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Review

Exploring the use of video podcasts in education: A comprehensive review of the literature

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ABSTRACT

The purpose of this article was to provide a comprehensive review of research on video podcasts from 2002 to 2011 in order to guide future studies and educational practice. Fifty-three, peer-reviewed articles were selected from an extensive search of the literature. Key topics included the history and growth of video podcasts, types of podcasts, previous literature reviews, benefits and challenges of using video podcasts, methodological concerns, and suggestions for future research. Key benefits included positive affective and cognitive attitudes toward video podcasts, control over learning, improved study habits, and increased learning performance. Key challenges included a variety of technical problems, preference of some students for lectures, and reduced class attendance. Methodological concerns involved insufficient description of video podcasts examined, limited sample selection and description, and the absence of reliability and validity estimates for data collection tools. Suggestions for future research include focusing on the quality and design of video podcasts, pedagogical strategies, viewing patterns and impact on learning effectiveness, and in individual differences in video podcast use.

Contents

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1. Overview

In this review, video podcasts refer to video files that are distributed in a digital format through the Internet using personal computers or mobile devices (McGarr, 2009). They have also been referred to as audiographs (Loomes, Shafarenko, & Loomes, 2002), podcasts (Heilesen, 2010), vodcasts (Vajoczki, Watt, Marquis, & Holshausen, 2010), webcasts (Shim, Shropshire, Park, Harris, & Campbell, 2007), and video streams (Bennett & Glover, 2008). In education, video podcasts have been used to record and transmit lectures (e.g., Griffin, Mitchell, & Thompson, 2009), visits from guest speakers (e.g., Wang, Mattick, & Dunne, 2010), explanations of how to solve problems (e.g., Crippen & Earl, 2004), supplementary materials for a course (e.g., McGarr, 2009), PowerPoint summaries (e.g., Holbrook & Dupont, 2010), and administrative tasks (Heilesen, 2010).

The purpose of this paper is to provide a comprehensive review of research on video podcasts from 2002 to 2011 in order to guide future studies and educational practice. Previous research reviews have examined audio podcasts exclusively (Hew, 2009) or have been somewhat dated and limited in focus (Heilesen, 2010; McGarr, 2009). Key areas covered in the current review include the history and growth of video podcasts, types of podcasts, previous literature reviews, benefits and challenges of using video podcasts, methodological concerns, and suggestions for future research.

2. History and growth of video podcasts in education

Research on the use of video podcasts in education began to surface in 2002 with references to audiographs (Loomes et al., 2002), video streaming (Foertsch, Moses, Strikwerda, & Litzkow, 2002; Green et al., 2003; Shephard, 2003) and webcasting (Reynolds & Mason, 2002). High speed bandwidth was relatively uncommon between 2000 and 2005 (Smith, 2010), therefore the use of video podcasts in education was limited by download times and research in this area was minimal. It is argued that two key factors changed the direction and frequency of video podcast use for entertainment and subsequently education.

First, in February of 2005, YouTube, a site designed to disseminate a wide range of video clips, was launched ("YouTube", 2011). By 2006, YouTube received 100 million views per day (Infographics, 2010). As of May 2011, YouTube was viewed over 3 billion times per day (Henry, 2011). Originally used for entertainment purposes, YouTube is a free source of numerous educational videos in a wide range of subject areas.

The second factor that helped change the landscape of video podcast use in education was increase and availability of bandwidth. Between 2006 and 2010, the adoption of high speed Internet access increased rapidly in homes and schools (Smith, 2010) as did research on the use of video podcasts in education. Prior to 2006, eight peer-reviewed articles had been written on the use of video podcasts in education. Since 2006, 52 new articles have been published. This literature needs to be examined and evaluated as a whole in order to gain a cohesive perspective on the benefits and challenges experienced while using video podcasts in education.

2.1. Types of video podcasts

Originally, podcasting was the name given to audio files played on Apple's IPod portable media player (Copley, 2007). Internet bandwidth restricted the type of information that could be exchanged in a reasonable time period to an audio format (Shephard, 2003), although early forms of video podcasts began to emerge in the form of audiographs (Loomes et al., 2002), video streaming (Foertsch et al., 2002; Green et al., 2003; Shephard, 2003) and webcasting (Reynolds & Mason, 2002). Since 2005, video podcasts can categorized according to purpose, segmentation, pedagogical strategy, and academic focus.

2.1.1. Purpose

With respect to purpose, four kinds of video podcasts have emerged including lecture-based (e.g., Heilesen, 2010), enhanced (e.g. Holbrook & Dupont, 2010), supplementary (e.g., McGarr, 2009), and worked examples (e.g., Crippen & Earl, 2004). Lecture-based or "subsitutional" video podcasts are recordings of an entire lecture that students can review instead of or after a face-to-face meeting. An enhanced video podcast is video footage of PowerPoint slides presented with an audio explanation. Supplementary video podcasts augment the teaching and learning of a course and include administrative support (e.g., Heilesen, 2010), real-world demonstrations (Jarvis & Dickie, 2009), summaries of class lessons or textbook chapters (e.g., McGarr, 2009) or additional material that may broaden or deepen student understanding

(e.g., McGarr, 2009). Finally, worked examples provide video explanations of specific problems that students may need to solve in a particular course, often in the area of mathematics or science.

2.1.2. Segmentation

Video podcasts can also be classified based on segmentation. Non-segmented podcasts consist of entire lectures that can be played from start to finish using VCR type controls. Segmented video podcasts are broken up into smaller chunks that can be searched and viewed according to the needs of the user (e.g., Zhang, Zhou, Briggs, & Nunamaker, 2006).

2.1.3. Pedagogy

Pedagogical strategy is another way of identifying podcasts. Three distinct teaching approaches are evident in the current literature and include receptive viewing, problem solving, and created video podcasts. Receptive viewing of podcasts assumes that learning material in whatever format is to be viewed by a student in a relatively passive manner. Students may search for desired segments or pause and review noteworthy concepts or facts, but the main pedagogical strategy is the delivery of information. Receptive viewing is by far the most common type of video podcast, examined in 95% of papers reviewed in this study.

Problem-solving video podcasts are clips designed to explain, articulate and assist students in learning how to solve specific problems endemic to courses like mathematics, science, and engineering. The pedagogical strategy still involves the delivery of information, but the focus and learning objective of the video podcast is much narrower. Only two studies in this review (Crippen & Earl, 2004; Loomes et al., 2002) made reference to problem-solving or worked example video podcast use.

The final strategy involves students planning and creating their own video podcasts. Students learn by investigating, collaborating, researching, and eventually developing academic-based video podcasts. This approach to using video podcasts is uncommon with only two studies covered in the current review (Alpay & Gulati, 2010; Armstrong, Massad, & Tucker, 2009).

2.1.4. Academic focus

The final way to categorize video podcasts is academic focus. Two clear foci emerged from literature: practical and conceptual. Approximately half the video podcasts researched targeted practical skills or specific problems. These podcasts are typically short in length or segmented. The other half of video podcasts target higher level concepts, are relatively long, and may be segmented.

In summary, while the digital format and dispensing of video podcasts has stabilized over the past five years, the type of podcasts vary considerably according to their purpose, degree of segmentation, pedagogical strategy, and academic focus.

2.2. Previous literature reviews

Three previous literature reviews have been conducted on the use of podcasts in education (Heilesen, 2010; Hew, 2009; McGarr, 2009). Hew's (2009) review, while focusing exclusively on audio podcasts, offers several insights that might extend to the use of video podcasts. Hew (2009) noted that the most common use of podcasts was for either lectures or supplementary course materials, that students tended to listen to podcasts at home rather than on mobile devices, and that the main benefit of podcasting was to review materials missed or not understand during class. However, Hew's (2009) review is somewhat limited because only 11 peer-reviewed articles were examined and a majority of the studies were descriptive.

McGarr (2009) examined the use of both audio and video podcasting in higher education, but did not distinguish the relative contributions of each type of podcast. The review was largely theoretical focusing mainly on the descriptive results of seven peer-reviewed articles in the area of podcasting. McGarr (2009) identified three primary uses of podcasts (lectures, support material, and creative use), but did not provide a detailed analysis of the benefits and challenges of podcasts in education.

Heilesen (2010) examined a relatively sparse sample of 13 peer-reviewed articles published from 2004 to 2009 on the use of both audio and video podcasts. He concluded that evidence supporting learning gains due to the use of podcasts is limited, but that affective and cognitive attitudes were positive. It is important to note that Heilesen (2010) did not intend for his review to be comprehensive. Furthermore, 21 peer-reviewed articles on the use of video podcasts have been published since 2009.

The current review is unique because it focuses exclusively on video podcasts, analyzes over 50 peer-reviewed articles from 2002 to 2011, offers a systematic, comprehensive analysis of both benefits and challenges, and explores opportunities to improve future research.

3. Method

3.1. Overview

Several procedures were followed to ensure a high quality review of the literature on video podcasts. First, a comprehensive search of peer-reviewed journals, but not conference papers or reports, was completed based on a wide range of key terms including podcasts, vodcasts, video podcasts, video streaming, webcasts, and online videos. Five databases were searched including the AACE Digital Library, Academic Search Premiere, EBSCOhost, ERIC, Google Scholar, Scholars Portal Journals. Second, the reference section for each article found was searched in order to find additional articles. Third, key educational and technology journals from around the world were searched independently and included the following publications: Australasian Journal of Educational Technology, British Journal of Educational Technology, Canadian Journal of Learning and Technology, Computers and Education, Computers in Human Behavior, Educational Technology Research and Development, Interdisciplinary Journal of E-Learning and Learning Objects, Journal of Computer Assisted Learning, Journal of Educational Computing Research, Turkish Journal Online Journal of Distance Education. The search process uncovered 53 peer-reviewed articles published from 2002 to 2011.

3.2. Type of articles collected

An analysis of the 53 studies conducted revealed six different areas of focus including use of video podcasts ($n = 30$), comparing video podcasts with other teaching strategies ($n = 11$), evaluating the quality of video podcasts ($n = 5$), literature reviews ($n = 3$), creation of video podcasts ($n = 2$) and video podcast pedagogy ($n = 1$). Regarding impact of video podcasts, 33 studies looked at attitudes, 28 studies examined behavior, and 20 assessed learning performance. In terms of methodological approach, 14 studies were exclusively survey-based, nine studies collected only qualitative or descriptive data, 25 studies used a mixed data collection approach, and 21 studies concentrated on learning outcomes (see Appendix B).

3.3. Data analysis

Each study in this paper was analyzed based on the following elements: year of study, number of video podcasts used, length of video podcasts, type of video podcast used, sample population, sample size, sample description, subject area, reliability and valid-

ity of data collection tools, study area of focus, and impact of video podcasts (attitude, behavior, and learning performance). See Appendix A for detailed description of the coding scheme used in this study and Appendix B for a list of the coded articles.

It should be noted that a meta-analysis was not conducted because (a) the focus of studies, method of data analysis, subject area, and type of podcasts used varied considerably, (b) quantitative measurement of impact was assessed in only 26 of the 53 studies reviewed, and (c) reliability and validity were rarely reported for data collection tools. The overall lack of assessment precision would make a meta-analysis essentially meaningless.

4. Results and discussion

4.1. Context of video podcasts use

The predominant sample population for the 53 studies reviewed in this paper consisted of undergraduate students ($n = 38$ studies). Other populations investigated included graduate students ($n = 8$), teachers ($n = 4$), secondary school students ($n = 4$), middle schools students ($n = 3$) elementary school students ($n = 2$) and professionals ($n = 1$). With respect to subject area, 17 studies were in the domain of science and technology, 15 were in arts, 11 in health, six involved a variety of subject areas, four were in mathematics and business, and three were in education. Sample size ranged from 4 to 3019 students with an overall mean of 316. In summary, the current review represents the attitudes, behaviors and learning outcomes of undergraduate students studying science, technology, arts, and health.

4.2. Viewing behavior and video podcasts

Several video podcast viewing patterns emerged from the literature review. First, students tended to view video podcasts outside of working hours during evenings and weekends (Copley, 2007; Heilesen, 2010; Hill & Nelson, 2011; Traphagan, Kusera, & Kishi, 2010; Wang et al., 2010). Second, some evidence suggests that students viewed video podcasts immediately before exams (Brittain, Glowacki, Van Ittersum, & Johnson, 2006; Heilesen, 2010), although one study observed more balanced viewing patterns (Chester, Buntine, Hammond, & Atkinson, 2011). Third, a large number of studies ($n = 12$) suggest that students viewed video podcasts at home using their personal computers and not on mobile devices. McGarr (2009) argued that the level of processing required to deconstruct and understand information presented in a video podcast limits viewing effectiveness on a mobile platform, particularly when students are reviewing for tests and exams. Walls, Walker, Acee, Kucsera, and Robinson (2010) added that choice of device may partially depend on podcast content. Students listened to tangential, supplementary video podcasts with mobile devices and lecture video podcasts on personal computers at home while studying.

There were several different viewing styles observed. In two studies, students preferred to look at an entire lecture as opposed to watching specific segments (Chester et al., 2011; Traphagan et al., 2010), although it was not clear why they preferred this approach. Other viewing patterns included stopping the video podcast to take notes (Foertsch et al., 2002) or simply reviewing material repeatedly (Hill & Nelson, 2011).

One study looked at viewing behavior explicitly (de Boer, Kommers, & de Brock, 2011) and noted four distinct styles: linear (watching a complete video once), elaborative (watching a complete video twice), maintenance rehearsal (watching part of a video repeatedly) or zapping (skipping through a video and watching brief segments). It is worth noting that the video podcast students were watching in this study was segmented, eights minute long, and focused on how to use a piece of digital equipment. Viewing style might be different for a non-segmented, full length lecture, presenting multiple higher-level concepts. de Boer et al. (2011) also noted that viewing style was not constant and appeared to shift based on cognitive needs of the user. He also suggested that viewing patterns may be partially related to innate cognitive ability. For example, if a student has a relatively weak short-term memory, then he/she might have to review a video clip more often than a student with a stronger short-term memory (de Boer et al., 2011).

4.3. Benefits of using video podcasts

Benefits of using video podcasts were organized into four categories: reasons for use, attitudes toward video podcasts, behaviors, and impact on learning performance. Each of these areas will be discussed in detail.

4.4. Reasons for using video podcasts

A majority of studies asked students about why they used video podcasts using surveys, open-ended questions, or focus group data. Three principle reasons were cited including improving learning, increasing control over the learning, and missed classes.

4.4.1. Learning

The number one reason students noted for using video podcasts was to improve learning ($n = 23$ studies). Twenty-one studies reported that students used video podcasts to review for impending tests or examinations. Other learning-based reasons for using video podcasts included preparing for class (Bennett & Glover, 2008), self-checking for understanding (Fernandez, Simo, & Sallan, 2009; Foertsch et al., 2002; Wang et al., 2010), obtaining a global overview of chapters read (Fernandez et al., 2009), and taking better notes (Copley, 2007; Traphagan et al., 2010). One particularly interesting reason for using video podcasts was to improve the quality of face-to-face classes. Before a traditional class, students watched video podcasts that targeted procedural tasks (Jarvis & Dickie, 2010) or direct instruction of concepts (O'Bannon, Lubke, Beard, & Britt, 2011). Professors then had the time during face-to-face meetings for hands-on practice and developing a deeper understanding of concepts.

4.4.2. Control

The second reason students wanted to use video podcasts was control over learning ($n = 9$ studies). Dolnicar (2005) observed that there were at least two types of students: idealists and pragmatists. Idealists enjoyed listening to traditional lectures whereas pragmatists simply wanted the information necessary to succeed. Video podcasts match the temperament of pragmatists well. Several theorists have noted that pragmatists in higher education are rapidly growing and refer to this group as being part of the "net" generation (Montgomery, 2009; Palfrey & Gasser, 2008; Tapscott, 2008). According to Tapscott (2008), the "net" generation wants freedom in everything they do, particularly freedom of choice or control over their environment. With respect to video podcasts, students enjoyed control over when and where they learned (Heilesen, 2010; Hill & Nelson, 2011; Jarvis & Dickie, 2010; McGarr, 2009;Winterbottom, 2007), what they needed to learn (Fill & Ottewill, 2006; Heilesen, 2010) and the pace of learning (Chester et al., 2011; Clark & Mayer, 2008; Fill & Ottewill, 2006; Griffin et al., 2009; Hill & Nelson, 2011; Winterbottom, 2007).

4.4.3. Missed classes

The third reason students noted for using video podcasts was to make up for missed classes ($n = 9$ studies). In at least four studies, 60–80% of the students agreed that video podcasts were very useful for catching up on classes they were unable to attend (Dupagne, Millette, & Grinfeder, 2009; Lonn & Teasley, 2009; Pilarski, Johnstone, Pettepher, & Osheroff, 2008; Traphagan et al., 2010). One study suggested that students appreciated video podcasts because they allowed them to fit courses into their busy schedules (Foertsch et al., 2002). A final study indicated that video podcasts were appreciated by students who had to travel a considerable distance to attend class (McKinney & Page, 2009).

4.5. Positive affective attitudes toward video podcasts

Researchers who examined affective attitudes toward video podcasts reported that students' feelings or emotions were predominantly positive ($n = 14$ studies). General comments suggested that video podcasts were enjoyable to watch (Copley, 2007; Dupagne et al., 2009; Green et al., 2003; Vajoczki et al., 2010; Winterbottom, 2007) and satisfying (Traphagan et al., 2010; Zhang et al., 2006). A number of studies indicated that students felt that video podcasts were motivating (Alpay & Gulati, 2010; Bolliger, Supanakorn, & Boggs, 2010; Fernandez et al., 2009; Hill & Nelson, 2011; O'Bryan and Hegelheimer, 2007). Reasons cited for increased motivation included sustaining attention, relevance, and the excitement of producing video podcasts for their peers. Other students described video podcasts as interesting when the material was intellectually stimulating (Fernandez et al., 2009) or they wanted to see an outstanding lecture a second time (Wang et al., 2010). Two studies (Pilarski et al., 2008; Traphagan et al., 2010) noted that viewing video podcasts helped reduce student anxiety, presumably before a testing situation. Finally, several researchers observed that students believed that video podcasts helped build connections with the instructor (Fernandez et al., 2009) and other students (McCombs & Liu, 2007). The dynamics of how connections improved were not clearly articulated.

4.6. Positive cognitive attitudes toward video podcasts

Almost half the studies in this review ($n = 22$) examined cognitive attitudes toward video podcasts and over 85% of the findings were positive. A number of studies ($n = 15$) noted that students thought video podcasts were useful, helpful, and effective with respect to improving the learning process. This assessment is consistent with informal comments that students made about why they used video podcasts. Detailed analysis about why students had positive cognitive beliefs about learning were not provided, although one study suggested that the visual nature of podcasts brought the materials to life thereby helping to improve understanding (Hill & Nelson, 2011).

Two studies examining the creation of video podcasts (Alpay & Gulati, 2010; Armstrong & Massad, 2009) reported that students felt they improved with respect to analytic, communication, cooperation, creativity, and technology skills. Three studies made stronger claims about learning impact noting that students believed that their performance increased as a direct result of using video podcasts (Brittain et al., 2006; Crippen & Earl, 2004; Dupagne et al., 2009).

Students also appreciated that video podcasts were convenient and easily accessible (Bolliger et al., 2010; Dupagne et al., 2009; Fernandez et al., 2009; Shantikumar, 2010). One study noted that students enjoyed the opportunity that video podcasts afforded by offering lectures from a large of group of experts within wide geographical area. Finally, two studies reported that students liked the flexibility of using video podcasts by being able to select the time, location, and pace of learning (McCombs & Liu, 2007; Stephenson, Brown, & Griffin, 2008).

4.7. Positive impact of video podcasts on student behavior

Three benefits emerged with respect to student behaviors while using video podcasts: frequency of viewing, consistent attendance at lectures, and improvements in study habits. Regarding frequency of viewing, a number of studies indicated that students used video podcasts often and spent considerable time watching them (Crippen & Earl, 2004; Dupagne et al., 2009; Foertsch et al., 2002; Moss, O'Connor, & White, 2010; Pilarski et al., 2008; Shantikumar, 2010; Winterbottom, 2007). However, it was difficult to compare how often video podcasts were used because different frequency metrics were used including number of downloads per term (e.g., Crippen & Earl, 2004; Shantikumar, 2010), views per week (e.g., Moss, O'Connor, & White, 2010), percent of video podcasts viewed (e.g., Dupagne et al., 2009), percent of students who viewed podcasts (e.g., Winterbottom, 2007) and students ratings of use based on a Likert Scale (Pilarski et al., 2008).

With respect to lecture attendance, it was apparent that instructors were concerned about whether the availability of video podcasts would reduce student attendance (e.g., Brittain et al., 2006; Copley, 2007; Parson, Reddy, Wood, & Senior, 2009). Two studies indicated that video podcast use had little impact on the number of students who came to lectures (Brittain et al., 2006; Copley, 2007), however, one study noted that type of podcast was a moderating factor. Some students claimed that they would attend class if video lectures podcasts were available, but would consider missing class if they had access to enhanced PowerPoint summaries (Parson et al., 2009).

Concerning study habits, a wide range of improvements were observed including fostering more independence (Jarvis & Dickie, 2009), increasing self-reflection (Leijen, Lam, Wildschut, Simons, & Admiraal, 2009), more efficient test preparation (McCombs & Liu, 2007), reviewing material (Foertsch et al., 2002; O'Bryan and Hegelheimer, 2007) and increasing contact with academic staff (Chester et al., 2011).

4.8. Positive impact of video podcasts learning performance

Evidence supporting the beneficial impact of video podcasts on student performance has been presented in three different formats: test scores, self-report data and changes in practice. With respect to test scores, a number of studies observed significant differences in scores between students who used video podcasts vs. students exposed to more traditional teaching methods. Boster, Meyer, Roberto, Inge, and Strom (2006), Boster et al. (2007) reported that third, sixth, and eighth grade students who used video podcasts scored significantly higher than students who did not use them. Griffin et al. (2009) noted that students' scored higher on multiple choice tests as a result of using enhanced podcasts. Crippen and Earl (2004) stated that there was a significant positive correlation between the use of worked example video podcasts and test scores. Traphagan et al. (2010) stated that students who watched more video podcasts appeared to perform better in testing situations. Finally, two studies noted significant gains in grades as a result of using enhanced podcasts (Vajoczki et al., 2010) or segmented video lectures (Wieling & Hofman, 2010).

Regarding self-report data, students said that team and technology skills improved (Alpay & Gulati, 2010) as a direct result of using video podcasts. So, Pow, and Hung (2009) added that student teachers felt that they gained knowledge in a number of areas including teaching skills, teaching design, use of resources,

Table 1
Summary of benefits for using video podcasts.

Benefit	No. of studies	Details
Reasons for use		
Learning	23	• Review for assessment • Preparing for class, understanding, note taking • Improve face-to-face classes
Control	9	• Location, time and pace of learning
Missed Classes	9	• Students can review missed lectures
Attitudes		
Affective	14	• Enjoyable, motivating, interesting, stimulating
Cognitive	15	• Useful, helpful, effective, very positive about creating podcasts, easy to use
Behaviors		
Frequency	7	• No. of downloads, views per week,% of students who viewed,% podcasts viewed
Attendance	4	• Viewing podcasts had not impact on attendance, may depend of type of podcast used
Study Habits	6	• Independence, self-reflection, efficient test preparation, better review, increased contact
Learning performance		
Test Scores	7	• Higher scores in tests than traditional approaches
Self-Report	2	• Team and technology skills, teaching skills
Practical tasks	2	• Sunscreen use, field techniques

classroom management, and pupil participation. In terms of change in practice, Armstrong, Idriss, and Kim (2011) noted that video podcast users outperformed pamphlet users in terms of knowledge and the correct use of sunscreen. Jarvis and Dickie (2010) reported positive change in field technique practice as a result of viewing video podcasts.

It is important to note that studies investigating video podcasts and learning performance have not examined pathways to change. In other words, it is not clear what factors in viewing video podcasts contribute to losses or gains in performance. It is also worth noticing that performance gains as a result of using video podcasts may be partially dependent on knowledge area taught and type of podcast used. For example, Hill and Nelson (2011) found that a number of students said video podcasts helped them learn facts, but did not necessarily improve comprehension. Additionally, Zhang et al. (2006) observed that viewing segmented video podcasts improved learning performance, whereas watching non-segmented video podcasts had no effect.

4.9. Summary of benefits

Table 1 provides a summary of five key benefits regarding the use of video podcasts. First, almost half of the studies reviewed, suggest that the main reason video podcasts are used is to improve learning. Students particularly welcomed the fact that video podcasts permitted them to learn when, where, and at the pace they wanted. Second, more than half the studies analyzed suggest that students have very positive attitudes toward video podcasts describing them as useful, helpful and effective, as well as enjoyable, motivating, and stimulating. Third, a number of papers indicated that study habits change as a result of having video podcasts available and that students use podcasts frequently, especially prior to a test or examination. Fourth, in some cases, video podcast use does not reduce class attendance. Finally, there is some evidence, that use of video podcasts has a direct and positive impact on test and skill performance.

4.10. Challenges of using video podcasts

Challenges associated with using video podcasts were organized into four main categories: reasons not use video podcasts, attitudes toward video podcasts, behaviors, and impact on learning performance. Each of these areas will be discussed in detail.

4.11. Reasons not to use video podcasts

Four areas of challenge emerged from the literature review and included technical issues, lecture preference, awareness, and time. A key area of challenge involved technical problems and included excessive file size (Chester et al., 2011; Copley, 2007), download speed (Hill & Nelson, 2011; McCombs & Liu, 2007; McKinney & Page, 2009; Winterbottom, 2007) not having a mobile device (McCombs & Liu, 2007), display size (Foertsch et al., 2002), or not knowing how to get video podcasts to work (Chester et al., 2011; Dupagne et al., 2009; McCombs & Liu, 2007; O'Bannon et al., 2011).

Another significant challenge was related to student preference for lectures. In one study (Chester et al., 2011), most students simply favored lectures and claimed video podcasts were not sufficient to support their needs. In two other studies, students refrained from watching video podcasts because they deemed them as irrelevant to the learning goals of the course (Dupagne et al., 2009; O'Bannon et al., 2011). In another study, students noted that video podcasts were not as engaging as real world lectures and that there were more distractions when viewing video podcasts at home (Foertsch et al., 2002). Three researchers reported that students missed being able to ask questions or get immediate clarification on issues (Foertsch et al., 2002; McKinney & Page, 2009; O'Bannon et al., 2011). Finally, Winterbottom (2007) noted that some students took twice as long to watch video podcasts versus the time spent to attend a lecture.

A third challenge, although less prominent, was linked to student awareness. In three studies, students did not use video podcasts because they were not aware they existed (Chester et al., 2011; Copley, 2007; Shantikumar, 2010). In one case, almost 50% of the students did not know they were available (Chester et al., 2011). A final challenge was that students claimed they were too busy and did not have enough time to watch video podcasts (Dupagne et al., 2009; Hill & Nelson, 2011).

4.12. Negative attitudes toward video podcasts

In terms of affective attitudes toward video podcasts, the current literature review revealed only positive responses, however, with respect to cognitive attitudes several concerns were noted. Two papers indicated that students simply liked lectures better than video podcasts and saw the latter as supplementary aids at best (Parson et al., 2009; Stephenson et al., 2008). Walls et al. (2010) reported that supplementary video podcasts were seen as

too repetitive and that students wanted new, more meaningful material. Finally, Winterbottom (2007) observed that students who were exposed to video podcasts exclusively wanted more face-to-face contact.

4.13. Negative impact of video podcasts on student behavior

Three challenges were observed with respect to behaviors and video podcasts. The first issue was student attendance. In five studies, students who watched video podcasts, consistently attended fewer lectures (Chester et al., 2011; Foertsch et al., 2002; Holbrook & Dupont, 2010; McCombs & Liu, 2007; Traphagan et al., 2010). Interestingly enough, it was not articulated in any of these studies why not attending classes was a concern. There was no evidence presented to suggest that students who watched video podcasts and did not attend lectures were at an academic or social disadvantage.

Second, frequency of video podcast viewing was relatively low in at least three studies (Lonn & Teasley, 2009; McCombs & Liu, 2007; Wang et al., 2010), however reasons for limited use were not given. Finally, self-discipline proved to be an issue in at least one study where students felt they had to be far more focused when using video podcasts as opposed to following traditional lectures (Traphagan et al., 2010).

4.14. Neutral impact of video podcasts on learning performance

With respect to learning performance, some studies reported that video podcasts had no significant impact on exam scores (Bennett & Glover, 2008; Hill & Nelson, 2011), test scores (Boster, Meyer, Roberto, Inge, & Strom, 2006; O'Bannon et al., 2011), learning (Dupagne et al., 2009), or teacher–child interactions (Pianta, Mashburn, Downer, Hamre, & Justice, 2008). None of these studies examined why video podcasts had no impact on learning.

4.15. Summary of challenges

Table 2 offers a summary of key challenges experienced when using video podcasts. It is important to note that the number of studies reporting challenges is noticeably fewer than the studies reporting benefits (Table 1). The main reason students did not use video podcasts involved a variety of technical problems. A second salient challenge was preference for lectures–students liked being able to ask questions and interact with the professor. An indirect challenge emerging from video podcast use is reduced attendance in lectures, although the results are mixed with five studies claiming decreased attendance and four studies claiming no impact (Table 1). Finally, there is some evidence to indicate that video podcasts do not have a significant impact on learning performance. Research on the impact of video podcasts on learning is more positive than neutral, with 11 studies noting significant gains (Table 1) and six studies reporting no impact.

4.16. Methodological concerns

Considerable research has been conducted over the past five years on the use of video podcasts in education and a number of interesting results have been reported. However, it is critical to address three significant methodological concerns in order to establish the reliability and validity of results, compare and contrast results from different studies, and address some of the more difficult questions such as under what conditions and with whom are video podcasts most effective. The three major problem areas are description of video podcasts, sample selection and description, and data collection.

4.16.1. Description of video podcasts

In order to fully examine the impact of video podcasts, it is important to describe these tools clearly in the methods section. Content, number of video podcasts, and length are potentially useful characteristics that should be provided. In the current review, only one third ($n = 16$) of the studies provided a clear description of the video podcast content. Without a clear description, it is difficult to understand the kind of knowledge that may best be communicated with this medium. Furthermore, only 24 studies reported the number of video podcasts used. In other words, we do not have a accurate understanding of exposure – some studies may be using one video while others may be using hundreds. Finally, only 19 studies revealed the length of video podcasts. It is possible that the potential benefits and challenges of using video podcasts are partially related length. A 2 min video podcast may have a decidedly different impact than one fifty minutes long.

4.16.2. Sample selection and description

Almost three quarters ($n = 38$) of the current research on video podcasts focus on undergraduate populations. More research needs to be done at the K-12 level in order to acquire a broader understanding of video podcast use. In addition, only 11% of the studies ($n = 6$) provided a clear description of the sample population. Over 60% ($n = 33$) failed to include information such as age, gender, or where and how the sample was selected. The omission of basic details limits understanding of video podcast research.

Table 2
Summary of challenges when using video podcasts.

Challenge	No. of studies	Details
Reasons not to use		
Technical	9	• File size, download time, not owning a mobile device, knowledge required to use podcasts
Preferred lectures	7	• Irrelevant podcasts, not engaging, distractions, no interactivity
Awareness	3	• Did not know video podcasts were available
Time	2	• Too busy to view
Attitudes		
Affective	0	• No studies reported negative affective attitudes
Cognitive	4	• Video podcasts an add on at best, repetitive, want more face-to-face contact
Behaviors		
Attendance	4	• Students who viewed video podcast attended fewer lectures
Frequency	4	• Students did not view video podcasts often
Self-discipline	1	• Video podcasts required more self-discipline
Learning performance		
Test scores	6	• No significant impact on learning, test scores, target behaviors

Table A1
Coding of research papers reviewed examining video podcasts.

Variable	Description	Scoring criteria
Year	Year study was conducted	Year
No. of video podcasts (VPs)	Number of video podcasts used in the study	Leave blank otherwise report actual number of podcasts
Length	Length of video podcast used	Leave blank otherwise report actual length in minutes
Type	Type of video podcast used	Enh – Enhanced (PowerPoint) Sup – Supplementary Lect – Lecture-Based WE – Worked Example
Population	Sample population	E – Elementary M – Middle School S – Secondary UG – Undergraduate Gr – Graduate Tch – Teachers Prof – Professionals
Sample size	Size of sample population	Leave blank otherwise report actual number of subjects
Sample Description	Description of sample	NC – Not Clear SC – Somewhat clear C – Clear
Subject area	Area taught with video podcasts	Arts – Arts Sci – Science & Technology Mth – Math Bus – Business Hl – Health Edc – Education Var – Variety
Reliability	Were reliability estimate given for measure used?	No Yes
Validity	Were validity estimates given for measure used?)	No Yes
Qualitative Method	Description of the quality of qualitative method used.	NC – Not Clear SC – Somewhat clear C – Clear
Type of study	What was the main focus of the video podcast study?	Use – Use of VPs Comp – Comparing VPs to other methods Qual – VP quality Ped – VP pedagogy Create – Creating VPs Lit Rev – Literature Review
Attitudes	What was the impact of VPs on attitudes?	N – Negative NI – No impact N & P – Negative & Positive P – Positive
Behavior	What was the impact of VPs on behavior?	N – Negative NI – No impact N & P – Negative & Positive P – Positive
Performance	What was the impact of VPs on learning performance?	N – Negative NI – No impact N & P – Negative & Positive P – Positive

4.16.3. Data collection

The reliability and validity of quantitative measures used to assess the impact of video podcasts is clearly lacking. Five out of 39 studies that used survey data provided reliability estimates and only two studies assessed validity. Qualitative assessment of video podcasts was also limited with respect to providing critical details such a transparency of data analysis, credibility of data, providing negative cases, triangulation, or rich descriptive data. Only two out of the 33 studies collecting qualitative information offered a clear description of data collection and analysis. It is difficult to have confidence in the results reported, if the measures used are not reliable and valid or the process of qualitative data analysis and evaluation is not well articulated.

4.17. Future research

The current review strongly suggests that, while there are some challenges, students are very positive about the of video podcasts to support learning. Affective and cognitive attitudes, learning behaviors, and performance are relatively consistent in the support of using video podcasts in higher education. Nonetheless, a number of suggestions for future research have emerged from the quality and content of previous studies and can be organized into the following categories: methodology, quality and design of video podcasts, instructor perspective, pedagogy, viewing patterns, and individual differences.

4.17.1. Methodology

One recommendation for future researchers is to clearly describe the content, type, length and number of video podcasts used, as well as provide a detailed description of the sample selected, and clear indicators of reliability and validity of data collection tools and methods. These simple steps would help to unify and improve the quality of future results reported.

Table B1
Coded articles included in video podcast review.

Authors and year	No. VPs	Focus	VP Type	Len (Min)	Educ level	Subject area	Samp. desc	Samp. size	Surv. rel.	Surv. val.	Qual. meth	Type	Att	Beh	Perf
Alikhan, Kaur, and Feldman (2010)	50		Sup		UG	Health		50			NC[a]	Qual			
Alpay and Gulati (2010)	2	Prac	Sup	5	UG	Science	NC[a]	10	Yes	No	NC[a]	Create			Neg & Pos
Armstrong and Massad (2009)			Sup	7.5	UG	Science	NC[a]	32	No	No		Create	Pos		
Armstrong et al. (2011)	1	Prac	Sup		Prof	Health	NC[a]	94	No	No		Comp	Pos	Neg & Pos	Pos
Bennett and Glover (2008)		Con	Lecture		UG	Health	NC[a]	108	No	No		Use	Pos	Neg & Pos	NI[d]
Berger (2007)		Prac			UG	Science	NC[a]	38	No	No	NC[a]	Use			
Bolliger et al. (2010)		Con	Sup	21	UG, Gr	Various	C[c]	191	Yes	Yes	NC[a]	Use	Neg & Pos		
Boster et al. (2006)	30	Prac	Sup		M, S	Arts/ Science	NC[a]	1471				Comp			Pos
Boster et al. (2007)	25	Prac	Sup		M, S	Math		3019				Comp			Pos
Brittain et al. (2006)			Enhance		UG	Science	NC[a]	70	No	No	NC[a]	Use	Pos	NI[d]	
Chester et al. (2011)		Con			UG	Various	C[c]	273	No	No	NC[a]	Use	Pos	Neg & Pos	
Cihak, Ayres, and Smith (2010)	10	Prac	Sup	2.5	E	Arts	C[c]	4			C[c]	Use		Pos	
Copley (2007)	18	Prac	Enhance	45	UG, Grad	Science	SC[c]	84	No	No	NC[a]	Use	Pos	NI[d]	
Crippen and Earl (2004)		Prac	WE		UG	Science	NC[a]	187	No	No	NC[a]	Use	Pos	NI[d]	Pos
de Boer et al. (2011)	1	Prac	Sup	8	UG	Arts	NC[a]	50	No	No		Use		NI[d]	
Dupagne et al. (2009)	12	Con	Lecture	30	UG	Arts	NC[a]	261	Yes	Yes		Comp	Pos	NI[d]	N NI[d]
Fernandez et al. (2009)	13	Prac	Enhance	10	UG	Science	NC[a]	60	No	No	SC[c]	Use	Pos	NI[d]	
Foertsch et al. (2002)		Prac			UG	Science	C[c]	539	No	No	NC[a]	Comp	Pos	NI[d]	
Green et al. (2003)	3	Con	Sup		UG	Health	NC[a]	656	No	No	NC[a]	Use	Neg & Pos	NI[d]	
Griffin et al. (2009)	2	Prac	Enhance		UG	Various	NC[a]	90	No	No		Comp	NI[d]		NI[d]
Heilesen (2010)					UG							Lit Rev			
Hew (2009)					E, M, S, UG	Various					NC[a]	Lit Rev	Pos	NI[d]	
Hill and Nelson (2011)	6	Con	Sup	17.5	UG	Science	NC[a]	24	No	No	NC[a]	Use	Pos		NI[d]
Holbrook and Dupont (2010)		Con	Enhance		UG	Science	NC[a]	610	No	No		Use	Pos		
Jarvis and Dickie (2009)		Prac	Sup		UG	Arts	NC[a]				NC[a]	Use	Pos	Pos	
Jarvis and Dickie (2010)	37	Prac	Sup		UG	Arts	NC[a]				NC[a]	Qual	Pos	Pos	
Keelan, Pavri-Garcia, Tomlinson, and Wilson (2007)	153		Sup			Health	NC[a]	153	No	No		Qual			
Lawlor and Donnelly (2010)	1	Con	Enhance, Lecture	60	Grad	Science	NC[a]	15	No	No		Qual			
Leijen et al. (2009)		Prac	Sup		S	Arts	SC[c]	17			NC[a]	Use		Pos	
Lonn and Teasley (2009)		Con	Enhance, Lecture		UG	Various	NC[a]	901	No	No	NC[a]	Use	Pos	NI[d]	
McCombs and Liu (2007)			Enhance		UG	Various	NC[a]	1375	No	No		Use	Pos	Pos	Pos
McConville and Lane (2006)	18	Prac	Sup	2.5	UG	Health	SC[c]	145	No	No		Use			NI[d]
McGarr (2009)			Sup								NC[a]	Lit Rev		NI[d]	
McKinney and Page (2009)	2		Sup		UG	Health	NC[a]	125	No	No	NC[a]	Use	NI[d]	NI[d]	
Moss, O'Connor, and White (2010)			Enhance		UG	Arts	SC[c]	159	Yes	No		Use			
O'Bannon, Lubke, Beard, and Britt (2011)	12	Con	Enhance	10	Teachers	Science	C[c]	69	No	No	NC[a]	Comp			NI[d]
O'Bryan and Hegelheimer (2007)	2	Con	Lecture	47.5	UG, Grad	Arts			No	No		Use	Pos		
Parson et al. (2009)		Con	Enhance, Lecture		UG	Arts	SC[c]	167	No	No	NC[a]	Use	Neg & Pos	NI[d]	
Pianta et al. (2008)		Prac	Sup		Teachers, Education		C[c]	113				Use			NI[d]
Pilarski et al. (2008)		Con	Lecture		Grad	Health	NC[a]	104	No	No	NC[a]	Use	Pos	NI[d]	
Reynolds and Mason (2002)		Prac	Lecture	30	UG	Health	SC[c]	220	No	No	NC[a]	Use	Pos		
Shantikumar (2010)	13		Enhance	12.5	Grad	Health	NC[a]	211	No	No	NC[a]	Use	Pos		
Shim et al. (2007)					UG, Grad	Arts, Business	NC[a]	183	No	No		Qual			
So et al. (2009)		Prac	Sup	37.5	Teachers, Education		NC[a]	4			NC[a]	Misc		NI[d]	Pos
Stephenson et al. (2008)		Con	Enhance, Lecture		UG	Science	NC[a]	76	No	No	NC[a]	Comp			NI[d]
Swan and Hofer (2011)			Sup		Teachers	Arts	SC[c]	8	No	No	NC[a]	Ped			Neg & Pos

Table B1 (*continued*)

Authors and year	No. VPs	Focus	VP Type	Len (Min)	Educ level	Subject area	Samp. desc	Samp. size	Surv. rel.	Surv. val.	Qual. meth	Type	Att	Beh	Perf
Traphagan et al. (2010)			Lecture	50	UG	Science	NC[a]	364	Yes	No	NC[a]	Comp	Pos	Neg	Pos
Vajoczki et al. (2010)			Enhance		UG	Arts, Business	NC[a]	1675	No	No	NC[a]	Use	Pos		Pos
Walls et al. (2010)		Con	Sup		UG, Education	Bus	SC[c]	99	No	No	NC[a]	Use	Neg & Pos	Neg & Pos	
Wang et al. (2010)		Con	Lecture		Grad	Health	NC[a]	20			NC[a]	Use	NI[d]	NI[d]	
Wieling & Hofman, 2010	13		Lecture	90	UG	Arts	NC[a]	474				Comp			Pos
Winterbottom (2007)	8	Con	Lecture		UG	Science	NC[a]	94	No	No	NC[a]	Use	Pos	NI[d]	
Zhang et al. (2006)	1	Prac	Lecture	29	UG	Arts, Science	SC[c]	138	No	No		Comp	NI[d]	NI[d]	Pos

[a] NC – Not complete.
[b] SC – Somewhat Complete.
[c] SC – Complete.
[d] No Impact.

4.17.2. Quality and design of video podcasts

A number of questions remain regarding the design of video podcasts. For example, while some work has been done on comparing video podcast vs. traditional teaching (e.g., Copley, 2007; Dupagne et al., 2009; Hill & Nelson, 2011), no research has been conducted on the characteristics of video podcasts that effect learning. Factors such as quality of visuals used, type of explanations offered, cognitive load, engagement and tone of voice, pace, length, and segmentation need to be examined in more detail in order to improve the effectiveness of video podcasts as learning tools.

4.17.3. Instructors perspective

No studies in this review concentrated on the instructors' perspective of video podcasts used, One indirect issue did arise with respect to reduced student attendance as a result of using video podcasts (e.g., Vajoczki et al., 2010). A more detailed analysis, though, about why reduced attendance is a concern needs to be investigated. For example, is this a political or learning issue? Other instructor related issues might include workload, planning and design challenges, training, student contact, and copyright. Finally, it is important to ask instructors their attitudes about the role and effectiveness of video podcasts.

4.17.4. Pedagogy

Few studies in this review examined the pedagogical strategies for using videos podcasts (Alpay & Gulati, 2010; Armstrong & Massad, 2009). Most video podcasts were viewed in a relatively passive manner. There is some evidence to suggest that the creation of video podcasts offers considerable promise with respect to skill development (Alpay & Gulati, 2010; Armstrong & Massad, 2009) although more research is needed. Another interesting study reversed the organization of a typical lecture assigning basic course material as homework through the use video podcasts and using face-to-face classroom time for hands-on applications and enhanced discussion (Foertsch et al., 2002). This is a unique approach that needs to be explored further. Other pedagogical questions might include:

- What is the optimum length for video podcasts and does that depend on the nature of content?
- Are summaries more effective than full lectures video podcasts?
- Are worked-examples better addressed through the use of video podcasts than in lectures?
- Can administrative tasks be adequately addressed using video podcasts?
- Could video podcasts be used to give feedback to students?
- What type of content or concepts are best suited to the video podcast format and is there still a roll for audio podcasts?

4.17.5. Viewing patterns

Some interesting preliminary work was noted in this review with respect to viewing patterns of students including when and where they watch video podcasts as well as how they view materials (e.g., all at once or in small chunks). Future research in this area could focus on a more detailed analysis of viewing style and its impact on learning outcomes. For example, students who jump from segment to segment may integrate less knowledge than students who view podcasts more systematically.

4.17.6. Individual differences

Another opportunity for future research is to examine individual differences in the use and impact of video podcasts. One obvious suggestion, noted earlier, is to expand the sample population to K-12 students. Other areas of interest might be the impact of gender, subject area ability, technological comfort level, and distractibility on the use of video podcasts. Finally, a promising area of research involves the role and impact of video podcasts in helping students with special needs.

Appendix A

See Table A1.

Appendix B

See Table B1.

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