecting with video lectures through diverse social media and other distribution channels ("Distribution on iTunes U").

Discussion and conclusions

In this research, we investigated the relationship between students' USE and IU with their video lecture usage patterns. This research revealed that there are usage patterns related to students' USE and IU video lectures. Video lecture research has mainly focused on the acceptance and learning performance of video lectures based on students' attitudes (eg, Evans, 2008; Giannakos, 2013; Maag, 2006). Hence, this research provides a step toward the analysis of video-based learning by analyzing students' attitudes through the lens of their usage behavior.

To explore the relationship between students' usage behavior and attitudes to video lectures, this study developed eight hypotheses. In particular, four hypotheses were about the relationship between students' usage behavior and video lectures USE (H1a–H4a); and four were about the relationship between students' usage behavior and IU video lectures in the future (H1b–H4b). The hypotheses guide us in understanding how different usage patterns contribute to different attitudes toward video lectures.

The findings indicate that previous experience with video lectures has a positive effect on USE (H1a accepted) but a nonsignificant effect on IU (H1b rejected). This result is consistent with what Liao and Lu (2008) and Giannakos and Vlamos (2013) found in their research for e-learning tools; hence, prior experience with video lectures can shape students' attitudes. Our findings also indicated that the video platform used significantly affects USE (H2a accepted) but not IU (H2b rejected). This is in alignment with the study conducted by Chen and Sun (2012), which identified that different video-based multimedia significantly affect students' attitudes and even emotions. As such, the findings of this research suggest that previous experience with video lectures and the design of the platform play an important role in determining the USE. However, these two characteristics are not influencing students' IU video lectures in their study.

Additionally, the watching style (watching the full video or parts) does not affect students' USE (H3a rejected) but affects their IU (H3b accepted). Specifically, our results reveal that compared with students using short-duration video lectures, learners using longer-duration video lectures had higher IU video lectures in the future. Like watching style, the duration of the video (short and long videos) does not affect students' USE (H4a rejected) but affects their IU (H4b accepted).

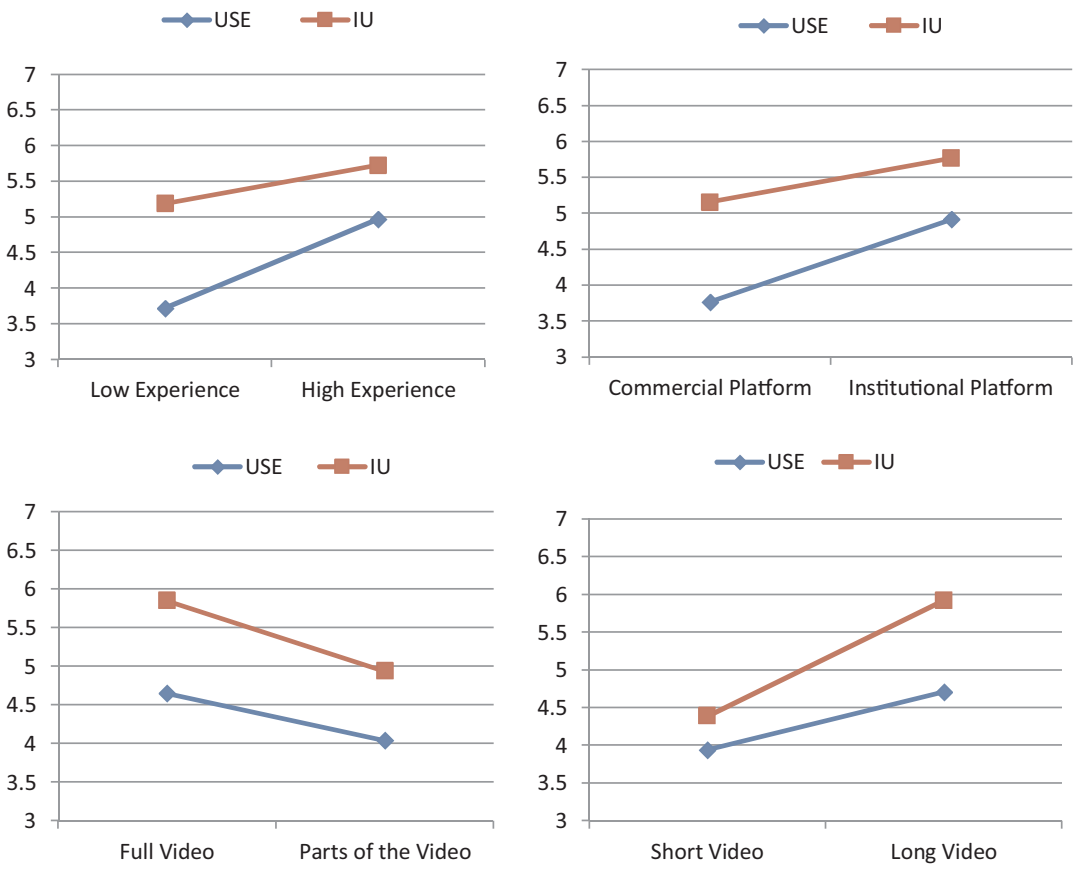

Figure 7: Visualization of the results

This means that students watching parts of the videos exhibit lower IU video lectures in the future than those who watch the full videos. Based on the literature of video-based learning (Giannakos, 2013; Kay, 2012), watching patterns are considered as one of the most important yet not well-researched areas.

Questions regarding the watching style and length of video lectures are still unexplored (Giannakos, 2013; Kay, 2012). Although many studies have compared video-based learning with traditional teaching (eg, Hill & Nelson, 2011; von Konsky *et al*, 2009), no research has been conducted on how specific styles affect students. These results shed light in this area and suggest that watching patterns (style and duration) play a very important role in students' IU video lectures without affecting the usefulness perceived by the student. Figure 7 summarizes and provides a visualization of the empirical results.

From the analytics of the videos, we can clearly see that the YouTube platform has more views than the Institutional platform for each video, which aligns with students' responses regarding platform used. Another interesting observation is that the results from the log files (platform analytics) overlap with the results obtained from surveys. For instance, although the ranking is not exactly the same, the top-viewed videos on each platform are the same. Given that analytics are derived from the total pool of students (not only the 40 who respond to the survey), the validity of the collected data is increased. We also noticed that there are some discrepancies among the analytics of the two platforms; for instance, the Configuration Management video is

the least viewed on the Institutional platform but the second most viewed on YouTube. This led us to believe there might be some differences in the findings, based on the nature (eg, content, instructor) of the video lectures. As such, further analysis based on the nature of the video lectures will shed light on issues like: why do some video lectures have much more views than others? Are there specific characteristics that make a video lecture "attractive"?

The study has implications for theory and practice. The findings demonstrate that students with relatively high experience in video lectures find them more useful. Therefore, instructors should focus on incorporating video lectures into freshmen-level syllabi to engage students with the benefits of video lectures early in their education. Instructors should avoid using short-duration videos in their syllabi as these videos are not used consistently by the students, resulting in lower adoption. On the other hand, longer-duration videos result in better adoption from students. Instructors should also use strategies to encourage students to use the full lecture (instead of parts). Video lectures are ideal for reviewing and scanning through content; however, watching full videos increases students' decision to adopt and incorporate this medium in their learning. Another important aspect is the possession and maintenance of institutional video platforms, as students perceive video lectures provided by their institutions as more useful, even when the videos are exactly the same.

Although empirical studies can provide meaningful insights on designing learning technologies, we should always consider their limitations. First, our respondents were mostly Norwegian students of CS/IT discipline, as such they were highly experienced with technology and well educated, thereby potentially limiting the generalization of the findings. Second, a self-report scale was employed to measure variables, as such some of the findings might have a common method bias. Hence, other methods such as interviews, observations and extended use of the log files could provide a deeper understanding of the findings. Third, an important limitation is also the relatively small scale of the study (40 students); however, capturing and analyzing the experiences of 40 students who had intense, controlled experience for a long period of time provided us with a clear dataset, and allowed us to understand how students used and perceived video-supportive materials.

Future research would valuably contribute to the understanding of students' behavior on video-assisted learning services. In addition, it would be interesting to see how the use of video-assisted learning services is related to the actual performance of students and potential differences among disciplines (eg, social sciences). In the next step of this ongoing project, we will distribute video lectures via a video analytics system (Giannakos, Chorianopoulos & Chrisochoides, 2014). Using such a system will enable us to capture students' interactions with the video lectures (eg, replay, forward), information about their learning performance (using incorporated tests) and their attitudes (using incorporated questionnaires). Conducting an empirical study with the assistance of such a system, we will be able to discover certain characteristics in both the system and the content development, and practices to improve the use of video-assisted learning in higher education.

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Statements on open data, ethics and conflict of interest

The authors will provide the data upon request. The data collected in this research were anonymous (no information that may identify the individuals involved), and therefore are exempt from

the Data Protection Official for Research, Norwegian Social Science Data Services (NSD). The authors declare that they have no conflicts of interest.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix: Questionnaire.