Implementing Enhanced Podcasts in a Virology Class to Complement a PBL Learning Strategy: Students’ Perceptions and Impact on Final Grade

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Abstract
Enhanced podcasts are playing an ever-greater role in higher education. In an undergraduate virology course, the problem-based learning (PBL) approach was implemented. However, in a lecture-based faculty, non formal interviews with students showed that discontinuing lectures was a source of concern and stress. To complement the PBL strategy, enhanced podcasts were used as a support tool. This study aimed to explore the students experience after using a hybrid course in which basic knowledge was delivered via enhanced podcasts. In this practical-purposed and descriptive study, two questionnaires were administered to 28 students in order to examine student’s attitude regarding enhanced podcasts in complement to the PBL strategy. In addition, we analyzed the impact of using enhanced podcasts on the grades earned for exams and for the general grade average of the course. Evaluation of this innovation by students showed that they appreciate the tool’s pedagogical value, but its impact on their final grade was minimal compared to the traditional course.

INTRODUCTION
The Problem-based learning (PBL) model is a well-established learning method, where students take center stage in case-based, self-directed learning [1,2]. In PBL, problems are introduced first and presented in a real-world context as material for learning the subject [3,4]. The professor serves as a facilitator/guide to help students identify learning topics, strategies and critically evaluate knowledge sources. The PBL approach has been described as an effective learning strategy that can encourage students to become self-directed learners and to develop transferable skills, such as critical-thinking skills, problem-solving skills, and teamwork skills [5-7]. PBL may further develop students’ abilities to think like scientists and encourage participation in undergraduate research [8].

Despite several advantages over the more traditional lecture- and seminar-based courses, numerous systematic reviews and meta-analyses comparing PBL with the traditional curriculum have failed to provide unequivocal support in favor of the PBL [8-13]. Although some studies have found PBL to be more effective in promoting clinical skills and professional competency, its usefulness in promoting the broad knowledge remains uncertain [12,14,16,17]. In addition, students may experience discomfort when using PBL [18]. Indeed, early research in PBL shows that the initial transition from a traditional to a PBL curriculum may be a difficult adjustment for students [12]. The adjustment is difficult for two reasons: 1) Students are concerned about content coverage in PBL environments [19,20], and 2) Their concerns also relate to uncertainty about their grades [21]. Ultimately, though, students become generally satisfied with PBL [18]. The inconsistency between students’ initial and longer-term perceptions suggests that professors must help students make a smooth transition to PBL [18].

Pedagogies are not static and need to evolve through time with innovative teaching and learning tools [22]. Technological innovations are growing rapidly in number, thereby offering unique opportunities to the world of education for creating physical and virtual spaces that actively engage students in the learning process using a wide range of pedagogical methods [23]. A specific modality of technological innovations is the podcast. A podcast is a tool for distributing an audio or audio/video file or series of files through a platform that is accessible via the Internet and readable on portable media players (iPods) and personal computers [24]. While early definitions of podcasts referred solely to audio recordings, increased access to bandwidth and the growth of streaming sites have expanded the definition to include other forms of media such as video [25]. Video podcasts have been referred to as audiographs, podcasts, vodcasts, webcasts, and/or video streams, leading to ambiguity in terminology [25]. A recent review of podcasting in higher education attempted to eliminate this ambiguity by describing the term ‘enhanced podcasts’ as containing “multimedia information such as slides, pictures, images, photographs, and short videos” [26].

In education, a common use of enhanced podcasts has been recorded lectures. Studies have shown that podcast-based asynchronous video lectures are equally as effective in teaching medical content [27-31]. Further, a recent review of enhanced podcasts with video concluded that they led to enhanced study habits and motivation to learn [25]. Several studies have shown that students perceive the courses or parts of courses made available on podcasts to be an additional resource offering great value in supporting their learning [32-34] without lowering their classroom attendance [35-37]. Using podcasts is seen as a factor that encourages good tests results [35].

Virology is a rapidly expanding science and its instruction presents a number of challenges, including the exponential growth of publications and knowledge in the field. The virology course (VIR500) for the Baccalaureate in Biology at the Faculty of Sciences at Université de Sherbrooke was usually taught entirely in the form of lectures, a type of teaching in which students are more in a receptive mode than actively participating in the learning process. A change in the educational paradigm led to a redesign of the course when learning-centered approaches were adopted. More specifically, the PBL approach was instituted in 2008. According to a survey taken at the beginning of each virology course between 2008 and 2010, an average of 96% of students in the class were using PBL for the first time as part of a science course. While it offers many advantages, PBL made certain students uncomfortable. Indeed, working as a team represents a considerable challenge and, for more than half of the students, discontinuing lectures was a source of concern with regard to the material they should study for exams. To respond to the educational issues for the VIR500 course while taking into consideration PBL’s destabilizing elements for students, the addition of another innovative approach, enhanced podcasts, was developed. Thus, a hybrid teaching model was implemented and offered online as a complement to classroom attendance in the summer of 2013.

Here we present a pedagogical innovation developed in a virology class in which enhanced podcasts were used as a complement to the in-class course content, according to the problem-based approach. Students’ perceptions of the introduction of this innovation as a teaching aid are shown and the impact of the podcasts on the students’ final grades is evaluated.

**METHODOLOGY**

**Course description**

Among the nine undergraduate Department of Biology programs in the Faculty of Sciences at Université de Sherbrooke, there is one virology course (VIR500) offered during the second year of the program. Each term, approximately 30 students on average participate in this 30-hour course. The goal of this 2-credit course is to teach basic knowledge of the study of viruses in terms of their physical/chemical, biochemical, and biological properties. This course therefore enables students to fully understand the pathogenesis of a dozen viruses that infect humans. It also introduces them to the core techniques of basic and clinical research. By the end of the course, the student should be able to 1) Understand and explain concepts specific to virology; 2) Understand the main steps of the replicative cycles based on selected examples of DNA and RNA viruses; 3) Explain how the various virus transmission modes affect the host response; 4) Make the connection between immune response and virus dissemination; and 5) Apply this knowledge and these principles to simple practical cases to explain and interpret them. To fully understand concepts specific to virology, the students must also understand concepts from genetics and microbiology.

**Enhanced podcast design and content**

The material taught in this virology course is divided into eight modules. For each of these modules, the material was recorded by the professor in the form of an oral presentation accompanied by slides made using the Keynote visual presentation software program, then transferred to MP4 format for compatibility with various computer systems (computers, mobile phones, MP3 players). The recordings containing the oral and visual presentations were then uploaded onto the Moodle platform, which is accessible from the Université de Sherbrooke site. Topics as well as the duration of each enhanced podcasts are presented in Table 1. The podcast dealing specifically with the module being studied in class was available four days prior to the class session so that students could familiarize themselves with it before attending class.

**Participants and outcomes measures**

In the summer of 2013, students enrolled in the course were invited to fill out a questionnaire on the use of podcasts; this was done twice during the term: after midterm exams and after the final exam. The group of 28 students was made up of 18 women and 10 men. They were 21.2 years of age on average. All of the enrolled students agreed to answer the survey and confidentiality about their responses was made clear. The mid-term and final questionnaires had three sections: the first collected data on participants’ demographic characteristics, the second related to their podcast-listening habits, and the third asked participants to determine the effect of this technology on their learning and interest using a Likert scale [38]. However, the final questionnaire had an additional section; in this open-section, students were invited to comment on their experience.

To analyze the impact of using podcasts on the grades earned for exams and the general average of the course, we compared the final results for students enrolled during the 2013 winter term (without podcasts) with those of the 2013 summer term. For these two groups, the same mid-term and final exams were administered. The group that did not use enhanced podcasts was composed of 16 students; 9 women and 7 men. The statistical analysis comparing the grades was performed using the Student’s t-test where the p values were considered to be statistically significant if they were less than 0.05.

**RESULTS**

Students in the group being studied had relatively limited experience in using podcasts, either for personal reasons or...
in an educational setting. Indeed, a very high proportion of students (89%) was not familiar with and/or had never used this technology in a learning context. The results relating to podcast listening habits for the virology course show that students primarily listened to them at home (75%), while a small proportion (25%) did so both at home and on campus. No students listened to podcasts exclusively on campus. The personal computer was the preferred system for listening to the course; only eight students used MP3 players or tablets to listen.

For each of the eight modules of the course, the podcasts had a recording time of approximately two hours. The analysis of the questionnaire responses as to the time spent by students listening to podcasts indicates that the students spent between one and four hours weekly. While half of the students spent two hours listening (50%), others listened for three or four hours (29 and 7%, respectively) and some spent only one hour listening to the podcasts (14%). The students who spent only one hour listening to the podcasts justified this time by saying that they listened to them selectively, concentrating only on the notions and concepts of which they had little or no prior understanding.

The questionnaire analysis also made it clear that students greatly appreciated using podcasts as a supplement for the virology course materials. Indeed, 43% strongly agreed with the statement “I like using the VIR500 podcasts” while 54% agreed and 3% were neutral. Moreover, a very large majority of the students found the podcasts easy to use. Hence, 32 and 46% of students strongly agreed or agreed, respectively, with the following statement: “The podcasts are generally easy to use.” We observed that 18% of the students were neutral with regard to this statement and 4% found the podcasts more difficult to use.

Another series of questions more clearly showed how students perceive the relevance of podcasts as a supplemental tool for learning virology concepts (Figure 1). It is interesting to note that students viewed podcasts as an important tool for learning (Figure 1A). The data show that 50% of students very strongly agreed that “Podcasts are interesting tools for learning virology” and 46% agreed. Only 4% of students were neutral with regard to this statement. For the vast majority of students, this technological tool facilitates comprehension of virology concepts, as Figure 1B shows. Only 4% disagreed with this statement and 11% did not perceive any impact of this technology on their comprehension of virology concepts. Additionally, podcasts appear to be an important review tool for students (Figure 1C). Indeed, 64% of students strongly agreed and 14% agreed that podcasts are useful as a pre-exam review tool. Some students (11%) were neutral toward or disagreed with the use of podcasts as review tools. As shown in Figure 1D,
analysis of the questionnaires also shows that 75% of students strongly agreed and 7% agreed with the following statement: “Podcasts make it easier to take notes in virology,” while 4% disagreed. At midterms, 70% strongly agreed, 22% agreed, 4% disagreed, and 4% strongly disagreed with the proposal that they receive podcasts for all of the course modules until the end of the term. Conversely, their responses were more lukewarm on listening to supplementary podcasts on current virology topics as part of the course. The data reveal that only 8% strongly agreed, 32% agreed, 48% were neutral, 4% disagreed, and 8% strongly disagreed with their possible use.

Another series of questions indicated students’ interest in using podcasts as a learning tool regardless of the course (Figure 2). For the statement "I would like all courses to use podcasts," 22% of students strongly agreed, 41% agreed, 19% were neutral, 15% disagreed, and 4% strongly disagreed (Figure 2A). When we asked whether podcasts could be interesting learning tools regardless of the course, 36% of students strongly agreed, 39% agreed, 11% were neutral, 11% disagreed, and 4% strongly disagreed (Figure 2B). Conversely, students were less enthusiastic about being assigned podcasts to listen to on supplementary topics as part of the virology course (Figure 2C). The results show that 7% of students strongly agreed, 32% agreed, 50% were neutral, 7% disagreed, and 4% strongly disagreed to listening to podcasts on supplementary virology topics.

The questionnaires also enabled us to collect comments from students during and after podcast use for the course. Students generally felt positive about the use of this new technology. The negative items primarily involved technical difficulties related to the recording and synchronizing of the podcasts for modules 1 and 2. Thereafter, the professor must have made a number of technical changes to make the podcasts user-friendlier. As a result, the podcasts for modules 3 to 8 benefitted from the solutions provided for problems encountered during the two first recordings. The students stated that this tool greatly facilitates note taking and is a beneficial supplement to attending class. Some of their comments are presented in Table 2.

Lastly, we determined the impact of using podcasts on midterm and final exam grades, as well as on the final grade for the course. Data analysis shows that using this technology had no impact on exam results or on the final grade. Table 3 lists the comparison of the cumulative average of all students who had access to podcasts during Summer 2013 with those of Winter 2013. Data analysis shows that the cumulative average difference between students who had taken the course in winter and those who had taken it in summer is not statistically significant.

DISCUSSION

In-class lectures continue to prevail in science education although this system is outdated and fails to address student needs. The purpose of this study was to explore science...
Table 1: Length of enhanced podcasts used in the virology class during the summer 2013.

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Length of podcasts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction and virus structure</td>
<td>1 h 28 min 02 sec</td>
</tr>
<tr>
<td>2</td>
<td>Viral pathogenesis</td>
<td>52 min 23 sec</td>
</tr>
<tr>
<td>3</td>
<td>Methods in virology</td>
<td>1 h 07 min 45 sec</td>
</tr>
<tr>
<td>4</td>
<td>Host immune response to viral infection</td>
<td>59 min 02 sec</td>
</tr>
<tr>
<td>5</td>
<td>Replication patterns of specific pathogenic viruses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1- Viruses contracted via the respiratory tract (rhinovirus, influenza, measles)</td>
<td>1- 1 h 17 min 36 sec</td>
</tr>
<tr>
<td></td>
<td>2- Viruses ingested with food or water (Rotavirus, Adenovirus, Hepatitis A)</td>
<td>2- 1 h 16 min 35 sec</td>
</tr>
<tr>
<td></td>
<td>3- Viruses transmitted from mother to child (Hepatitis C, Hepatitis B, HTLV-1)</td>
<td>3- 1 h 12 min 24 sec</td>
</tr>
<tr>
<td></td>
<td>4- Viruses spread sexually (HIV-1, human papillomavirus, Herpes virus)</td>
<td>4- 1 h 30 min 07 sec</td>
</tr>
<tr>
<td>6</td>
<td>Virus and cancer</td>
<td>52 min 18 sec</td>
</tr>
<tr>
<td>7</td>
<td>Emerging viruses</td>
<td>39 min 05 sec</td>
</tr>
<tr>
<td>8</td>
<td>Strategies to protect against and combat viral infection</td>
<td>46 min 17 sec</td>
</tr>
</tbody>
</table>

Table 2: Student comments on using podcasts in virology class.

<table>
<thead>
<tr>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
</tr>
<tr>
<td>- I think that quickly reviewing the modules after listening to the podcasts facilitates comprehension and learning.</td>
</tr>
<tr>
<td>- Listening to podcasts combined with attending class encourages comprehension of the material.</td>
</tr>
<tr>
<td>- The big difference with podcasts is that you can go back to or quickly fast-forward over certain parts. These are advantages that traditional courses don't offer.</td>
</tr>
<tr>
<td>- In class, everything goes by too fast and that doesn't give us much time to take notes. I really liked the podcasts because I can take my time for taking notes and understanding.</td>
</tr>
<tr>
<td>I really like using the podcasts. I have a lot of trouble staying focused in class and I'm not good at taking notes. With podcasts, when my concentration level drops, I can put the podcast on pause and come back to it later.</td>
</tr>
<tr>
<td>- Very good idea and highly appreciated tool for pre-exam review.</td>
</tr>
<tr>
<td>- I was sick for a few days, but with the podcasts I didn't miss anything from class... Wonderful!</td>
</tr>
<tr>
<td>Negative</td>
</tr>
<tr>
<td>- The attended class session is too long and repetitive if you have listened to the podcasts. Replace them with a question period.</td>
</tr>
<tr>
<td>- Software for recording the class needs to be improved.</td>
</tr>
<tr>
<td>- At first, I had trouble playing the podcasts.</td>
</tr>
</tbody>
</table>

Table 3: Impact of using podcasts on the cumulative average for the virology course in 2013.

<table>
<thead>
<tr>
<th></th>
<th>Winter 2013 (without podcasts)</th>
<th>Summer 2013 (with podcasts)</th>
<th>Statistical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative average</td>
<td>80.92 %</td>
<td>82.06 %</td>
<td></td>
</tr>
<tr>
<td>Average grade</td>
<td>3.33</td>
<td>3.54</td>
<td>t = -0.3599</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>7.17</td>
<td>13.82</td>
<td>degrees of freedom= 41.7519</td>
</tr>
<tr>
<td>Variance</td>
<td>51.41</td>
<td>190.99</td>
<td>p = 0.7207</td>
</tr>
<tr>
<td>Maximum</td>
<td>91.50%</td>
<td>92.32%</td>
<td>95% CI</td>
</tr>
<tr>
<td>Minimum</td>
<td>64.60%</td>
<td>17.33%</td>
<td></td>
</tr>
</tbody>
</table>

students’ experience of using podcasts as a support to PBL in a virology class. Indeed, we developed a hybrid strategy using enhanced podcasts to improve the instructional delivery in a undergraduate virology course. The analysis of this innovation shows unequivocally that students had a positive experience while using podcasts as part of the virology course, although the vast majority was more familiar with traditional university-level teaching. The results of this study are consistent with previous literature in terms of students’ perceptions of the benefits of podcasting to their learning. Podcasts are perceived as a being very useful resource and more useful than traditional teaching by means of lectures, class notes, and reference manuals/books [39-45]. Likewise, in our study, podcasts were considered to add value to class attendance by the majority of students. Only two students recommended that the in-class session in which the major concepts presented in the podcasts were reviewed be
replaced by question periods. Students appreciated podcasts as a tool for taking notes and reviewing important concepts before exams, which is consistent with other research results [46-48]. This tool is flexible and practical because students can listen to podcasts wherever and whenever they like. Our results show that students prefer to listen to podcasts at home, as previous studies have also shown [49-51]. In addition, the issue of student anxiety in regard to the use of PBL in the classroom was addressed by the use of podcasts. Indeed, students felt that podcast sessions offer a support where they can have access to concepts under consideration within the specific modules. However, despite students’ positive perception of podcast use on their learning and understanding of virology concepts, this use had no impact on the final course result, as others before us have noted [51-53].

The pedagogical approach developed here is similar to the Flipped Classroom (FC) model [54]. In this educational model, learners are first exposed to pre-recorded lecture videos or readings before attending class. During the class time, students are engaged in student-centered learning activities like inquiry and problem solving as proposed in our settings. There are contradictory claims made about the effectiveness of the FC in sciences or medical education; however, the quality of the empirical evidence used to back up these claims is not evident. Studies are performed in different settings, and different parameters were measured [55-57].

This study does have several limitations. First, the study was performed without a control group during the period of investigations. Although we compared the final marks, we did not concurrently compare the perceptions of students using PBL only and those using the hybrid version. Also, the small sample size and the fact that the heterogeneous group of students came from a single term and single program are other limitations that could impact our conclusions. Secondly, the questionnaire designed to evaluate the innovation is specifically tailored to this course. Therefore, the findings of this study may not be generalizable to other graduate courses and higher institution settings. However and while our analysis of this pedagogical innovation has limitations, our personal experience with establishing podcasts in the classroom remains positive and podcasts are now used as an integral part of this virology course.

Constant evaluation of this strategy and of the technological and pedagogical improvements required will be necessary to refine this technological innovation and to make it an effective teaching and learning tool. Some students reported that podcasts of Module 5 were too long in length and experienced difficulties to stay focused. Indeed, research has shown the average attention spans of today’s students range from 10-15 minutes [58]. Thus, we designed shorter enhanced podcasts for the same sequence. With examples for each modes of transmission, three viruses are presented in the course. Thus in the new version of the course, each viruses were presented separately. For one specific virus, three sections were recorded; 5-10 minutes for the virus structure, 20-30 min for the replicative cycle, and 10-15 for the clinical aspects of the viral infections.

Implementing enhanced podcasts requires effort and can be difficult. However, we have been able to transform the class format into a new student learning opportunity. Our small-scale study provides evidence that blended instructional between PBL and podcasting are positive for undergraduate students. As discussed earlier, the use of enhanced podcasts yielded neutral academic outcomes. Thus further research is needed to access whether analytical and critical thinking skills may be affected by this approach.

REFERENCES
41. Echo 360, Blended learning technology: Connecting with the online-all-the-time students. Echo 360, 2012.


Cite this article