RICH MEDIA E-COMPENDIUMS: A NEW TOOL FOR ENHANCED LEARNING IN HIGHER EDUCATION

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Abstract

Electronically supported learning has increasingly been introduced and accepted into the academic community over recent decades, and a variety of new digital learning tools have been developed to serve students both for distance education and on-campus blended learning.

To serve our distance education nursing students, we recently developed unique rich media e-compendiums, based on a combination of PDF and Flash technologies, as a substitute for on-campus lectures. Our e-compendiums are also available for our on-campus students as a supplement to their other learning tools (e.g., lectures, textbooks and podcasts). The aim of this study was to explore students' perceptions of the e-compendiums as a learning tool compared with the other e-learning tools and more traditional tools used in a first-semester course.

The study had a descriptive quantitative design and the data were collected by means of a questionnaire developed for this study. We found that a clear majority of the students scored the e-compendiums as a better learning tool than lectures, multiple-choice questions, podcasts and textbooks.

Our results indicate that rich media e-compendiums were perceived as better learning tools than both traditional learning tools and other electronically supported learning tools.

Keywords: e-learning, e-compendiums, higher education, blended learning

Introduction

E-learning, defined as "learning incorporating electronic media" (Caudill, 2007), has increasingly entered schools and higher education in recent decades, and a variety of e-learning tools have been developed. These include games (Blakely, Skirton, Cooper, Allum, & Nelmes, 2009; Ke, 2008; Kim & Chang, 2010; Kuhn, 1995; Lopez-Morteo & López, 2007), rich media solutions, such as Camtasia and Mediasite (Blevins & Elton, 2009; Harvel & Hardmann, 2012; Vasu & Ozturk, 2008), the use of Skype (Michaels & Chang, 2011), Web 2.0 tools (Laru, Näykki, & Järvelä, 2012; Luckin et al., 2009), including podcasts (Delaney, Pennington, & Blankenship, 2010; Evans, 2008) and wiki tools (Jancarik & Jancarikova, 2010), different m-learning tools (Caudill, 2007; Singh, 2010), online multiple-choice tests (Douglas, Wilson, & Ennis, 2012), Webquest (Hassanien, 2006) and various learning management systems, such as WebCT, Moodle and Blackboard (Burgess, 2003; Galy, Downey, & Johnson, 2011), which are also referred to as virtual learning environments (VLEs). Most of these tools are highly applicable to, and sometimes made specifically for, distance education. However, they are definitely not limited to such education and may be used in hybrid or blended learning, in which a substantial proportion of the course contents are also delivered online (Galy et al., 2011; Percival & Muirhead, 2009).

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The use of e-learning tools in higher education serves different purposes. Some tools make distance education possible and flexible (Burgess, 2003; Singh, 2010). Others improve learning (Douglas et al., 2012; Hassanien, 2006; Laru et al., 2012; Singh, 2010), or add enjoyment and/or build confidence in learning (Blakely et al., 2009; Douglas et al., 2012). Another element that makes e-learning tools topical is the fact that today's students simply expect or demand flexibility and digital technologies in their learning processes (Gabriel, Campbell, Wiebe, MacDonald, & McAuley, 2012; Owens & Floyd, 2007; Percival & Muirhead, 2009).

In 2009, the current form of distance nursing education at our institution was initiated. While all practical training is done on campus and in hospital/community health care, the courses are generally organized via the local VLE. As a substitute for lectures, a brand new e-learning concept, based on a combination of PDF and Flash technologies, and appearing as electronic rich media compendiums (e-compendiums), was developed. The e-compendiums cover the topics of the lectures given on campus, and are available to both distance education students and on-campus students. Thus, the e-compendiums constitute one of several learning tools for the on-campus students.

To the best of our knowledge, our e-compendiums were unique in an international context at the time of their first publication, and represent a completely new e-learning concept. It is therefore important to investigate how students perceive these e-compendiums as learning tools. The aim of this study was therefore to explore students' perceptions of our e-compendiums as a useful learning tool in comparison with other e-learning tools and more traditional tools.

Course content and learning tools

There are three on-campus, first-semester courses of study in baccalaureate nursing (á 10 ECTS, i.e. course credits corresponding to 1/3 full semester study), one of which is "Science in nursing-1". Three of the main subjects for this course are anatomy and physiology (A&P), microbiology and basic pharmacology (BPH). During the course, the students have access to various optional learning tools (Table 1):

1. lectures,
2. textbooks,
3. study tasks,
4. task seminars,
5. e-compendiums,
6. podcasts,
7. digital multiple-choice questions (MCQ), and
8. a digital discussion forum (DDF).

The e-compendiums, MCQ and DDF are all available on the VLE (itslearning, itslearning AS, Bergen, Norway), and the podcasts are available through iTunesU (Apple Inc., CA, USA).

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E-compendiums and appurtenant podcasts

Sixteen e-compendiums were used in this study: 14 in A&P, one in microbiology, and one in BPH (Table 1). Generally, the contents of the e-compendiums correspond to the contents of the lectures.

The e-compendiums are electronic rich media PDF files (Figure 1). In addition to text, they contain audio files for each paragraph to enable the students to listen to the texts, figures, photos, animations, interactions and a short multiple-choice test at the end of the compendium. In addition, all the features of Adobe Reader® are available to the user. These include the highlighting of text, personal notes (including voice notes) and search functions for both the text of the compendiums and personal notes. To take full advantage of the rich media and features of the PDF format, the e-compendiums were specifically designed for use in digital computer format; however, the print feature of the PDF format also allows printing of the content in the same format in which it appears on the screen (What You See Is What You Get, WYSIWYG principle). Thus, the e-compendiums are not restricted solely to e-learning, and serve multiple learning styles.

Table 1: Overview of course content in A&P, microbiology and BPH in first-semester "Science in nursing-1". *class10 and class12.

	Learning tools	**number**	**total quantum (approx.)**
A&P	Lectures	14 / 15*	42-44 hours
	e-comp.	14	429 pages
	Podcast	14	709 minutes 51 minutes on average
	MCQ-tests	14	449 tasks 32 tasks per test on average
	Study tasks		180 / 165* tasks
	Task seminars	14	28 hours
	Textbook	1	600 pages English
	DDF: discussion topics and questions initiated by students and responded on by co-students and lecturer		
Microbiology	Lectures	1	3 hours
	e-comp.	1	43 pages
	Podcast	1	103 minutes
	MCQ	1	44 tasks
	Study tasks*		17 tasks
	Textbook	1	69 pages Norwegian
BPH	Lectures	2	5-6 hours
	e-comp.	1	53 pages
	Podcast	1	116 minutes
	MCQ	1	60 tasks
	Study tasks*		20 tasks
	Textbook	1	100 / 86*pages Norwegian

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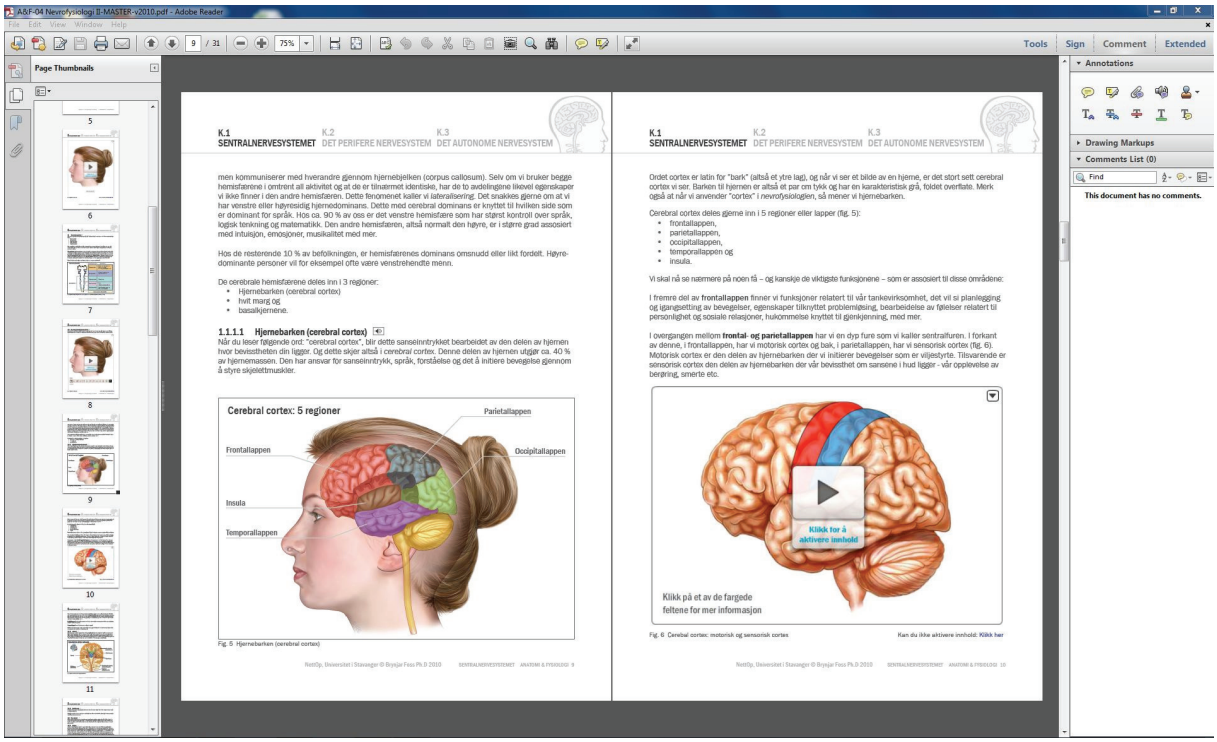

Figure 1. Screenshot of an e-compendium.

The audio files from each e-compendium were made available as podcasts on iTunesU. Each podcast covers the content of one e-compendium. Students were able to download the podcasts from iTunesU to their PCs or mobile devices. The podcasts were available in audio only (mp3) and in an enhanced version, which also included the graphics of the e-compendiums (Figure 2).

A brief introduction to the usability of the e-compendiums was given to the students in the first-semester course briefing session, but no in-depth demonstrations were given. The students were repeatedly encouraged to use the e-compendiums and podcasts as well as other learning tools (Table 1) in their studies.

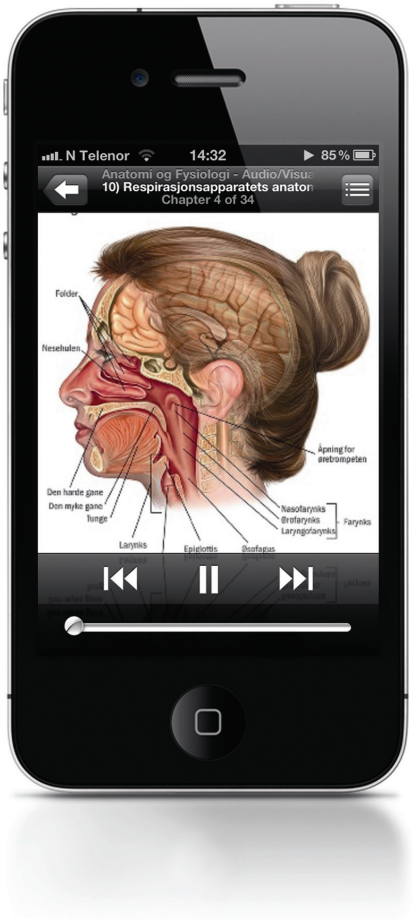

Figure 2. Enhanced version of a podcast presenting the graphics of an e-compendium on an iPhone.

Lectures

As shown in Table 1, 14-15 lectures were given in A&P, one in microbiology and two in BPH. Each lecture was divided into three parts of 45 minutes each. PowerPoint presentations were used for every lecture, and were available on the VLE, without illustrations, before the lectures. The same lecturer presented all subjects.

Textbooks

The primary textbook recommended for A&P was in English; however, a Norwegian textbook was also recommended for those students who struggled to read English. Norwegian texts were recommended for both microbiology and BPH (Table 1).

Study tasks and task seminars

In all three subjects for classes starting in 2010 and 2012 (see Table 1 for details), study tasks were developed by the lecturer. The study tasks focused on important topics most relevant for the final exam. This was clearly and repeatedly communicated to the students.

To support and supervise the students in their work on the study tasks, 14 task seminars were offered in A&P (Table 1). These lasted for about two hours, during which time the lecturer was available to help the students in their tasks.

ISSN 1027-5207

MCQ

MCQ were provided via the VLE for all three subjects (Table 1). Fourteen MCQ tests were given for A&P (one for each lecture) and one MCQ test was given for each of the subjects of microbiology and BPH. The MCQ tests aimed to repeat the lectures, and were constructed by using the PowerPoint presentation from each lecture as a template. The students were able to use the MCQ tests as often as they liked, with the scores provided after each test, allowing the tests to be used as study tools.

DDF

One DDF was created by the lecturer on the VLE to allow the students and the lecturer to discuss all subjects within, and even beyond, the curriculum. In general, the lecturer would not get involved in the discussion unless i) the discussion topic was directly aimed at the lecturer, or ii) the discussion went in the wrong direction. The topics or debates initiated in the DDF were only rarely or never on the subjects of microbiology and BPH.

Methods

The study had a descriptive quantitative design and data were collected by means of a questionnaire developed for this study.

First-semester students from 2009 (class09), 2010 (class10) and 2012 (class12) were invited to participate in the study (a similar study was not done in 2011 due to organizational issues). During these three years, a total of 630 students started at first semester. The study invitation was given at the end of the first semester on the VLE as well as during lectures. Reminders were also given by e-mail.

The questionnaire was an anonymous digital questionnaire launched on the VLE characterizing self-reported study habits and how the different learning tools were perceived by the students. Items on the students' lecture attendance were rated on a four-point Likert scale ranging from "all" to "none". The items on the students' use of the textbook in A&P were rated as "yes" or "no". The 20 items related to e-compendiums and other learning tools were intended to measure the extent to which the students perceived that these learning tools contributed to learning. They were rated on a four-point Likert scale ranging from "very good" to "bad". In addition, the students were able to check "not used" (see Tables 2-4).

Ethical considerations

The questionnaire was automatically depersonalized by the VLE. The Norwegian Social Sciences Data Service (NSD) approves the use of anonymous questionnaires on this VLE for research on general basis.

Results

Fifty-five percent (n = 349) of the 630 students who started first semester participated in the study. The participation rates by study year were 57 % (n = 117) for class09, 54 % (n = 111) for class10 and 55 % (n = 121) for class12.

Students in class10 and class12 were offered eight different learning tools (including lectures) for A&P. Students in class09 were offered six of these tools (see Table 2 for details). Approximately 85 % of the students reported that the e-compendiums were "very good" as a learning tool that

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contributed to learning and 14 % of the students reported them to be "good" (Table 2). Lectures were reported as "very good" on average by 76 % and "good" by 20 % of the students; the figures for MCQ were 68 % "very good" and 27 % "good" (Table 2). Based on the number of "very good" responses only, the e-compendiums were rated as better than all other learning tools in A&P (Figure 3). The task seminars, DDF and textbooks were not rated as highly (see Table 2 and Figure 3). Interestingly, 61 % of the respondents did not use the recommended English textbook in A&P. The majority of these seemed to use a Norwegian textbook and/or the e-compendiums instead (results not shown).

Importantly, the high percentage of students rating the e-compendiums as a "very good" learning tool was consistent over the years. More class10 and class12 students rated the e-compendiums as "very good" compared with lectures. In class10, 87 % of students rated the e-compendiums as "very good" and 77 % of the students rated the lectures as "very good". In class12, 85 % and 67 % of the students scored the e-compendiums and lectures as "very good", respectively, while in class09, 83 % and 84 % of the students scored the e-compendiums and lectures as "very good", respectively.

Table 2: Percentages within sections of the scoring range and standard deviations for tools that contributed to learning in A&P (n = 349). * n = 232 (podcasts and DDF not included in the study of class09).

	very good	good	less good	bad	not used
e-comp.	84.8 (1.7)	13.6 (1.5)	1.1 (0.4)	0.0 (0.0)	0.3 (0.5)
Lectures	75.8 (8.5)	19.7 (7.0)	2.2 (0.4)	0.6 (0.5)	1.1 (1.2)
MCQ	67.6 (7.8)	26.5 (3.9)	3.9 (3.0)	1.1 (0.4)	0.5 (0.5)
Study task	63.0 (4.5)	26.2 (4.5)	5.1 (3.2)	2.0 (1.0)	2.8 (0.5)
Podcast*	25.7 (3.2)	32.0 (3.1)	8.1 (0.0)	2.5 (1.0)	30.4 (6.1)
Task seminars	17.9 (3.0)	33.9 (3.6)	15.0 (2.6)	5.0 (5.1)	26.5 (4.8)
DDF*	17.7 (5.6)	41.6 (4.0	14.9 (0.6)	5.2 (1.6)	19.0 (4.0)
Text book	9.7 (3.4)	32.5 (8.1)	39.2 (7.5)	12.7 (1.8)	5.1 (2.3)

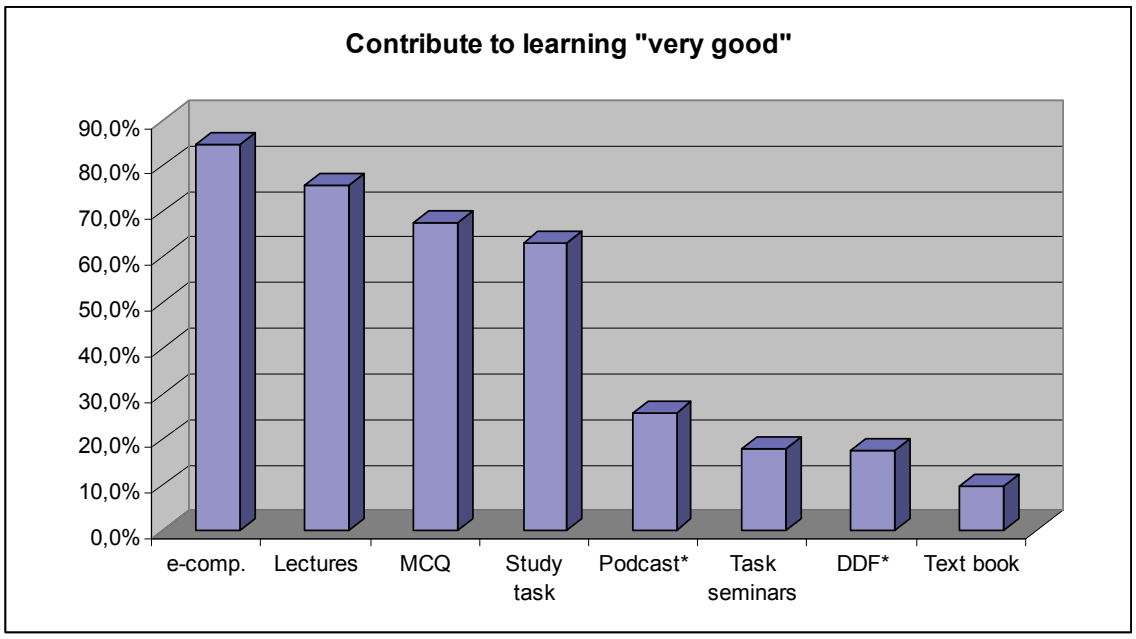

Figure 3. Comparison of students' average "very good" ratings (%) for various learning tools that contribute to learning in A&P for all three classes (n = 349). *n = 232 (podcasts and DDF not included in the study of class09).

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The students in class10 and class12 were offered six different learning tools in microbiology and BPH, and the students in class09 were offered four (Tables 3 and 4). Seventy-two percent of students reported e-compendiums to be "very good" tools that contributed to learning in microbiology and 73 % reported them to be "very good" in BPH. In both subjects, this was higher than all other learning tools. In these two subjects, slightly more students reported MCQ as "very good" compared with lectures (Tables 3 and 4).

Table 3: Percentages within sections of the scoring range and standard deviations for tools that contributed to learning in microbiology (n = 349). * n = 232 (podcasts and study tasks not included in the study of class09).

	very good	good	less good	bad	not used
e-comp.	71.9 (7.4)	22.4 (8.0)	1.1 (0.5)	0.0 (0.0)	3.1 (0.4)
Lectures	61.4 (6.1)	31.9 (4.2)	1.4 (0.6)	0.8 (0.1)	3.3 (2.9)
MCQ	64.2 (7.9)	27.6 (2.7)	2.8 (2.5)	1.1 (1.2)	2.8 (2.0)
Study tasks*	53.7 (1.8)	27.9 (5.1)	8.2 (2.4)	0.8 (1.1)	7.3 (1.1)
Podcast*	24.9 (5.5)	27.5 (5.7)	4.8 (2.2)	1.7 (0.1)	38.6 (2.4)
Text book	17.3 (5.6)	39.2 (3.5)	18.3 (3.7)	4.0 (2.8)	19.8 (1.2)

Table 4: Percentages within sections of the scoring range and standard deviations for tools that contributed to learning in BPH (n = 349). * n = 232 (podcasts and study tasks were not included in the study of class09).

	very good	good	less good	bad	not used
e-comp.	72.6 (3.6)	20.3 (2.1)	0.5 (0.5)	0.3 (0.5)	5.1 (1.6)
Lectures	61.7 (7.3)	24.5 (4.7)	3.0 (2.4)	0.6 (1.0)	7.6 (3.5)
MCQ	62.2 (9.1)	22.5 (4.9)	4.2 (2.2)	1.1 (1.2)	8.8 (1.9)
Study tasks*	51.1 (0.4)	27.9 (5.1)	6.8 (0.7)	1.3 (0.7)	10.3 (2.0)
Podcast*	22.6 (0.1)	23.9 (1.8)	7.7 (0.6)	2.1 (0.4)	41.2 (1.0)
Text book	23.8 (1.1)	34.6 (3.3)	16.3 (1.7)	3.3 (2.4)	20.2 (2.1)

An interesting and surprising result is the relatively high proportion of students that did not use the podcasts at all. Thirty percent of the A&P respondents, 39 % of the microbiology respondents and 41 % of the BPH respondents reported that they did not use the podcasts (Tables 2–4). Thirty-eight percent of the A&P students, 42 % of the microbiology students and 40 % of the BPH students who did use the podcasts perceived them to be "very good" learning tools (results not shown).

Approximately 66 % of the respondents attended all 14 lectures in A&P, 85 % attended all microbiology lectures and 63 % attended all BPH lectures (results not shown). The overall percentage of students that rated the lectures as "very good" was 84 % in A&P, 65 % in microbiology and 59 % in BPH (Table 5).

Table 5: Percentages within sections of the scoring range and standard deviations for overall perception of lectures in A&P, microbiology and BPH (n = 349).

	very good	good	less good	bad	not used
A&P	84.2 (5.3)	14.1 (3.7)	0.6 (1.0)	0.0 (0.0)	0.8 (1.4)
Microbiology	64.8 (7.3)	29.7 (5.8)	0.9 (0.9)	0.5 (0.5)	3.5 (3.0)
BPH	58.8 (5.4)	30.3 (8.4)	2.5 (1.6)	0.5 (0.5)	7.1 (4.1)

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Discussion

The most interesting result of this study is that e-compendiums were rated better than all other learning tools, including lectures (Tables 2–4; Figure 3). The differences between the total "good" and "very good" ratings between e-compendiums, lectures and MCQ in A&P were small (Table 2), but when only the "very good" responses are considered, e-compendiums seem to be a better learning tool than the other tools supplied to our students, at least over the last two years. This is supported by our results from microbiology and BPH.

An interesting result of our study is that a higher number of students in class10 and class12 rated the e-compendiums as "very good" compared with lectures, whereas the students in class09 rated e-compendiums and lectures more or less equally. This may be explained by the fact that the students who entered higher education from 2010 (i.e., class10 onward) were the first students who had experienced the compulsory daily use of computers for schoolwork throughout secondary school. This may help to explain why students in class10 and class12 were more enthusiastic about the e-compendiums as learning tools (see below).

One might argue that the higher ratings of e-compendiums compared with the other learning tools does not indicate that it is the e-compendiums that are good tools, but rather that the other learning tools are not very good. This may be a plausible argument. However, the majority of the respondents reported that they perceived the lectures to be "very good" in A&P, and similar reports were also given for microbiology and BPH (Table 5). Thus, the students reported the lectures to be good, but the e-compendiums to be even better learning tools in all three subjects studied.

Another interesting result in our study is that the textbooks scored poorly as learning tools (Tables 2–4; Figure 3). This was particularly noticeable in A&P. This result may be explained by the fact that the recommended textbook in A&P is written in English. Approximately 60 % of the students did not use the recommended textbook in A&P, and a majority of the students reported that a Norwegian textbook and/or the e-compendiums were used instead. It is important to note that the questionnaire feedback on this topic in A&P was inconsistent, and that the results presented here portray our most conservative analysis, and are in accordance with the impressions we gained from meetings with the students during lectures and task seminars. Nevertheless, these results must be interpreted carefully. On the other hand, it is unlikely that students not using the recommended English textbook would use an alternative English textbook. Together with the fact that the students used Norwegian textbooks in microbiology and BPH, we therefore conclude that most of the students who participated in our study used Norwegian textbooks. All together, these findings suggest that i) textbooks, independent of language and subject, are not regarded as "very good" learning tools for a majority of our nursing students, and ii) the e-compendiums are perceived as better tools for learning than ordinary textbooks. Considering that most courses in higher education are based on textbooks, these findings may imply that the new generation of higher education students are more enthusiastic about, or even demanding of, digital learning tools with new possibilities, as previously described (Gabriel et al., 2012; Owens & Floyd, 2007; Percival & Muirhead, 2009). This is further supported by our finding that MCQ scored better as a learning tool than the more traditional textbook and task solving tools (Figure 3).

A third interesting result in our study is that a relatively high proportion of students reported that they did not use the podcasts (Tables 2–4). This was somewhat surprising, because the audio tracks used in the podcasts were actually the same as those used in the corresponding e-compendiums, which were well liked by the students. We expected that the students would see the added value of such a flexible, mobile learning tool for non-traditional learning settings.

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However, there are several potential explanations for this finding: i) the students may have simply attended the lectures and therefore did not need another audio presentation of the topics, ii) the students already had the audio files in their e-compendiums and therefore did not see the need to download them again from iTunesU, iii) the students may not have been familiar with podcasts or understood that they needed to be downloaded from iTunesU rather than the VLE, which may have increased the threshold for their use (even though the easiest way to distribute podcasts is through iTunesU or similar services outside a VLE), and iv) the number of learning tools was high and podcasts were the tool that was given lower priority. The same reasons may also explain why podcasts do not score highly as learning tool. Only 38 % of the students who used the podcasts in A&P regarded them as "very good" tools. This is somewhat surprising for two reasons. Firstly, previous research suggests that podcasts are good learning tools (Delaney et al., 2010; Evans, 2008). Secondly, the results presented here are somewhat in contrast to the results of our previous short survey, in which 49 % of our nursing students scored the podcasts as contributing "highly" to learning (Foss, Oftedal & Løkken, 2012). However, in that study, the students (n = 107) only used up to eight podcasts (average = 3.5) over a shorter period of time, thus making the findings less comprehensive and perhaps not comparable with the results presented here. Overall, the low proportion of podcast users and the relatively low ratings of podcasts as learning tools that contribute to learning surprised us, and ought to be further studied.

A relevant and plausible question is whether the use of our e-compendiums increased learning outcomes and exam scores. This was not addressed in our study. Even though a few studies show that e-learning tools may improve learning (Douglas et al., 2012; Hassanien, 2006; Laru et al., 2012; Singh, 2010), identifying how learning tools affect learning outcomes seems difficult because of the numerous variables, including student engagement, as previously discussed (Säljö, 2010). On the other hand, there are different ways to improve the learning process. A review of educational gaming (Blakely et al., 2009) show various positive outcomes of gaming that are not directly linked to exam results, such as increased motivation and active learning reinforced by instruments of entertainment. These kinds of outcomes may be relevant for other e-learning tools as well as our e-compendiums. Importantly, such outcomes, which may not in themselves improve exam results, may improve study habits and motivation, which in turn may affect exam results in the long run. Whether this is the case for our new e-compendiums is yet to be studied.

Methodological considerations

Several aspects of this study suggest that our results must be interpreted carefully. Firstly, the lecturer who taught all three subjects (A&P, microbiology and BPH) is also the e-compendiums subject matter expert and created the other learning tools (MCQ tests and study tasks). It is possible that the lecturer may have unintentionally affected the students' perceptions and ratings of the various learning tools, for example, by the way the tools were presented or reviewed. This may have affected the outcome of the study. It is still worth noting that the same lecturer recommended the English textbook in A&P, and that this did not have a noticeable positive outcome, suggesting that the lecturer was not always able to affect the students' use, perception and rating of tools. Furthermore, we argue that the fact that only one lecturer was involved makes the results of our questionnaires across subjects highly comparable.

Secondly, in this study, various learning tools were compared. It may be argued that these comparisons are not always reasonable, and that, for example, comparing the perceived effects of e-compendiums with DDF or MCQ may not be meaningful because different tools have different contents, purposes and effects on learning. We do agree that this can be questioned. However, the aim of this study was to compare different learning tools, even though the different tools may have different goals for students' learning processes.

ISSN 1027-5207

Thirdly, it is possible that the students who participated in this study were those who were most engaged by the available learning tools, and that those who were less enthusiastic did not participate. On the other hand, the students' perceptions of their textbooks as learning tools indicate that not all the tools in the study were embraced with enthusiasm. Moreover, all our data were based on self-reports, which can be prone to recall bias. It has been suggested that the most pervasive problem for response bias is people's tendencies to present a favourable image of themselves (Polit & Beck, 2004). We cannot exclude the possibility of such bias in our study, but according to Polit and Beck, the effects of such bias should not be exaggerated.

Fourthly, it is important to take into account the fact that our study was done at a Norwegian university among nursing students, and that the outcome of this study may not be representative of other students at other institutions of higher education.

Conclusion

Our study shows that rich media e-compendiums were perceived as very good learning tools by 85 % of the students in A&P and by 72 % and 73 % of the students in microbiology and BPH respectively. These results of the e-compendiums as learning tools were always higher than the compared lectures, task solving, textbooks and the e-learning tools of MCQ and podcasts.

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Conflict of interest

Foss is the main author of all e-compendiums used in this study, and may receive royalties if the e-compendiums are commercialized in the future.

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