Journal of the Scholarship of Teaching and Learning, Vol. 17, No. 2, April 2017, pp. 1-23.
doi: 10.14434/josotl.v17i2.21125

The impact of vodcast utilisation upon student learning of Physiology by first year graduate to entry medicine students

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Abstract: The current study sought to determine the effectiveness of video-on-demand podcasts (vodcasts) as a tool for facilitating the understanding of Physiology by first year undergraduate Graduate Entry to Medicine (GEM 1) students. Seventy three GEM 1 students were provided with full length vodcasts of lecture material in advance of each of nine Physiology lectures. Exam performance, using identical sample questions, was assessed against performance of the 2012-2013 GEM 1 class, which did not have access to the vodcasts. Qualitative information on students' perceptions of the vodcasts was also gathered and analysed. Analysis revealed that the study group of 2013-2014 GEM 1 students achieved significantly higher grades in various examination formats in comparison to the control 2012-2013 GEM 1 cohort. Qualitative analysis of responses to the attitudinal survey revealed that the majority of students liked the vodcasts and that previewing them before lectures did indeed facilitate understanding of the lecture material. However, only 15% of the class was able to view all nine of the prepared vodcasts prior to lectures. Notably, the majority of students indicated that they also considered the vodcasts to be valuable revision tools. This study is the first to show that the use of vodcasts can provide clear, quantifiable benefits for GEM student learning over and above lecture notes and/or lecture slides alone. Our analysis suggests that this improvement was due both to their use as a preview tool as well as facility for later revision of lecture content.

Keywords: adult learning, improving classroom teaching, interactive learning environments, media in education, teaching/learning strategies.

Introduction

The current era of rapid technological advancement has had multiple significant and direct impacts on education in terms of both teaching and learning. One of the most significant advances in this regard has been the growth in the use of digital media such as podcasts as an alternative, or adjunct, to the traditional lecture (Ravenscroft, Tait, & Hughes, 1998; Stephenson, Brown, & Griffin, 2008), a development which is broadly very popular with students (Evans, Gibbons, Shah, & Griffin, 2004; Heilesen, 2010). Importantly however, the use of digital media such as podcasts also seems to have a positive and measurable impact upon learning and teaching when used as an adjunct to the traditional didactic lecture (see *inter alia* Evans, 2008; Fernandez, Simo, & Sallan, 2009; Heilesen, 2010; Lazzari, 2009; Lin, Zimmer, & Lee, 2013; McGarr, 2009; Morris, 2010).

With the advent of higher speed bandwidths there has been a significant shift towards combined audio and video podcasts (VODcasts – where the 'VOD' acronym stands for 'video-on-demand'; Meng, 2005). Studies investigating the use of vodcasts in education have largely found that, as with audio podcasts, they are popular with students at a fundamental level as they provide them with control over their own learning environment, both in terms of where

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and when they learned (Heilesen, 2010; Jarvis & Dickie, 2010; McGarr, 2009; Stephenson et al., 2008; Winterbottom, 2007), their pace of learning (Chester, Buntine, Hammond, & Atkinson, 2011; Griffin, Mitchell, & Thompson, 2009; Stephenson et al., 2008; Winterbottom, 2007) and what they had to learn (Fill & Ottewill, 2006; Heilesen, 2010). However, the primary reason for their popularity with students was that they felt that they helped to improve their learning (for review see Kay, 2012).

However, their favourable reception by the majority of students notwithstanding, is there any empirical evidence that vodcasts actually improve students' learning performance? Although studies investigating the effect of vodcasts specifically on examination performance are still relatively limited, of those that have been conducted, the results are generally, although not always (McNulty et al., 2009; O'Bannon, Lubke, Beard, & Britt, 2011; Schreiber, Fukuta, & Gordon, 2010), positive (Crippen & Earl, 2004; Griffin et al., 2009; Traphagan, Kucsera, & Kishi, 2010; Vajoczki, Watt, Marquis, & Holshausen, 2010; Wieling & Hofman, 2010). However, one can only make extremely general extrapolations about the utility and transferability of these findings as, not only are vodcasts sometimes deployed in different formats (*e.g.* segmented *versus* full length, lecture-based *versus* worked example, *etc.* (see Kay, 2012) and different purposes (*e.g.* for lecture preparation or revision), they are also drawn from multiple educational spheres (*e.g.* humanities, law, chemistry, medicine, *etc.*) and attainment levels (*e.g.* secondary school, undergraduate and postgraduate).

This relative dearth of empirical information about the utility of vodcasts in facilitating learning and understanding equally applies to medical education in general, and, more specifically, to accelerated graduate entry medical (GEM) programs (where enrolled students are required to cover the same depth and breadth of material in one and a half years as 'direct entry' medical students cover in three, but with roughly only half the number of lectures), the subject of the current study. Indeed, to the best of our knowledge, at the time of writing only five full research articles and one short abstract have been published investigating the effects of lecture vodcasts (Jones, Doleman, & Lund, 2013; Pilarski, Alan Johnstone, Pettepher, & Osheroff, 2008; Schreiber et al., 2010; Shantikumar, 2009), or recorded live lectures (Cardall, Krupat, & Ulrich, 2008; McNulty et al., 2009), specifically on various aspects of medical training as a whole. Of these, only two examined the effect of vodcasts on exam performance, with one showing no effect compared to students who attended 'live' lectures (Schreiber et al., 2010) and the other demonstrating that individuals' frequency of use of vodcasts was actually correlated with *lower* exam scores (McNulty et al., 2009). To date, no studies have examined the effects of their usage within GEM education. We therefore sought to begin to fill this information void by both determining students' perceptions of vodcasts of lecture material, as well as empirically examining their effects on exam performance in a compulsory Physiology component of a module taken by GEM 1 students.

Study Rationale

The central aim of the current study was to investigate the hypothesis that previewing vodcasts of lecture material *prior to* attending scheduled lectures on the same topic would enhance student understanding of the material being taught and, as a result, improve exam performance relative to students who did not have access to vodcasts. The rationale underlying this approach was that students attending traditional didactic lectures are usually first exposed to the material contained within a lecture only during the lecture period itself. Thus, in terms of Bloom's revised taxonomy (Krathwohl, 2002), students will normally, at best, only be engaged in lower level cognitive work (gaining knowledge and comprehension) during an actual lecture (as this will likely be the first time that they will have encountered the material), with any higher order cognitive work (application, analysis, synthesis and/or evaluation) only likely to take place

when the lecture is 'revised' afterwards in the students' own time. Thus, those students who preview material prior to attending lectures, should theoretically be able to process that material at a deeper level than students experiencing their 'first pass' of the same information during the lecture itself (Krathwohl, 2002) and should therefore procure greater educational benefits from this face-to-face time with lecturers than their unprepared colleagues.

In addition to the primary goal of using vodcasts as a means of facilitating the understanding of Physiology by GEM students, measured empirically by performance in exams, we were also interested in gauging these students' perceptions about the vodcasts. Specifically, we wished to determine if this particular cohort of students, which is relatively distinct from other undergraduates due both to their prior higher educational experience, as well as the heavy study load that they experience relative to students enrolled upon the more common 'direct entry' undergraduate medical programs, would view the vodcasts as potentially valuable learning tools in their own right, for example, for revision purposes.

Therefore, the specific aims of the study were to:

1) Investigate the hypothesis that the deployment of vodcasts of lecture material in advance of the lectures themselves would enhance student understanding of the material being taught and, as a result, improve exam performance relative to students who did not have access to vodcasts.
2) Gather student opinions on the vodcasts in order to determine, a) if they perceived them as being useful learning tools, and b) if they did indeed utilise them as they were intended for the study, namely as preview tools before lectures, or if they were used as a revision tool, or a mixture of the two approaches.

This type of study is important due to the relative paucity of data investigating the effect of vodcast usage on student exam performance in general. However, more importantly from the perspective of the current study, in spite of the growth of accelerated graduate entry programs within Ireland and the UK, there are still very few studies investigating the impacts of utilising newly developed 'interactive' teaching tools (*e.g.* smartphones, webcasts, tablets, *etc*.) upon the students enrolled upon these courses.

Methodology

Study groups

The study was carried out at University College Cork during the autumn term of the 2013-2014 academic year. A total of 73 participants (39 females, 34 males) were full time, first year Graduate Entry to Medicine (GEM 1) students studying their first compulsory basic science module (GM1001 – Fundamentals of Medicine). All students entering this programme must possess a minimum of a second class honours, grade one (2H1 or equivalent) result in their first honours bachelor degree (NFQ level 8) and have attained an appropriate grade in either the Graduate Medical School Admissions Test (GAMSAT) or Medical College Admissions Test (MCAT).

For quantitative purposes, the 2013-2014 GEM 1 class's performance against specifically selected and identical Physiology questions in continuous assessment, end of module and end of year exams was compared with that of the preceding year's (2012-2013) GEM 1 class (who had no exposure to the vodcasts and could therefore act as a control group), which contained 69 students (30 females, 39 males).

Creating and publishing the vodcasts

Vodcasts were created using Panopto lecture capture software installed onto an office PC and used in conjunction with a webcam to record the slide narration. Vodcast slides were themselves created using Microsoft PowerPoint (MS PPT). MS PPT was utilised for this purpose primarily because, a) it is the 'industry standard' for lecture delivery, and b) it integrates well with the Panopto lecture capture software used here for the creation of the vodcasts. The Panopto software itself allows the user to record presentations in a combined audio and visual package, such that students can view the MS PPT presentation whilst hearing simultaneous commentary and seeing the relevant cursor moves. Furthermore, the user can pause, move forward and backward through the content or skip to specific slides as and when desired.

Once recording was completed, vodcast files were made available to the students on UCC's virtual learning environment, Blackboard (supplied by Blackboard Inc.), at least two weeks prior to each scheduled lecture slot, and remained available for download until the end of the academic year. From the Blackboard website, students could either directly playback the files or download them in MP4 format for playback on compatible portable mobile devices. Additionally, for both the 12-13 and 13-14 year groups, the MS PPT presentations used to prepare each vodcast, and full sets of learning outcomes accompanying each lecture (which were both identical for both years), were also posted on Blackboard for students to download as they wished.

Vodcast content

The nine vodcasts and lectures utilised in the study (out of a total of twelve Physiology lectures in the module) were all recorded and delivered by the same lecturer over the course of ten weeks in the fourteen week teaching period of module GM1001. The other three lectures in the module were delivered in traditional didactic format by one other lecturer and were not accompanied by vodcasts or additional content of any description. The mean duration of each recorded vodcast was 47.3 ± 1.9 minutes (range = 36.2 – 56.3 mins).

GM1001 lecture style

In the first week of module GM1001, the 13-14 GEM 1 students were informed that vodcasts for nine of their Physiology lectures in GM1001 had been, or would be, prepared and made available to them prior to each lecture, and that they should view each of these prior to attending the relevant lecture. Previewing of the vodcasts in advance of each lecture however was not mandatory.

In order to further facilitate higher level cognitive work by the students during the actual lecture slots, the lectures themselves, which covered broadly similar material to that contained within the vodcasts, were very loosely based upon the 'flipped classroom' teaching technique (Crouch & Mazur, 2001; Gannod, Burge, & Helmick, 2008), where students as a group (as opposed to being provided with individual response units for example), having been asked to prepare for each lecture in advance, were then asked questions about the lecture material during lecture time, thus facilitating at least limited 'active learning' (Bonwell & Eison, 1991). In this particular study the questions utilised were relatively unsophisticated, and were largely based around answering questions about material that had been removed from the original lecture slides (*e.g.* see Figure 1), but which the students could still access prior to, and during, the lectures themselves.

The same nine GM1001 Physiology lectures delivered to the 2012-2013 GEM 1 class the previous year were all delivered as traditional didactic lectures with minimal student participation, as were the other three Physiology lectures which were, again, delivered by the one other Physiology lecturer on this module.

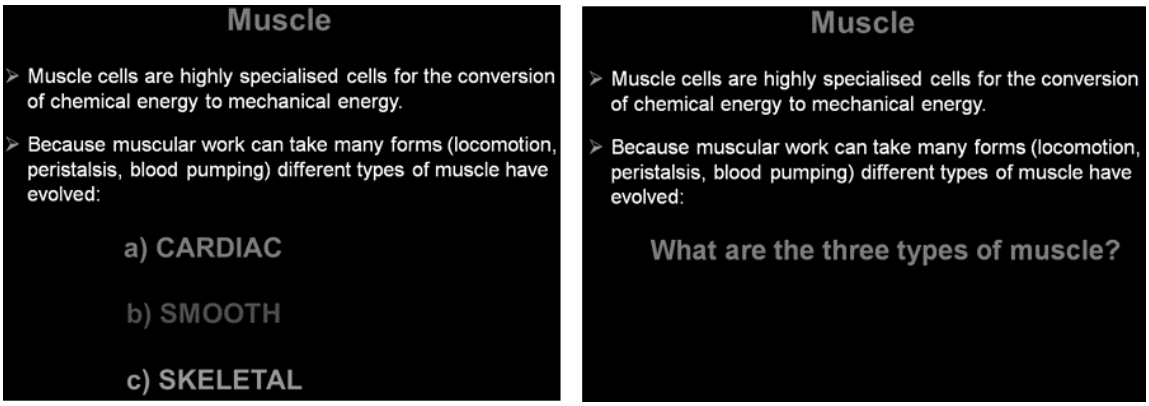

Figure 1: Sample question in a Physiology GM1001 13-14 presentation. Screen grabs of examples of the type of slide alteration utilised in GM1001 presentations. On the left hand side is the original slide as used for the vodcast. On the right hand side is a slide which has had information removed which was used for the respective lecture on the same topic. In the 13-14 lecture, students were then asked if they could name three different type of muscle.

Quantitative assessment of efficacy of vodcasts on exam performance usage using single best answer questions

In order to quantitatively assess the efficacy of vodcast usage in the 13-14 GEM 1 year group against the control 12-13 GEM 1 year group, their performance in the Physiology component of three distinct examination scenarios, continuous assessment (CA), end of module (EOM) and end of year exams (EOY), was assessed. The primary mode of assessment in all three types of examination was the use of single best answer (SBA) questions, whereby questions are formulated around a question stem and students have to select the single best answer from a list of five options.

Both the 12-13 and 13-14 GEM 1 students sat six Physiology CA exercises at regular intervals (roughly one every two weeks) throughout the GM1001 module. Each CA test was conducted electronically using a secure browser in the same proctored setting each time, with the class as a whole. Access to the CAs was restricted only to members of the GEM 1 classes and was secured by specific student identification number.

Each CA contained approximately 20 questions of which roughly half were in SBA format and *related directly to the material covered by the nine vodcasts*. This yielded a total of 63 SBA questions which were identical to those that had been answered by the 12-13 GEM 1 year group the previous year and could therefore be used for comparing performance between the two years.

For the GM1001 EOM exam, which was conducted one week after the completion of the GM1001 lectures, the number of valid identical Physiology SBA questions which could be used for comparative analysis fell to 15. For the GM1001 EOY exam, which took place approximately seven months after completion of the GM1001 module, the number of valid identical Physiology SBA questions which could be used for comparative analysis was 17. Due to the fact that the questions used for our analysis had been deployed in both CA exercises and

EOM and EOY exams, it was possible for us to monitor performance both whilst the course was still being taught as well as after all of the material had been delivered.

Statistical analysis

Statistical analyses were performed using Microsoft Excel. For analysis of success rates of the 12-13 *versus* 13-14 year groups against the questions utilised in their GM1001 CA, EOM and EOY examinations, a paired Student's *t*-test was employed with all data expressed as mean ± standard error of the mean (S.E.M.). For data which were unpaired (*e.g.* comparison of MCAT and GAMSAT scores, student ages between the two year groups, *etc.*), an unpaired Student's *t*-test (assuming equal variance) was utilised. Graphs of data were prepared using GraphPad Prism 5 (GraphPad Software Inc., San Diego, CA, USA).

Attitudinal questionnaire

At the end of the 2013-2014 GM1001 module students were asked to complete a questionnaire **(**see Appendix**)** about their experiences with, and perceptions of, the vodcasts in the month following the delivery of the final study lecture for which the vodcasts had been prepared. The survey remained available for completion for eight weeks until the day after the class's EOM exam. The survey initially determined the sex and educational background (biomedical or non-biomedical) of the students. Thereafter the survey took the form of 6, five –point Likert scale questions (strongly agree, agree, neutral, disagree, strongly disagree), two sematic differential items and one open-ended essay-type question which provided students with an opportunity to explain their answers or to add further comments.

Of the 73 students in the 13-14 class, 63 completed the survey (86% response rate), with a further four being submitted incompletely. Of the respondents, 28 were male and 37 were female. In terms of the students' educational/professional background upon entering the GEM course, 20 males described themselves as having a biomedical education, with 7 describing themselves as having a non-biomedical background. For the females, 21 described themselves as having a biomedical background, with thirteen describing themselves as having a non-biomedical background.

Survey data were manipulated to provide a read out of the class's overall percentage responses to each question/statement in the survey. However, survey data were analysed further to determine if there were any major differences in the types of responses to the survey questions between,

a) <u>all</u> males and <u>all</u> females

b) <u>all</u> students from a self-declared biological background versus <u>all</u> students from a self-declared non-biological background

c) male students from a self-declared biological background versus male students from a self-declared non-biological background

d) female students from a self-declared biological background versus female students from a self-declared non-biological background.

When the Likert options for each question were condensed by combing the 'strongly agree' with the 'agree' option, and 'strongly disagree' with the 'disagree' option, analysis revealed that, apart from relatively minor differences in the actual percentages of students selecting the various Likert options in each question, there were no differences in the overall sentiment of

each subset of students. For this reason, only the overall class response to each statement will be displayed and discussed in the text.

Results

12-13 vs 13-14 Medical College Admission Test (MCAT) and Graduate Medical Schools Admission Test (GAMSAT) scores

There was no statistically significant difference in the overall relative intellectual abilities of the 12-13 and 13-14 GEM 1 classes as determined by either their MCAT (12-13 = 31.5 ± 0.4, n=37 *vs* 13-14 = 30.7 ± 0.4, n=39) or GAMSAT scores (12-13 = 58.4 ± 0.6, n=37 *vs* 13-14 = 58.3 ± 0.5, n = 39), or between males and females either within each group or between each year group (figures 2A and 2B).

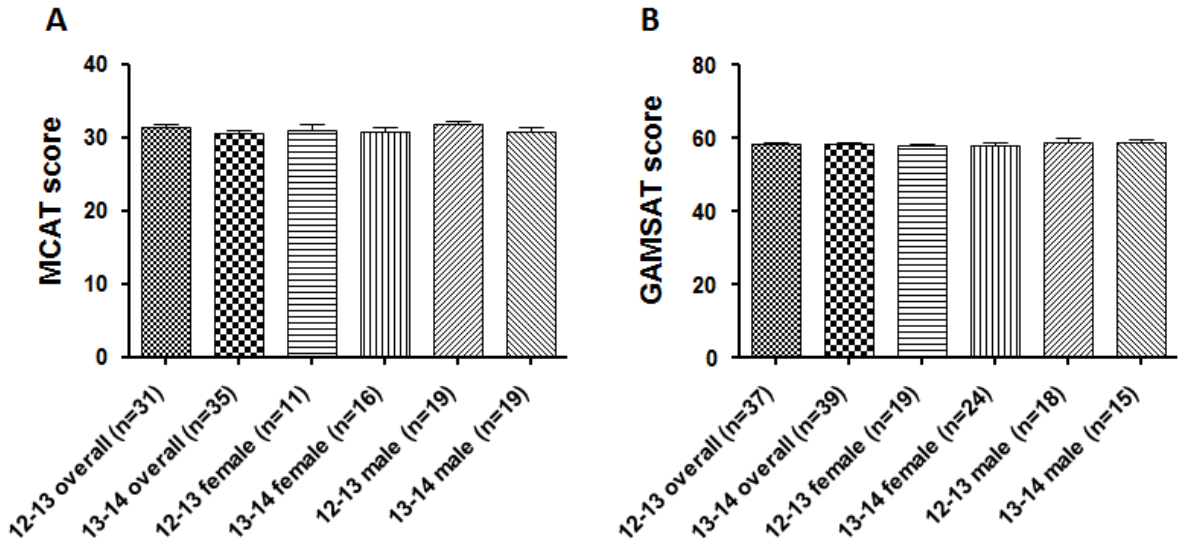

Figure 2: Comparison of MCAT and GAMSAT scores of GEM 1 students from academic years 2012-2013 and 2013-2014. Histograms illustrating the averaged absolute scores of the respective GEM 1 year groups in the MCAT (A) and GAMSAT (B) entrance exams. For comparison's sake these data were also broken down into averaged male and female scores.

Although a relatively crude measure of intellectual ability of a class as a whole, this result does provide some assurance that, broadly speaking, the intellectual levels of the two year groups investigated in the study were very similar.

One of the most important questions arising from this study was that of whether or not the students' use of vodcasts was reflected in improved exam performance which was measured in three ways that will be discussed below.

CA examination results

When the performance of the two year groups against the 63 identical questions asked of both groups in the six continuous assessment (CA) exercises that were conducted throughout module GM1001 we found that there was a statistically significant improvement in the results

of the 13-14 year group relative to those of the 12-13 year group (69.0±2.6% in 12-13 *vs* 73.2±2.3% in 13-14, n=63, *P*=0.0096, Student's paired *t*-test; figure 3).

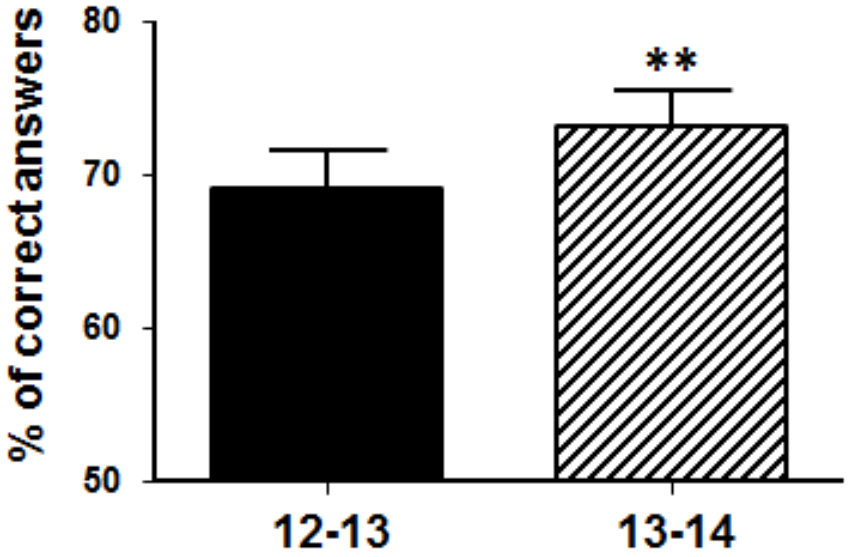

Figure 3: Comparison of performance between 12-13 and 13-14 GEM 1 students in questions in GM1001 CA exams. Histogram illustrating the averaged percentage of correct responses provided by GEM 1 12-13 (black bar) and 13-14 (hatched bar) students to 63 identical questions posed in six continuous assessment exercises spread throughout module GM1001. ** indicates *P*<0.01.

As this module was co-taught by the lead author and only one other colleague (who delivered the three other GM1001 lectures to both year groups), it was possible to control for the effects of the students' use of the vodcasts by comparing performance in the 12-13 *versus* 13-14 years on the questions within the CA exams covering material delivered by the other lecturer (21 identical questions in total). In contrast to the results shown in figure 3, this analysis revealed that there was no statistically significant difference in performance between the two year groups (61.3±6.3% in 12-13 *vs* 61.3±5.6% in 13-14, n=21, *P*=0.5, Student's paired *t*-test; *data not shown*).

It should be noted that of all the disciplines contributing to the GM1001 module (*e.g.* Anatomy, Biochemistry, Pathology/Microbiology, Pharmacology as well as Physiology), Physiology was the only discipline delivering this type of regular CA to the students during the course of the module.

EOM examination results

Students' performance in the GM1001 EOM examination, which took place one week after teaching on the GM1001 module had ended, (but seven weeks after the final 'vodcast lecture') was also examined. The results, illustrated in figure 4, show no significant difference between the results obtained by the 13-14 *versus* the 12-13 class in the 16 identical questions posed in each respective GM1001 EOM exam (65.2±3.0% in 12-13 *vs* 64.9±2.8% in 13-14, n=16, *P*=0.5, Student's paired *t*-test).

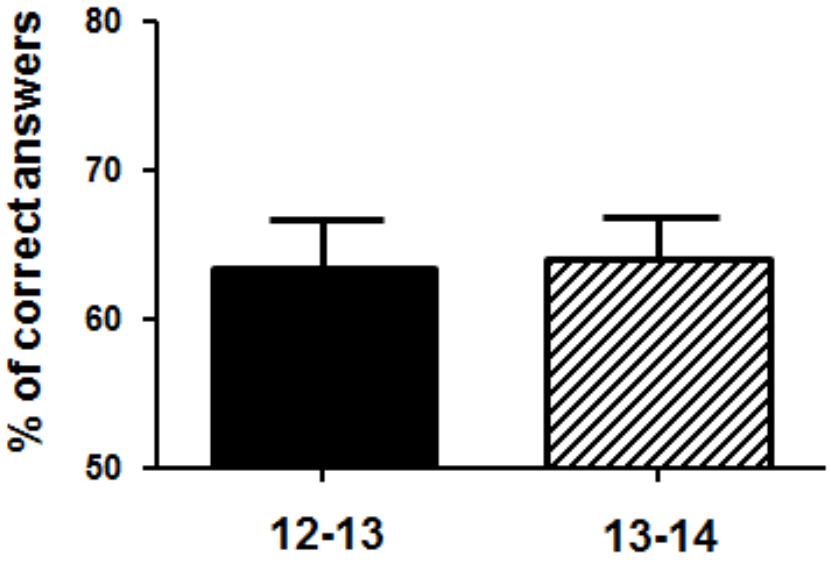

Figure 4: Comparison of performance between 12-13 and 13-14 GEM 1 students in questions in GM1001 EOM exams. Histogram illustrating the averaged percentage of correct responses provided by GEM 1 12-13 (black bar) and 13-14 (hatched bar) classes to 16 identical questions posed in each respective GM1001 EOM exam.

EOY examination results

We next examined GM1001 EOY examination performance. These exams took place nearly seven months after completion of the GM1001 module. The results of this analysis are shown in figure 5 and illustrate a significant improvement in performance for the 13-14 *versus* the 12-13 year group when performance was averaged across the 17 identical questions used for analysis (68.6 ± 4.8% in 12-13 *vs* 73.2 ± 4.1% in 13-14, $P = 0.01$; paired Student's *t*-test, n = 17).

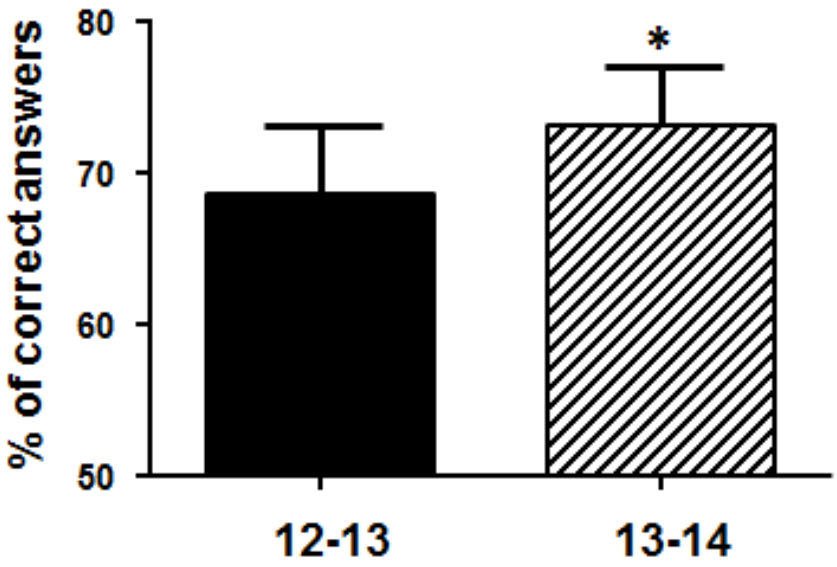

Figure 5: Comparison of performance between 12-13 and 13-14 GEM 1 students in questions in GM1001 EOY exams. Histogram illustrating the averaged percentage of correct responses provided by GEM 1 12-13 (black bar) and 13-14 (hatched bar) classes to 17 identical questions posed in each respective GM1001 terminal exam. * indicates $P<0.05$.

It is interesting to note that the performance of students against 9 questions in the EOY exam relating to material taught by the one other lecturer on the module (and not accompanied by vodcasts of that material), was not significantly improved relative to the performance of the 12-13 GEM1 year group ($P = 0.33$, n=9, paired Student's *t*-test; *data not shown*).

Attitudinal survey results

For the current study 63/73 (86%) eligible students in GEM year 1 completed the survey in the autumn term of 2013, with a further four being submitted incompletely.

Vodcast viewing statistics

As the central goal of the study was to determine if viewing vodcasts in advance of the face-to-face lectures had any significant effect on overall class exam performance, option 4 of the survey asked '**Of the nine that have been made, how many of the GM1001 Physiology vodcasts did you view/listen to *prior to* attending the relevant lecture?'**, with the responses shown in figure 6. The results indicate that 77% of respondents viewed at least one vodcast prior to attending the respective lecture, but that only 15% did so for all nine of the GM1001 vodcasts. It is also significant that over 20% of the class did not view/listen to any of the vodcasts at all prior to attending classes (overall class average = 2.6 ± 0.3, n=62).

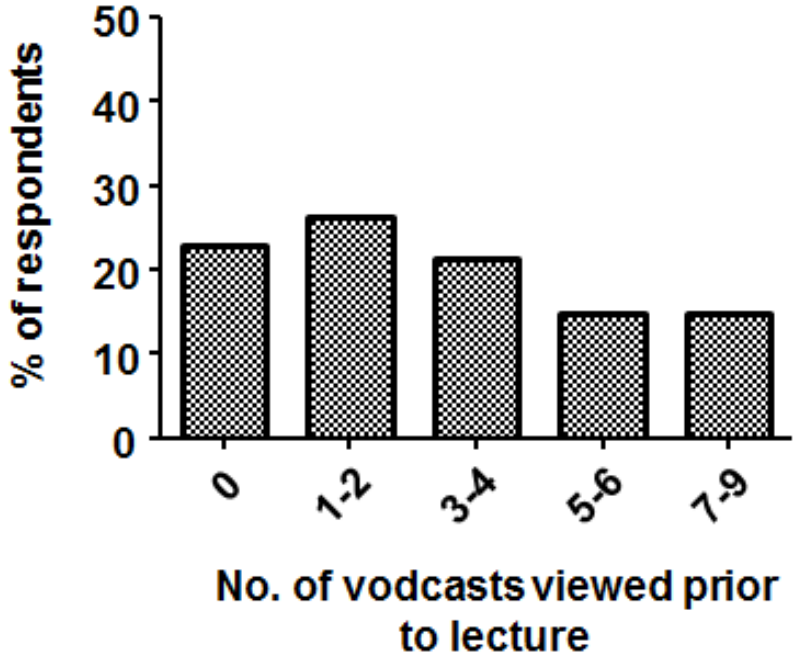

Figure 6: Number of vodcasts viewed in advance by students. Histogram illustrating responses to the statement 'Of the nine that have been made, how many of the GM1001 Physiology vodcasts did you view/listen to prior to attending the relevant lecture?'

When these data were analysed in more depth, we found that female students viewed significantly fewer of the vodcasts than their male counterparts prior to attending the respective lectures (2.1±0.5, n= 34 *vs* 3.3 ± 0.5, n=28 respectively, $P = 0.02$, Student's unpaired *t* test). Furthermore, although biomedical students on average viewed fewer vodcasts prior to the respective lectures relative to non-biomedical students, this difference was not significant (2.5 ± 0.4, n=41 *vs* 3.2 ± 0.6 respectively, n=20, $P = 0.2$, Student's unpaired *t* test).

Student perceptions of vodcasts as a preview and/or review tool

As shown previously in figure 6, although 77% of the class viewed at least one of the vodcasts prior to attending a lecture, it was clear that relatively few of the survey respondents viewed all nine prior to each respective lecture. It was therefore important to try and determine the reason for this relatively low uptake. To this end, options 7, 8 and 11 on the attitudinal survey sought students' opinions on the statements, a) '**Of the GM1001 Physiology vodcasts I have viewed/listened to *prior to* attending the relevant lecture, they have helped me to better understand the material presented during the lecture'**, b) **'I believe that the GM1001 Physiology vodcasts have enabled me to understand the lecture material better than if I was only able to view the lecture slides alone**' and c) '**In terms of the general GM1001 Physiology vodcast presentations, I like the fact that the audio is paired with the PowerPoint presentations (*i.e.* rather than hearing either the audio alone, or viewing the slides without commentary)'** respectively, the results of which are shown in figure 7.

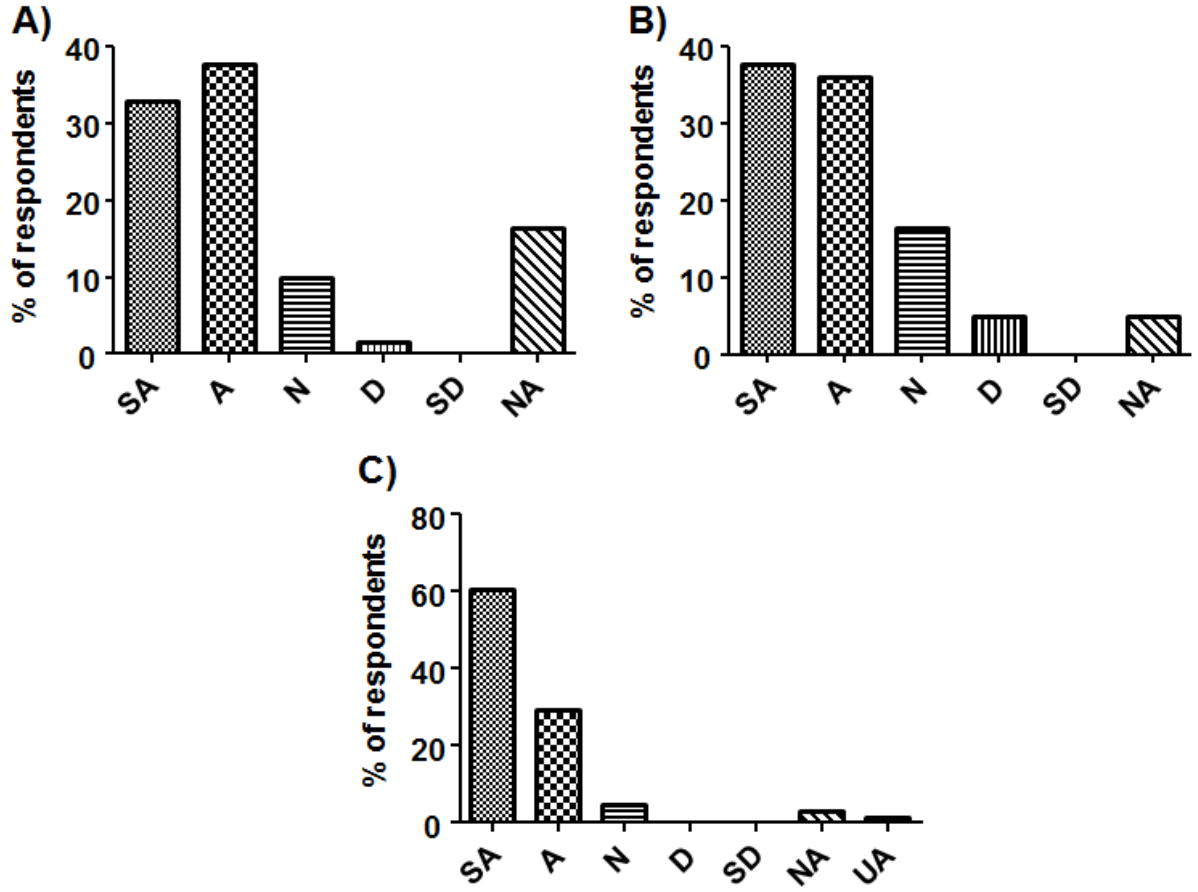

Figure 7: Student perceptions of vodcasts as a preview tool. Histograms illustrating responses to the statements *'Of the GM1001 Physiology vodcasts that I have viewed/listened to prior to the relevant lecture, they have helped me to better understand the material'* (A), *'I believe that the GM1001 Physiology vodcasts have enabled me to understand the lecture material better than if I was only able to view the lecture slides alone'* (B) and *'In terms of the general GM1001 Physiology vodcast presentations, I like the fact that the audio is paired with the PowerPoint presentations (i.e. rather than hearing either the audio alone, or viewing the slides without commentary)'* (C). SA = strongly agree, A = agree, N = neither agree nor disagree, D = disagree, SD = strongly disagree, NA = not applicable, UA = unanswered.

Figure 7A illustrates that nearly 64% of respondents either strongly agreed or agreed that previewing the vodcasts prior to attending lectures did improve their understanding of the material discussed in class, with only 6.6% disagreeing. Figure 7B indicates that over 74% of respondents believed that the vodcasts had helped them to understand the taught material better than the presentation slides alone (only 4.9% disagreed with this suggeston). Figure 7C illustrates that over 90% of respondents felt that the paired audio and visual functionality afforded by the vodcasts was also preferable to audio podcasts alone.

Although a central aim of the study was to encourage students to preview lecture material, by way of the vodcasts, prior to attending lectures inn order to improve student understanding and learning *during* lectures, we were of course aware that the vodcasts could, and probably would, also be used as revision tools and therefore wanted to acquire information about this possibility. To this end, survey options 5, 9, 6 and 10 of the survey sought students' opinions on the statements, a) **'Of the nine that have been made, how many of the GM1001**

Physiology vodcasts have you viewed/listened to only after the relevant lecture?', b) **'Of the GM1001 Physiology vodcasts I have viewed/listened to whilst reviewing the relevant lecture, they have helped me to better understand the material presented during the lecture'**, c) **'I plan to view/listen to all nine of the GM1001 Physiology vodcasts (for example, prior to sitting GM1001 exams)'** and d) **'The GM1001 Physiology vodcasts will be/have been a useful revision tool'**, respectively, with the results shown in figure 8.

Figure 8A indicates that, although a significant proportion of the respondents did not view any of the vodcasts after any of the lectures (28%), 71% of the class did view at least one vodcast afterwards and 13% viewed all nine again (class average = 2.7 ± 0.3, n=62). Figure 8B illustrates that 71% of respondents strongly agreed or agreed that viewing the vodcasts whilst reviewing the lecture material helped them to better understand the said material, with only 7% disagreeing. Figure 8C shows that the majority of the class (67%) did plan to use the vodcasts specifically for exam revision purposes prior to their exams. However, it is interesting to note that this number increased even further to 85% in response to survey option 12 (figure 8D).

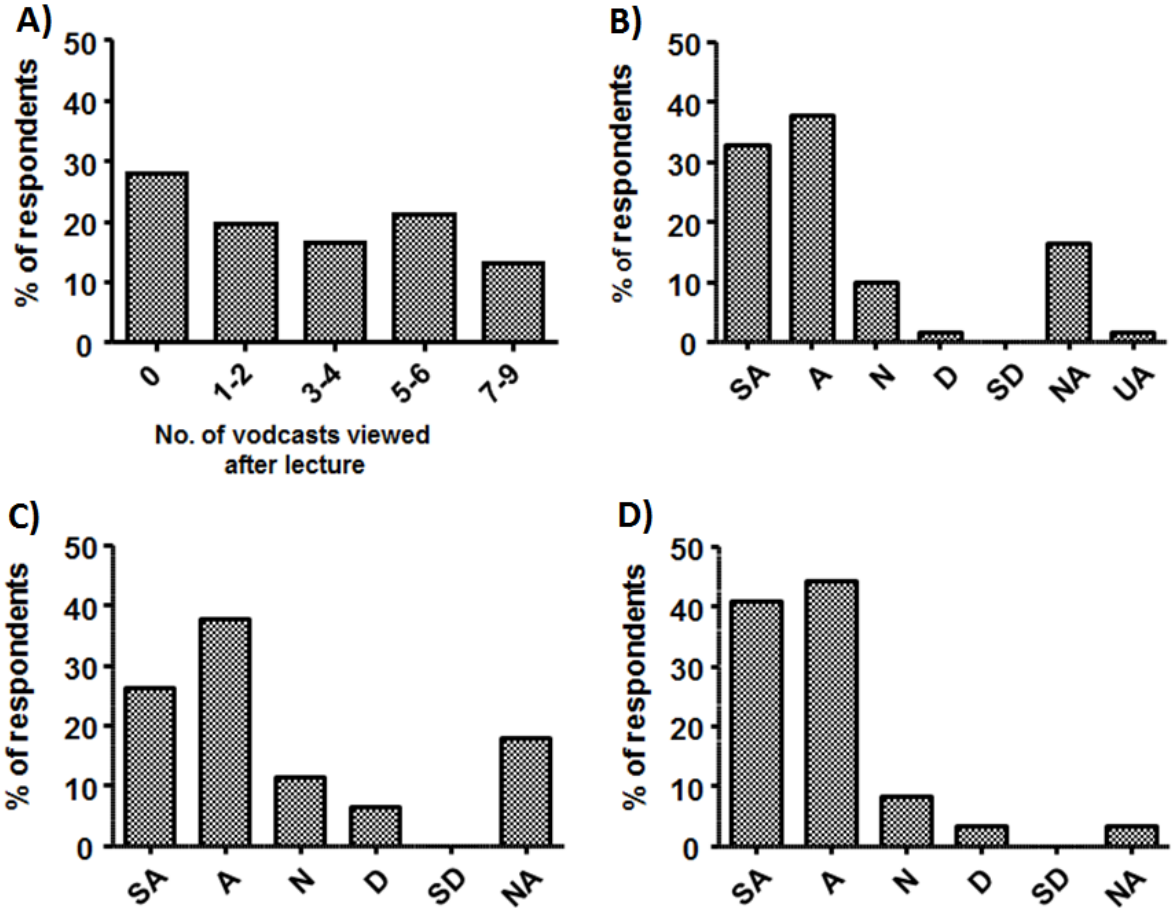

Figure 8: Student perceptions of vodcasts as a review tool. Histograms illustrating responses to the statements, '*Of the nine that have been made, how many of the GM1001 Physiology vodcasts have you viewed/listened to only after the relevant lecture?*' (A), '*Of the GM1001 Physiology vodcasts I have viewed/listened to whilst reviewing the relevant lecture, they have helped me to better understand the material presented during the lecture'* (B), '*I plan to view/listen to all 9 of the GM1001 Physiology vodcasts (for example, prior to sitting GM1001 exams)'* (C), and **'***The GM1001 Physiology vodcasts will be/have been a useful revision tool'*

(D). SA = strongly agree, A = agree, N = neither agree nor disagree, D = disagree, SD = strongly disagree, NA = not applicable, UA = unanswered.

Discussion

Effect of vodcasts on exam performance

The results of the current study are broadly in line with several previous studies in other non-biomedical disciplines (for review see Kay, 2012) in that they revealed that the majority of GEM students like vodcasts and, for those students who previewed them prior to attending face-to-face lectures on the same topic, they felt that they did improve their understanding of said material.

Importantly however, we were also able to demonstrate that the students' positive sentiment towards the vodcasts as a tool to help them understand and follow lectures more closely, translated directly to a significant and quantifiable improvement in their exam performance relative to a previous GEM 1 cohort that did not have access to the vodcasts used in this study. Thus, by comparing the success of the 13-14 GEM 1 year against that of the 12-13 GEM 1 control group in answering a total of 96 identical questions delivered across three different exam formats, at different times of the academic year we found that exam performance on the CA and EOY exams was statistically significantly improved in the 13-14 GEM 1 year group relative to the 12-13 year. This suggests that the availability of vodcasts to these students led to a measurable improvement in learning of the taught Physiology. Indeed, this conclusion is supported by the fact that the performance of the 13-14 year group against 21 questions in the CAs and 9 in the EOY exam relating to material delivered by the one other Physiology lecturer on the same module (who did not use vodcasts) was *not* significantly improved relative to that of the 12-13 group, a finding which one would not have expected if the improved test performance of the 13-14 GEMs was simply due to a general improvement in this class's ability relative to the 12-13 year.

However, it is unclear why we did not see a similar improvement in performance in the 13-14 GEM 1 EOM exams. One possible reason for the difference between the EOM and CA exam outcomes may be that whereas the CA exams were being conducted at the same time as the students were still actively utilising the vodcasts and attending lectures, the EOM examination came some seven weeks after the final lecture for which vodcasts had been prepared. Furthermore, in contrast to the period in which the CA exams were being conducted, where Physiology was the only subject in the module being routinely examined, for the EOM exam students had to prepare for an examination in which knowledge of four further subjects besides Physiology (*e.g.* Anatomy, Biochemistry, Pathology/Microbiology and Pharmacology) would be examined. Thus, the extra study burden imposed upon the students by these additional subjects may have effectively 'diluted' the impact of the Physiology vodcasts that was seen during the CA exams. This latter proposal though does not explain why we then saw an improvement in EOY exam performance as, similar to the EOM exam, all five contributory disciplines to the GM1001 module were also examined in the EOY exam. However, anecdotal evidence from the 13-14 GEM 1 students suggested that, although the initial previewing of the vodcasts during the module itself did indeed assist with understanding and processing of material at the time of delivery, for the EOY exams the same vodcasts were subsequently used as a revision tool. Thus, in this context the vodcasts had likely served a dual purpose: initially providing a 'first pass' exposure to lecture material prior to its delivery for those students who had previewed them (Krathwohl, 2002), but then also subsequently acting as an invaluable revision resource for the EOY examination nearly seven months after the material had initially been taught. Again though, one would have expected the same to apply for the EOM exams.

One potential further explanation for this 'discrepancy' is that, again anecdotally, students felt that they had already invested too much time studying Physiology for the 6 CAs to the detriment of the other subjects taught in the module which had not been examined in any form prior to the EOM exam. They therefore spent more time studying these other subjects for the EOM exam than Physiology, which they felt they had already 'covered'.

Student perceptions of vodcasts

As shown in figure 6 of the current study, although 77% of respondents watched at least one of the nine available vodcasts prior to attending the scheduled lectures, only 15% viewed all nine. Given this overall relatively low uptake in previewing of the vodcasts, the possibility existed that students simply disliked the format of the vodcasts, or even the whole idea underlying their use. However, the results shown in figure 7 suggest that this was not the case as they show quite definitively that that not only was their introduction popular with the vast majority of respondents (in preference to more traditional methods alone) but also that most of the class perceived that the previewing of vodcasts prior to lectures had been of benefit to their learning. This positive sentiment towards the vodcasts was also reflected in responses to survey option 3 which asked students to provide constructive comments about the vodcasts. For example, of the 50/58 students who expressed view(s) about the vodcasts which could be classified as either positive, neutral, or negative, the vast majority (66%) provided positive comments (33/50 students), with 30% (15/50 students) expressing relatively neutral comments (which included four students who had not used the vodcasts at all) and only 4% (two students) expressing negative comments about the use of vodcasts. A sample of some of these comments is reproduced below.

"I thought that reviewing the vodcasts before and/or after lectures made following along during lectures much easier"

"The vodcasts allow me to go through the lectures at my own pace (starting / stopping / rewinding) and review the material at my leisure, whether that be before or after class. These vodcasts are the epitome of educational technology for me. It's essentially a personal tutor at no cost. Hearing [the lecturer's] explanations is ineffably more helpful than reading the slides alone. He's so enthusiastic in the first place, which probably has a lot to do with it. It's not a pain to use the vodcasts - it makes learning fun and interesting. I also like that [the lecturer] revises the lectures based on listening to the vodcasts beforehand, because it really solidifies a lot of the points. It's extremely helpful to have that repetitive yet engaged way of presenting the material"

"I find that they are too similar to the actual lectures to feel like a good use of my time. If they were more of a review or alternatively increased detail or shifted focus from the in-class lectures then I think I would find them more beneficial."

Therefore, given the evident popularity of the vodcasts with students, it was very likely that there must have been some other extenuating factor(s) accounting for why only 15% of respondents previewed all of the nine available vodcasts prior to their respective lectures. The likely answer emerged from comments again provided to survey option 3. Thus, of the 58 students who provided a response to this option, 17% (11 students) made a specific point of commenting upon how the particularly heavy study load these students experience precluded them from devoting 'extra' time to the viewing of Physiology vodcasts as they felt that it impacted too much upon their study of the four other basic science disciplines covered in the

GM1001 module. Clearly, such a demanding workload severely restricts self-directed study time.

Furthermore, in spite of the broadly positive sentiment towards using vodcasts as a learning tool in general (time constraints notwithstanding) there was still an undercurrent within the comments provided about the vodcasts that some students were not comfortable with the proposed change in the student-lecture dynamic that the previewing of vodcasts heralded for teaching and learning in this module. (*e.g.* "I find it frustrating that the professor expects students [to] listen to vodcasts prior to class. I believe that I come to class in order to hear the lecture"). Thus, it was of great interest to us to determine if, even after encouraging the students to use the vodcasts as preview tools prior to attending lectures (and clearly explaining the pedagogical reasoning behind this process), the students still viewed the vodcasts simply as an additional revision tool when reviewing lectures afterwards. These results, shown in figure 8, very clearly demonstrate that although, as discussed earlier, the vodcasts were viewed very favourably by the students when used as a preview tool, they were in fact used by a much greater proportion of the class as a tool for reviewing/revising lecture material. Thus, 71% of respondents strongly agreed or agreed that they used them as a revision aid (figure 8) and that they helped them to better understand the lecture material (than lecture slides alone). Indeed, 85% of students also indicated that they planned to use them specifically for revision purposes prior to examinations. It is interesting to note however that, as shown in figure 8C, about one fifth of the respondents did not use, or plan to use, the vodcasts for revision purposes, with several students stating in the open – ended survey option 4 that they much preferred to use textbooks or just the presentation slides for their revision and/or study.

Further examination of the comments provided in survey option 3 on their use of the vodcasts, showed that of the 58 students who did respond, 72% (42 students) stated specifically that they used them as a revision tool, with only eleven students referring to their use as a preparatory tool and 14% (8 students) stating that they used them both as a preparatory and a revision tool. Some of the comments reflecting this are reproduced below.

"I found [the vodcasts] very useful as a means of reinforcing understanding about particular topics. I anticipate that I will return to the vodcasts again closer to examination time to recap on any areas that I still don't fully understand"

"Overall I find [the vodcasts] to be very useful, but more so after *the lecture has happened. I know they are supposed to make the lectures more interactive but I think that's difficult to achieve just in general in an Irish classroom even if everyone had listened to the vodcast. Afterwards when going back over the material, they are useful to have on as you work through material and can pause and rewind if necessary on something that is a bit muddy. I also look forward to using them closer to exams!"*

"The vodcasts are very useful in terms of revising the material before an upcoming exam. Also, you can listen to the vodcasts wherever you may be, whether that's on the bus home at the weekends or in general off-campus"

Limitations of the current study

Clearly, one of the major limitations of the current study design was the fact that we did not block student access to the vodcasts once each lecture had been delivered as this prevented us from making definitive conclusions specifically regarding how the previewing of vodcasts may have affected exam performance. The reason for this decision was simply because we felt that

it would be unethical to prevent students from accessing the vodcasts after the study period, particularly given the substantial unsolicited feedback we received from them about how useful they found them for revision. As such, we felt duty bound to leave the vodcasts available for use by students up until their final EOY exam. Nonetheless, had it been possible to do so, it would have been interesting to determine if the 15% of students who claimed to have previewed all of the vodcasts prior to lectures performed significantly better than those students in the class who did not preview any. Unfortunately, due to the anonymous nature of the survey it was not possible to make this comparison and, further, we would still not have been able to rule out the possibility that these same students were also utilising the vodcasts for revision purposes as well.

A second limitation of the study is that it was conducted in a single school, with a relatively limited number of students, on only one component of the overall GM1001 module. Therefore, one's ability to generalize its findings to other accelerated medical degree programs is limited. However, as discussed in the Introduction, given the relative paucity of published data pertaining to these types of undergraduate courses in general, all studies in this area, limited or otherwise should still be welcomed.

Future studies

In spite of these positive outcomes favouring the use of vodcasts of lecture material as a teaching tool demonstrated in this study, it is clear that the shortage of study time that GEM students in particular experience (due to the teaching intensive and compressed nature of the GEM course) represents a significant impediment to the widespread implementation of their use as a lecture preview tool as used in the current study.

Although the time constraints mentioned above seemed to have a particular impact upon students' ability and/or desire to use the vodcasts in advance of lectures, the same did not seem to apply to their use when it came to revising the lecture material, where 85% of survey respondents indicated that they viewed the vodcasts as a useful revision tool. This is perhaps indicative of the majority of students' attitudes towards lectures whereby they are seen primarily as a means of gaining 'first pass' exposure to a topic, with higher order cognitive processing of the same information occurring only when they come to review the lectures later in their own time. This 'sage-on-the-stage'-type of teaching (Goodman, 2016) is the teaching/learning model that most students (and lecturers) the world over recognise, so it is perhaps not too surprising that this 'habit' is difficult to break, even though previewing lecture material in detail prior to attending lectures in order to institute a fully, or semi-, 'flipped classroom' approach would likely facilitate a much more efficient use of the usually relatively limited time a class has with lecturers (Crouch & Mazur, 2001; Gannod et al., 2008). One possible solution for ameliorating the time burden placed upon students, whilst at the same time still enabling them to gain first pass exposure to lecture material, would simply be to reduce the duration of the vodcasts. To this end, we are currently investigating the use of so-called 'introductory vodcasts' as a preview tool, again for use with GEM 1 students, which have an average duration of only 10-15 minutes. It is hoped that the students find this length of vodcast more palatable, and therefore they acquire more views, than the full length lecture vodcasts used in the current study.

Conclusions

A central question of the current study was to determine specifically if previewing of vodcasts prior to face-to-face lectures improved student learning. However, from the discussion

above and from student responses to specific attitudinal survey questions relating to how they utilised the vodcasts, it is clear that students used the vodcasts both as a preview as well as review tool throughout the academic year. Thus, even though the majority of students clearly indicated that when they did preview the vodcasts it improved their understanding of the taught material, the fact that only 15% of respondents viewed all nine vodcasts prior to lectures makes it impossible for us to conclude that the improvement in student learning that we observed was solely due to the students previewing of lecture material in the vodcasts. Rather, it is more probable that the statistically significant improvement in exam performance we witnessed was due to a combination of both previewing, as well as reviewing, of the vodcasts. Furthermore, the addition of a small element of 'active learning' to certain lectures for the 13-14 GEM 1 class, albeit very limited in scope and quantity, may also have had a small positive effect on learning relative to an educationally equivalent GEM 1 year group that did not experience either modification in lecture format.

Therefore, the limitations of the study notwithstanding, we would still argue that 'on demand', fully controllable vodcasts represent a valuable teaching/revision tool for students. We feel that this is particularly true for students on accelerated professional courses such as GEM that face significantly larger study demands than students on 'standard' undergraduate degree programmes.

Appendix: GM1001 Physiology Podcast Survey

1. **Are you male or female?**

2. **Would you consider your educational background to be biomedical or non-biomedical?**

3. **Please provide any (constructive) comments / suggestions / observations about the vodcasts you feel is of relevance**

4. **Of the 9 that have been made, how many of the GM1001 Physiology vodcasts did you view/listen to prior to attending the relevant lecture?**

0
1-2
3-4
5-6
7-9

5. **Of the 9 that have been made, how many of the GM1001 Physiology vodcasts have you viewed/listened to only after the relevant lecture?**

0
1-2
3-4
5-6
7-9

6. **I plan to view/ listen to all 9 of the GM1001 Physiology vodcasts (for example, prior to sitting GM1001 exams for example).**

1.Strongly Agree
2.Agree
3.Neither Agree nor Disagree
4.Disagree
5.Strongly Disagree
6.Not Applicable

7. **Of the GM1001 Physiology vodcasts that I have viewed/listened to prior to the relevant lecture, they have helped me to better understand the material presented during the lecture.**

1.Strongly Agree
2.Agree
3.Neither Agree nor Disagree
4.Disagree
5.Strongly Disagree
6.Not Applicable

8. **I believe that the GM1001 Physiology vodcasts have enabled me to understand the lecture material better than if I was only able to view the lecture slides alone.**

1.Strongly Agree
2.Agree
3.Neither Agree nor Disagree
4.Disagree
5.Strongly Disagree
6.Not Applicable

9. **Of the GM1001 Physiology vodcasts that I have viewed/listened to whilst reviewing the contents of a particular lecture, they have helped me to better understand the material presented during the lecture.**

1.Strongly Agree
2.Agree
3.Neither Agree nor Disagree
4.Disagree
5.Strongly Disagree
6.Not Applicable

10. **The GM1001 Physiology vodcasts will be/ have been a useful revision tool.**

1.Strongly Agree
2.Agree
3.Neither Agree nor Disagree
4.Disagree
5.Strongly Disagree
6.Not Applicable

11. **In terms of the general GM1001 Physiology vodcast presentations, I like the fact that the audio is paired with the PowerPoint presentations (*i.e.* rather than hearing either the audio alone, or viewing the slides without commentary).**

1.Strongly Agree
2.Agree
3.Neither Agree nor Disagree
4.Disagree
5.Strongly Disagree
6.Not Applicable

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