The Use of a Supplementary Online Learning Course, and its Effect on Academic Achievement within an Undergraduate Nursing Programme*

Gabrielle McKee[†]
Paul Costello[†]
Audrey Adams[†]
Michael Porter[‡]

[†]Trinity College Dublin
[‡]University of Bradford

Abstract

Background: There has been much research into innovations, quality, barriers and satisfaction with online learning. In the rush for development however, there has been little empirical evidence of the effectiveness of online courses in promoting student learning.

Study Aim: The aim of this study was to examine the influence of an online learning course on student exam results.

Methods: The study design was a cross-sectional survey. The online learning course was supplementary material for a first year biological sciences module in a four year nursing degree programme. Students' access to the course was monitored automatically throughout the academic year. Student exam results and profile were collated from the School database. The data was analysed using SPSS version 16.

Results: 195 students participated in the study of which 95% were female and 36% mature students. The sample consisted of students from two strands of the degree: General nursing (84%) and Intellectual Disability (ID) nursing (16%). There was a significant difference in the exam results of General and ID nursing students. There was a significant difference in the usage of the online course depending on mode of entry to the degree programme with mature students making greater use of the online learning course. Spearman's correlation identified a very significant relationship between exam results and usage of the online course ($n = 185$, $r = 0.288$, $p = 0.0001$ (one tailed)). This indicated that usage of the online course accounted for 8% of the variability in exam results.

Conclusions: This study would appear to indicate that usage of the online course was related to improved higher exam results as students who used it most had better exam results. These findings go some way in establishing the evidence that is needed to justify the time, effort and cost of the implementing online courses.

Keywords: Online learning; nurse education; assessment; biology, examinations

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1. Introduction

Recent technological advances have dramatically changed many aspects of our society. One such change has been the introduction and use of various types of computer based material and technology at all levels of education. A plethora of terms refer to the integration of technology into educational programmes to signify differences in the way it is used. For example, Computer Based Learning (CBL) is an all-encompassing term indicating any use of a computer to aid learning (Adams 2004). Computer-Assisted Assessment (CAA) is using computers to deliver, mark and analyse student assignments or examinations (Seale 2002). Web-based learning and online learning may be used interchangeably as in both cases the medium for learning activities and/or content delivery is via the Internet. This paper reports on a stand-alone online course used to supplement in-class Biology instruction for first year undergraduate nursing students.

1.1 Context for the study

The use of web-based learning is popular in both the sciences and nursing (Washer 2001; Atack & Rankin 2002; Jeffries 2005; Twomey 2004; Barakzai & Fraser 2005; Childs et al. 2005; Glen 2005; Bourne & Davison 2006; Freeman et al. 2006; Johnston & McAllister 2008; Lockman et al. 2008). Science teaching in nursing programmes has moved away from the more technical laboratory based classes traditionally used in science and medical education. Such classes do not best serve the needs of the developing nurse and they are often expensive and pose health and safety issues (Tanner 2003; Jeffries 2005; Johnston & McAllister 2008).

In the Republic of Ireland, biological sciences is not a pre-requisite subject for students entering nursing programmes directly from secondary school and mature students who make up a significant proportion of those entering nursing programmes, often possess little or no formal education in biological sciences. Nursing students have traditionally found biological sciences difficult and the students in this study, both mature and school leavers follow this trend (Glackin & Glackin 1998; Jordan et al. 1999; McKee 2002). In order to address this knowledge deficit, the biology lecturers in this study developed a supplemental online learning course which students could access in their own time. The aim of the online course was to introduce or revise the fundamental building blocks of biology before students attended core lectures in the module.

1.2 Rationale for using online learning materials

There are many teaching and learning methods used today in higher education including lectures, discussion groups, and clinical simulations to name a few. Some studies have suggested that the effectiveness of the students' learning is dependent on the appropriate choice of teaching and learning methods rather than mode of delivery (Bata-Jones & Avery 2004; Buckley 2003). In other words, learning outcomes may be achieved whether the educational experience is in a physical classroom, or a virtual one.

Students have been found to be generally satisfied with online courses (Billings et al. 2001; Atack & Rankin 2002; Barakzai & Fraser 2005; Salyers 2005) citing one of the main benefits as greater flexibility in course scheduling (Kenny 2002; Salyers 2005). Students consider online learning more convenient (Billings et al. 2001; Seiler & Billings 2004), and more time efficient (Salyers 2005). These logistical benefits may contribute to an improved learning experience. Students have indicated that online learning provides them with the opportunity to have greater independence and control over their learning. Students indicate that one of the benefits of online courses is that they can self pace their learning (Welsh et al. 2003; Salyers 2005; Freeman et al. 2006) and therefore feel less pressure (Johnson 2005).

Kenny (2002) Johnson (2005), Salyers (2005) and Bourne & Davison (2006) agree that the ability to self pace within online courses goes some way towards catering for individual learning needs whether these are knowledge based, ability based, or language based. Well designed online material is usually broken down into smaller manageable units, which easily facilitates non-linear learning. Online learning tends to use a greater variety of instructional devices including audio, text, graphics, self-testing and feedback (Arbaugh 2005 as cited in Sitzmann et al. 2006) which facilitate different learning approaches and styles, promoting active learning and encouraging deeper understanding (Billings et al. 2001; Kenny 2002; Seiler & Billings 2004; Johnson 2005; Spiro & Jehng 1990 as cited in Sitzmann et al. 2006). In summary, the benefits of using online material are many, both directly to the student and indirectly by facilitating the use of effective teaching and learning methodologies.

All teaching methodologies have advantages, disadvantages and barriers to optimum use. The quality of online learning has advanced greatly in recent years reflecting better application of learning theory, and greater attention to specific educational contexts. Ideally, course designers should choose the most appropriate instructional design to support their students' achievement (Adams 2004). In this study an instructional design, based on a behaviourist approach to teaching and learning was used as it was considered best to reconcile learner needs with curriculum requirements. A behaviourist approach is effective and efficient, especially when applied to a structured knowledge domain such as the physical sciences (Santrock 2001). Behaviourism can also be an appropriate approach to adopt when some students have little knowledge of the subject and require supplementary tuition to reach the same level as the rest of the class (Alessi & Trollip 1991; Adams 2004). As with all teaching, effective instructional design and appropriate content are needed to promote educationally sound, engaging and effective learning material that generates satisfaction in users (Cragg et al. 1999; Billings et al. 2001; Howatson-Jones 2004; Twomey 2004; Childs et al. 2005; Johnson 2005).

1.3 Effectiveness of the use of online learning materials

Many studies have indirectly indicated the effectiveness of online learning. Students have reported that the use of online material helped their learning, and those who performed well in on online quizzes have done well in subsequent examinations of the similar material (Freeman et al. 2006). Ginns and Ellis (2007) found a positive correlation between good exam results and a positive perception of resources and teaching within an online course. In the rush to

develop online courses however there has been little empirical evidence of their effectiveness in promoting student learning. Some studies have shown that students using online learning achieve higher grades (Kumrow 2007) while other studies have shown no significant difference between classroom and online learning (Buckley 2003; Bata-Jones & Avery 2004). Sitzmann et al. (2006) in their meta-analyses of 10,918 students studying a range of disciplines, concluded that while online learning instruction was 6% more effective and supplementary online learning was 13% more effective than classroom instruction for knowledge transfer, the positive effect was reversed when students were randomly assigned to class types. Other research in this area revealed that examination results are not influenced by students' computer literacy, gender, or whether they were native or non native speakers (Barakzai & Fraser 2005). However Sitzmann et al. (2006) in their review indicated that significant differences between online learning and classroom learning effectiveness were removed if age was controlled for (Tallent-Runnels et al. 2006).

The aim of this study was to examine the influence of an online learning course on students' exam results.

The objectives of this study were:

- To identify student usage of online material
- To determine if usage of online learning material influenced biology exam results
- To determine if students' entry mode (mature or direct) affected the relationship between usage of the online course and biological sciences exam results

1.4 Online course description

Biological Sciences made up approximately one sixth of the students' first year nursing academic programme. The biology content was delivered via lectures, tutorials, practicals and supplemented by the online learning course featured in this study. The content of the online course was foundational to material delivered in later lectures and tutorials. The aim of the online course was to allow for the acquisition of a similar level of foundation biology knowledge by all students before the introduction of the core lectures. The online course was not separately graded and there were no formal teaching sessions or time limits on students' use of online materials, however students were given a schedule of classes and it was recommended that they complete the relevant online section of the course before the advanced material on the topic was delivered in lectures and tutorials.

The online course consisted of 12 units with each unit comprised of a set of learning objectives, the unit content itself, and a self assessment quiz following the same format as the students' end of module exam. The online course material contained text, images, rollover buttons, animations, quizzes, and links to relevant Internet sites. Although students may have experienced intrinsic reward and personal satisfaction in successfully completing the online quizzes, there was no extrinsic reward system in terms of marks towards their final grades for completing any or all of the online course. The instructional design incorporated drill and practice to facilitate retention of basic facts. Guidance on how to use the course was given at

the beginning of the academic year, reinforced in the second term with a computer laboratory session and reinforced verbally in lectures throughout the year. The basic content delivered online was not delivered again in class although students could consult the academic and IT support staff throughout the year regarding any difficulties or queries.

2. Methodology

The study was a naturalistic cross-sectional non-experimental survey, designed to evaluate the influence of an online course on students' exam results.

2.1 Data Collection

Biological sciences was assessed twice during the academic year using an MCQ format. The results of the end of year exam were utilised for the purpose of this study. The pass mark for exams within the school was 50%. The school database was used to collate students' exam results.

Students' entry status was also ascertained using the School database. Students entered the degree programme in one of two ways. The most common pathway was direct entry from secondary school using students' final school exams results to determine eligibility. The other method of entry was for mature students who must be over 23 years of age. Their suitability was assessed through a written application form, interview and aptitude test. The students in this study were enrolled in either General nursing or Intellectual Disability (ID) nursing.

The majority of studies to date examining the influence of online learning on students' knowledge acquisition have adopted a comparative methodology, comparing online and traditional or blended courses (Buckley 2003; Bata-Jones & Avery 2004; Tallent-Runnels et al. 2006). This study offers a novel approach by directly examining the association between use of online material and students' examination results in one module. The online course was constructed within WebCT which enabled recording of a number of parameters including the usage of the online materials in general and by each student individually. One parameter which was available for analysis but not selected was total time online. This parameter was considered to be too open to influence by other factors such as students' previous knowledge of biological sciences, their learning styles, as well as technical issues such as being 'logged on' but not actually using the materials . It was decided that total number of pages accessed by each student was the best indication of usage for correlation analysis. However this parameter does have its limitations in that it gives no indication of how long the student spent on each page.

2.2 Ethical issues

Permission for the study was granted by the School Research Ethics Committee. Students were given detailed information about the study in class including assurances that the data from exam results and records of their use of the online course would be anonymised.

2.3 Sample

195 students agreed to participate in the study. Students repeating the year and students who withdrew from the course before the end of the year were excluded from the analysis. The sample size changes slightly within the analyses due to missing data. The sample used in each test and subgroup is therefore reported in tables and text.

2.4 Analysis

The SPSS version 16 was used to analyse the data. Descriptive statistics were derived initially. The two main outcome parameters i.e. exam results and usage of online materials distribution curves were not normal so non-parametric tests were used. Mann-Whitney *U* tests were used to ascertain if there were significant differences in the usage of online material, exam results and mode of entry to the programme. Spearman's correlation was used to examine the relationship between online course usage and exam results. Effect size of the test outcomes were also derived, to ascertain if the effect was substantive or not. Cohen's *d* criteria were used to describe the effect size for the Mann-Whitney *U* tests and r^2 was used to ascertain effect size in the correlation test results. The criteria used to define the effect are: small 0.1, medium 0.3 and large 0.5 (Pallant 2007). A level of $p > 0.05$ was considered significant for all tests.

3. Results

3.1 Student demographics

The demographics of the study population are illustrated below in Table 1. The vast majority of the student population were female (95%) and 36% of the sample were mature students. A Mann-Whitney *U* test revealed that General nursing students had significantly higher exam results ($u = 1094.5$, $p < 0.0001$ (two tailed), see Table 2) than Intellectual Disability nursing students. This represents a medium size effect ($r = 0.3$). When the subgroups were divided by mode of entry a Mann-Whitney *U* test revealed there was no significant difference in exam results based on mode of entry, direct or mature entry ($u = 3627.5$, $p < 0.48$ (two tailed)), which represents a negligible effect ($r = 0.05$, see Table 2).

Total number of students	195
Male	9
Female	184
Direct Entry students	122
Mature students	70
General students	164
Intellectual Disability students	31

Table 1: Demographic profile of student population

	Exam results			
	n	**Mean**	**SD**	**Median**
All class	185	69.57	13.15	70.10
General students	156	71.44	12.48	72.10
Intellectual Disability students	29	59.49	12.27	60.90
Mature students	64	68.79	13.64	68.15
Direct entry students	121	69.98	12.92	70.80

Table 2: Descriptive statistics of sample and subgroup exam results

3.2 Usage of online material

There were 86 pages in total. Although all pages were accessed by at least 15% ($n = 29$) of students, on average only 29% of pages were accessed per student. The top five most popular pages visited were the interactive, highly illustrative pages on the systems of the body. The five least accessed pages related to the basic sciences: chemistry and genetics. These pages, although they contained interactive exercises, had a greater proportion of written material than the systems pages. There was no significant difference in online course usage between General nursing and Intellectual Disability nursing students ($u = 2232.5$, $p < 0.283$ (two tailed), see Table 3), a negligible effect ($r = 0.08$). There was a significant difference in online course usage according to mode of entry ($u = 3390$, $p < 0.044$ (two tailed)), with mature students using the online course more, the effect size was small ($r = 0.145$, see Table 3).

	Online course usage			
	n	**Mean**	**SD**	**Median**
All class	195	25.27	13.66	25.00
General students	164	25.66	13.31	26.00
Intellectual disability students	31	23.16	15.42	19.00
Mature students	67	28.18	14.89	28.00
Direct entry students	123	23.89	12.65	23.00

Table 3: Descriptive statistics of sample and subgroup usage of online course

3.3 Relationship of usage of online materials to exam results

There was a significant positive correlation between exam results of the total class and their online course usage rate ($n = 185$, $r = 0.288$, $p = 0.0001$ (one tailed)), with students who made more use of the online course attaining higher results. This is a very small effect size ($r = 0.288$, $r^2 = 0.08$) and indicates that usage of online course accounts for 8% of the variability in exam results.

4. Discussion

There is little empirical evidence on the influence of online learning on academic attainment, particularly the use of online materials within a traditional classroom-based course. This study found that those students who used online learning materials most, attained higher exam results.

Clark (1994) pointed out that care is needed not to rule out alternative explanations for group differences in non-experimental studies of this nature. Are students of lesser ability not using online material because they are uncomfortable with the medium, or have they failed to manage their time well enough to go online regularly? The use of online material in general has been shown to be difficult for novice users (Atack & Rankin 2002). From a technological point of view possible barriers to optimum usage include: availability of home computers, access to broadband, need for technological support and need for adequate computer skills, all of which need to be addressed (Cragg et al. 1999; Washer 2001; Atack & Rankin 2002; Welsh et al. 2003; Childs et al. 2005; Porter et al. 2007). The change from classroom based teaching to online learning requires a shift in focus on the students' part, with the lecturer playing a less prominent role. Some students still have a preference for lectures (Cragg et al. 1999; Freeman et al. 2006; Sitzmann et al. 2006; Porter et al. 2007). Even when these obvious barriers are taken into account as much as possible, there are other elements which will affect the utilization of online learning courses. Issues such as poor student organizational skills, poor academic support and time constraints will also impinge on students' ability to engage successfully in online learning courses, particularly when such courses are part of larger programmes (Billings et al. 2001; Washer 2001; Atack & Rankin 2002; Childs et al. 2005; Porter et al. 2007). These barriers to optimum use of online learning materials should be addressed as much as possible at the course development stage. In relation to this study, care was taken to develop a course that addressed the known barriers to the use of online materials. Clarke's (1994, p.26) statement that "there is nothing uniquely beneficial about any computer aided instructional medium" is indeed correct, but online learning does facilitate the clustering of many good teaching and learning practices and in so doing aims to facilitate better, more effective learning.

As online learning becomes ubiquitous in higher education, not only must we be assured that it is effective, but we must also insure that we identify and address moderators that may impede its effectiveness. This study found that mature students used online material significantly more than direct entry students. While it is impossible to attribute exactly why mature students use online material more from these results, relating this finding to previous studies may shed light on possible causes. A related parameter to maturity, age has been shown, in Sitzmann's et al. (2006) metanalysis, to influence effectiveness. However Sitzmann et al. (2006) demonstrated that when age was accounted for, there was no link between effectiveness and usage. Unfortunately the non-parametric nature of exam results and usage of online material in this study prevents this type of analysis. Tallent-Runnels et al. (2006) and Sitzmann et al. (2006), like many researchers and educators before them, concluded that mature students are both more highly motivated and attend to online course outcomes better

than traditional students. However further exploration of these studies indicated that the positive effect of online instruction on some types of learning was reversed when students were randomly assigned to online or traditional courses, suggesting those students with higher motivation or cognitive ability may have a preference for online learning. This could be a contributing factor to the differences we see in this study – the more motivated smarter students doing more study, irrespective of what medium it is.

As outlined earlier many factors, in particular course design, students' computer skills, and access to computers, influence online course usage, perceived effectiveness and user satisfaction (Childs et al. 2005; Atack & Rankin 2002; Kenny 2002). Some students are more satisfied with classroom based instruction (Porter et al. 2007), and although not all students enjoy the online learning experience (Lewis & Price 2007), effective learning may still occur. However, this study does add weight to the argument that an educationally sound online learning course, that addresses known barriers to effective use of this medium, can contribute significantly to students learning.

5. Recommendations

As students continue to become more strategic in their learning, course developers need to find ways to motivate, encourage and perhaps even reward students for using online learning materials to ensure their optimal use. Ensuring that such material is not viewed as optional but core to the programme may also improve usage. However care must be taken to ensure that all students have equality of access to online materials if they are to become mandatory components of a programme. Ensuring equality of access for students may include addressing technology access issues as well as familiarity with the technology itself (Porter et al. 2007). Students may find troubleshooting workshops in a computer laboratory particularly helpful or the inclusion of a frequently asked questions (FAQs) facility in the online materials useful.

It is expected that effectiveness of online courses will improve over time, as course design and delivery issues are addressed and students adjust to learning in the online environment (Sitzmann et al. 2006).

6. Conclusions

In this study students' usage of an online course was related to higher exam results. Where students have access to the internet, online learning is an anywhere, anytime learning opportunity. The increasing use of well designed and supported online learning in higher education programmes will have many benefits for students. The results of this study go some way to establishing the evidence that is needed to justify the time, effort and cost of implementing online courses.

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