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Abstract: Background: Web-based technologies are increasingly being used to create modes of online learning for nurses but their effect has not been assessed in nurse education.
Objectives: Assess whether participation in face-to-face discussion seminars or online asynchronous discussion groups had different effects on educational attainment in a web-based course.
Design: Non-randomised or quasi-experimental design with two groups - students choosing to have face-to-face discussion seminars and students choosing to have online discussions.
Setting: The Core Methods module of a postgraduate research methods course.

Participants: All 114 students participating in the first 2 years during which the course teaching material was delivered online.
Outcome: Assignment mark for Core Methods course module.
Methods: Background details of the students, their choices of modules and assignment marks were collected as part of the routine course administration. Students' online activities were identified using the student tracking facility within WebCT. Regression models were fitted to explore the association between available explanatory variables and assignment mark.
Results: Students choosing online discussions had a higher Core Methods assignment mark (mean 60.8/100) than students choosing face-to-face discussions (54.4); the difference was statistically significant ($t = 3.13$, $df = 102$, $p = 0.002$), although this ignores confounding variables. Among online discussion students, assignment mark was significantly correlated with the numbers of discussion messages read (Kendall's taub = 0.22, $p = 0.050$) and posted (Kendall's taub = 0.27, $p = 0.017$); among face-to-face discussion students, it was significantly associated with the number of non-discussion hits in WebCT (Kendall's taub = 0.19, $p = 0.036$). In regression analysis, choice of discussion method, whether an MPhil/PhD student, number of non-discussion hits in WebCT, number of online discussion messages read and number posted were associated with assignment mark at the 5% level of significance when taken singly; in combination, only whether an MPhil/PhD student ($p = 0.024$) and number of non-discussion hits ($p = 0.045$) retained significance.
Conclusions: This study demonstrates that a research methods course can be delivered to postgraduate healthcare students at least as successfully by an entirely online method in which students participate in online discussion as by a blended method in which students accessing web-based teaching material attend face-to-face seminar discussions. Increased online activity was associated with higher assignment marks. The study highlights new opportunities for educational research that arise from the use of virtual learning environments that routinely record the activities of learners and tutors.

Online v face-to-face discussion in a web-based Research Methods course for postgraduate nursing students

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[Word count for Abstract: 396 words]

[Word count from Introduction to Conclusions: 4440]

Key Words:

Nursing education

Teaching methods

Online learning

Comparative study

What is already known about this topic?

- Increasing use is being made of online environments in nursing education
- Online learning and teaching can be as effective as face-to-face methods in training for specific skills

What this paper adds

- Online discussions are associated with at least as good results as face-to-face seminar discussions in a web based postgraduate research methods course for nursing and healthcare students
- Increased use of online resources, including web sites and discussion boards, is associated with higher student achievement

Introduction

The Internet has created new opportunities for learning at distance. There are potential benefits of flexibility to individuals and employers, and for international access to education. One of the key advantages of distance education is that participants are able to customise their own programmes of study to fit into the structure of their lives in order to study when and where they want, and not be tied to a specified venue and/or timetable. Until the quite recent introduction of web-based communication however, many-to-many communication – communication between multiple course participants – has been lacking in such modes of study. Web based facilities are now enabling students to work together rather than individually, and to have direct and regular contact with staff in host institutions (Warschauer, 1999). Online discussions can be either synchronous (users must be online at the same time) or asynchronous (users can contribute at different times). As with almost every other area of professional study, web-based technologies are increasingly being used to create modes of online learning for nurses (Anthony, 2001, Belfry and Winne, 1988), ranging from entirely distributed modes of delivery (Epling et al., 2003), to 'mixed mode' approaches (Green et al., 2003, Morris and Maynard, 2000), where some form of face-to-face contact is combined with web-based learning. Online communication may be particularly useful in nursing education because students from a particular cohort or group are often distributed over multiple sites and available for study at different times.

The increase in web-based learning (and terminology, including online, e-learning and distributed learning) has led to a growing interest in evaluation, most of which has focused on evaluating online learning formats in terms of: the affordances of the communication environments (Bozik and Tracey, 2002, King, 2001); users' perceptions (Veerman et al., 2000); and the types of skills that users may require (Murphy, 2004, Trigwell et al., 1999). However, little research has focussed on providing a comparative evaluation of online and face-to-face environments (Sunal et al., 2003). A notable exception is a study of students' satisfaction with collaboration in either face-to-face or asynchronous conferencing facilities that found women were more satisfied with asynchronous collaboration than men (Ocker and Yaverbaum, 2001). In one experimental study 38 human resource development professionals were allocated to either face-to-face or online delivery of a graduate level instructional design course. The two methods of delivery were reported to produce no difference between the two course formats in several measures of learning outcomes but students in the face-to-face course held slightly more positive perceptions about the instructor and overall course quality (Johnson et al., 2000).

Within the small group of comparative studies very little work has been conducted to compare the teaching methods within a nurse education context. A survey of student opinion of participation in online and face-to-face seminars found online students reporting less interaction within their seminars (Thornam and Phillips, 2001). A comparison of CD-Rom based tuition of ECG and traditional class based tuition found no significant difference of either assessment marks results or attitudes between the two

groups (Jeffries et al., 2003). This latter study is particular noteworthy because it dealt explicitly with the comparative success rates in specific clinical skill training across the two forms of study.

Just as the potential purposes of evaluation are diverse, so are the methods used to accomplish it, including: questionnaires (Jelfs and Colbourn, 2002, Phipps et al., 2001); face-to-face interviews (Sweeney et al., 2004, Yazon et al., 2002); and content analysis of online messages (Mowrer, 1996, Weisskirch and Milburn, 2003). However there has been little exploration of the potential for examining statistical records of online activity. A key characteristic of online work activity is that the patterns of information transferral are available to be recorded. Each online action, including a request for information (such as downloading a document) or the provision of information (such as posting to an online discussion) can be registered and subsequently compiled. Through electronic logs of activity tutors can view what course participants do, including how often students view web pages, how frequently they read the discussion board contributions of others and how regularly they post to discussion boards. There is enormous potential for these data to enable detailed examination of the effectiveness of student behaviours. Such surveillance may raise questions about the compatibility with an underlying philosophy of education that emphasises autonomy (Epling et al., 2003).

While some progress has been made in understanding how face-to-face and online environments function, their comparative effect has not been examined in nurse education. The study reported here was designed to investigate the relative effect of face-to-face or online discussions on educational outcomes within a web-based course for

postgraduate nurses, and to investigate whether measures of online activity were associated with educational attainment.

Context

This research is based on the evaluation of a postgraduate research methods course at the School of Nursing, Midwifery & Social Work, The University of Manchester. This course had been taught previously in a face-to-face format as a weekly series of lectures attended by all students (usually between 50 and 60 in each cohort), and seminars of between 10-15 students. From 2002 this course was web-based, which meant that the traditional lectures were replaced by materials accessed across the internet through WebCT. Students could elect either to attend a series of face-to-face seminars (similar to the previous face-to-face course) or to participate in online asynchronous discussions within WebCT.

Methods

Objectives

The aims of the study were to assess whether participation in face-to-face discussion seminars or online asynchronous discussion seminars in a web-based course had different effects on educational attainment, and to examine associations between online activity and attainment.

Design

This was a non-randomised or quasi-experimental design comparing two groups: students who wished to attend face-to-face discussion seminars and students who wished to participate in online discussion seminars. Students were allowed to freely choose their discussion method at the start of the course.

Outcome measures

The students' performance on the course was assessed using a summative assignment essay (marked out of 100) consisting of a formal research proposal in an area of the student's own choice. This was submitted in paper format, and it was first and second marked by the two course leaders (one of whom, PC, was a member of the research team) for the qualitative and quantitative parts of the course, who were blind to each other's mark. As standard practice, a sample of scripts was also assessed by an external examiner. The assignment mark was taken to be the primary outcome measure. Secondary measures were whether a student competed the course unit within the time-frame of the study, and whether a student passed or failed (a mark of 40 or over was considered to be a "pass").

Participants

The participants were postgraduate students registering for our Core Research Methods course during 2002-2003 and 2003-2004. The course accounted for 15 M level credits and covered an introduction to qualitative and quantitative research methods. The course was compulsory for students registered for all Postgraduate Diplomas and Masters programmes in the School, including: Psychosocial Interventions ("COPE"), a part-time programme predominantly studied by nurses but also other mental health practitioners; Nursing Studies, for qualified nurses, mostly studied part time, with some full-time overseas students; and Clinical Nursing, a part-time programme for registered nurses working in the UK. Research degree students (MPhil and PhD) were also required to study the course; most were UK-based registered nurses studying part-time, but there were also full-time students, some of whom were from overseas.

The web-based course

All course material was accessible over the web via the University of Manchester's WebCT 3.4 virtual learning environment. Not all of the teaching material was held within WebCT: there were links to streamed video clips of conversations with researchers and PowerPoint presentations with audio commentary held on other web servers at Manchester and to supporting material at external sites. After an introductory session to familiarise students with WebCT and the course structure, students worked through five topics: question formulation and theoretical perspectives; sampling and access; data collection; data analysis; and rigour and critical appraisal. Each topic included presentations and sets of activities with one week, covering both qualitative and quantitative research methods. Students were expected to log onto the course individually from home, work or a University computing cluster, whichever was most

convenient, and read that week's course material, download resources (such as lecture transcripts and journal papers), and follow instructions to complete discussion-based tasks.

Discussion methods

Each week, students were expected to discuss the teaching material and assigned tasks with course tutors. They were offered a choice of discussion method, either a weekly face-to-face seminar or an online discussion using the discussion board within WebCT. Students were divided into discussion groups of around 10-12 students. Each group met weekly with two experienced tutors, one to discuss qualitative methods and one quantitative. The weekly face-to-face discussion seminars took place at a fixed time on campus and lasted one hour for qualitative and one hour for quantitative discussion; the online discussions had no fixed times, taking place throughout the week whenever students and tutors wished to post messages.

Data collection

Data were collected from two sources. Background details of the students, their choices of modules and assignment marks were collected as part of the routine operation of the course in Microsoft® Excel worksheets by our administrative staff. Online activity in WebCT was measured using a student tracking facility within WebCT for reporting the cumulative numbers of (a) all "hits" or accesses of course web pages (including the home

page, content module pages containing course material, the assignment page, WebCT email pages and discussion board pages); (b) discussion messages read; and (c) discussion messages posted for each student. The number of all hits included both the number of messages read and the number posted, so (b) and (c) were subsequently subtracted from (a) to give the number of hits not directly involved in online discussions. Counts for each student were extracted from WebCT at the end of the second semester and pasted into Microsoft Excel worksheets.

Approval and consent

Approval for the study was obtained from the relevant University of Manchester research ethics committee. Routinely collected data was available to the authors in anonymised form as part of the routine process of audit and quality monitoring that is good practice in course management. All students were informed about the project and gave informed consent for additional data collection.

Data analysis

The Microsoft Excel data were imported and merged in SPSS™ 11.5 (SPSS Inc, 2004). Most of the analysis in SPSS was descriptive, involving tables of frequencies, percentages and appropriate summary statistics. Fisher's exact test (extended to a 3 x 2 table) was used to compare retention by discussion method. Pearson's chi-sqaure test was used to examine the association between categorical characteristic variables and discussion method. The independent t-test was used to compare mean assignment mark

by discussion method, while Kendall's tau_b was used to measure the correlation between pairs of interval-level variables, some of which were skewed .

Simple regression models were fitted to explore the association between assignment mark and (a) available characteristics of students (year of intake, type of discussion method, gender, age, location and research programme) and (b) measures of online activity within WebCT (numbers of non-discussion hits, discussion messages read and discussion messages posted). The three WebCT activity variables were positively skewed, and they were included in models after taking the transformation $\log_e (x + 1)$, where $\log_e$ is the natural logarithm and the constant 1 was added to the value of the explanatory variable x to avoid problems when $x = 0$. Regression models using the untransformed variables, although easier to interpret, showed violations of the underlying assumptions of linearity and homogeneity of variance of the residuals for different values of the outcome variable. This assumption appeared to be acceptable for models based on the transformed variables.

Multiple regression models were fitted to explore the association between assignment mark and all explanatory variables showing an association significant at the 10% level in simple regression models. These models showed no evidence of multicollinearity, and the underlying assumptions of a Normal distribution and homogeneity of variance for the residuals also appeared to be valid.

Results

Recruitment: student characteristics and choice of discussion method

Table 1 shows characteristics of the participating students. Most students (85/114, 75%) were female, and the mean age of 38.5 years reflected the typical research pathway in Nursing, with experienced health professionals returning to academic study after some years in practice. Most students (68, 60%) were based in Greater Manchester. The Collaboration on Psychosocial Education programme (COPE) had the largest number of participants (48, 42%), followed by Nursing Studies (26, 23%), Clinical Nursing (21, 18%) and MPhil/PhD (17, 15%).

Please insert Table 1 here

Table 1 also shows a breakdown of student characteristics by choice of discussion method (face-to-face or online). Only research programme showed a significant association with discussion method (chi-square = 12.94, df = 4, $p = 0.012$). COPE and Nursing Studies students tended to opt for face-to-face discussions, while Clinical Nursing and MPhil/PhD students more often selected online discussions. The percentage of students choosing online discussions was higher in the second year (44%) compared with the first (36%).

Online activity

Online activity within WebCT, measured in terms of non-discussion hits, discussion messages read, discussion messages posted and all hits, was far higher for online discussion students than for face-to-face discussion students (Table 2). Online discussion students would be expected to have higher numbers of messages read and posted, as this was their only means of discussing the course material with each other and course tutors, but they also accessed the non-discussion parts of the course (median 183 hits) far more often than face-to-face discussion students (median 121 hits).

Please insert Table 2 here

Retention

Sixty of the 69 face-to-face discussion students (87%) submitted an assignment and passed with a mark of 40 or more; four students requested extensions, while five failed the assignment or dropped out without requesting an extension. The pass rate was slightly higher among online discussion students (41/45, 91%), with three students requesting extensions and one failing. The difference between the two discussion methods in terms of pass/not completed/fail was not significant (extended Fisher's exact test, $p = 0.601$).

Attainment: student performance

Table 3 shows a breakdown of assignment mark by discussion method for different student characteristics and overall. Where there were reasonable numbers in each subgroup, the mean mark for online discussion students was at least 4.7 higher than for face-to-face discussion students, with the exception of students from the Nursing Studies programme, where the difference in means was only 0.5. Overall, the mean assignment mark for online discussion students (60.8) was significantly higher than that for face-to-face discussions students (54.4, $t = 3.13$, $df = 102$, $p = 0.002$).

Please insert Table 3 here

There was no significant correlation between age and assignment mark, either overall (Kendall's $tau_b = -0.08$, $p = 0.258$) or within each discussion method. There were different patterns of correlations between WebCT activity variables and assignment mark within the two discussion methods. Among face-to-face students, only the number of non-discussion hits was significantly associated with assignment mark (Kendall's $tau_b = 0.19$, $p = 0.036$); among online students, only the number of discussion messages read (Kendall's $tau_b = 0.22$, $p = 0.050$) and the number of discussion messages posted (Kendall's $tau_b = 0.27$, $p = 0.017$) were significantly associated with assignment mark.

Factors affecting student performance

Table 4 shows the results of using regression models to investigate the association between available explanatory variables and assignment mark. Programme was

simplified to indicate whether the student was on our MPhil/PhD programme or not. MPhil/PhD students had the highest mean marks among both face-to-face and online discussion students, and preliminary analysis suggested that being on this research programme was associated with assignment mark. Using simple regression models to consider each variable in turn, only discussion method (1 = online), being on the MPhil/PhD programme (1= yes) and the three WebCT activity variables non-discussion hits, discussion messages read and discussion messages posted were significantly associated with assignment mark. Mean marks were higher for online discussion students and for MPhil/PhD students, and marks tended to increase as non-discussion hits, messages read and messages posted increased.

Please insert Table 4 here

A multiple regression model was fitted using the five explanatory variables found to be significantly associated with assignment mark individually, and using interaction terms between discussion method and each of the three WebCT activity variables. Only one interaction term (discussion method x non-discussion hits) was significant, and when the other two were dropped from the model, that interaction became non-significant too. For simplicity, the final multiple regression model presented here only includes the main effects variables (Table 4). Overall, there was a significant association with assignment mark (regression ANOVA $F = 4.56$, $df = 5, 96$, $p = 0.001$; $R^2 = 0.15$). When adjusted for other variables in the model, only being on the MPhil/PhD programme and $\log_e$ (non-discussion hits) showed a significant association with assignment mark. Adjusted for other variables, the mean assignment mark for MPhil/PhD students was 6.60 higher than for students on other programmes, the difference being statistically significant (p =

0.024). On the other hand, the adjusted mean for online discussion students was 4.35 higher than for face-to-face discussion students, a difference that was not significant (p = 0.109). Again adjusted for other variables, an increment of 1.0 in $\log_e$ (non-discussion hits) corresponded to a significant increase of 2.84 in the assignment mark (p = 0.045); however, this increment corresponds to a multiplicative increase in non-discussion hits by a factor of 2.718 (ie e^1). Only 15% of the variation in assignment mark was explained by the variables in the regression model, suggesting that there may have been other unmeasured factors contributing to assignment mark.

Figure 1 shows a scatter plot of Core Methods assignment mark against $\log_e$ (non-discussion hits), with students identified by whether they were on the MPhil/PhD programme and choice of discussion method. Symbols for online discussion students (filled triangles) tended to be to the right and above those for face-to-face discussion students (unfilled triangles), indicating more non-discussion hits and higher assignment marks. Four online discussion students managed to pass the assignment with relatively few hits, while some face-to-face discussion students (including the one with the highest mark) had as many hits as their online counterparts. On average, symbols for MPhil/PhD students (inverted triangles) tended to be to the right and above those for students from other research programmes (non-inverted triangles).

Please insert Figure 1 here

Discussion

Online v face-to-face discussion

This study demonstrates that a research methods course can be delivered to postgraduate healthcare students at least as successfully by an entirely online method in which students participate in online discussion as by a blended method in which students access the teaching material via the web and attend face-to-face seminar discussions. The demand for online discussions increased from 36% in the first year of the web-based course to 44% in the second, and it rose again in subsequent years. Most students completed the course and the online discussion students were at least as likely as face-to-face discussion students to finish and to pass the course.

The choice that students made between face-to-face seminars and online discussions enabled comparison of achievement of students studying entirely online with those attending face-to-face seminars. The comparison addressed the hypothesis that the different form of interaction in online discussion would negatively influence student achievement as compared with students experiencing face-to-face seminars. However, the marks attained by the group of students who elected to participate in online discussions were at least as high marks as students who elected to participate in face-to-face seminar discussions. Rather than being disadvantaged, participants in online discussions obtained higher marks generally in their assignments than those taking face-to-face seminars, suggesting that the online route was associated with higher achievement.

Increased online activity was associated with higher assignment marks. There were three steps each associated with higher student achievement as measured by assignment mark. The first step was reviewing the online learning resources: frequency of access to web-based materials was associated with higher marks, particularly among face-to-face discussion students. The next step associated with higher marks in the assignment was the frequency with which online discussion students read online postings. Finally, higher marks were associated with the most frequent contributors to online discussions. Thus the more active students were in their use of learning materials, reading postings and in contributing to online discussion, the higher were their assignment marks.

However, it is important to note that other variables were associated with assignment marks. The second cohort achieved higher average marks than the first cohort. Several factors could have affected the marks of the second cohort: while the assignment was similar, a research proposal, the format was simplified and length slightly shortened for the second cohort, which was also required to submit a few weeks earlier in the semester. There were more technical problems experienced in the first year of the course. It is likely that the tutors were more confident in their approach to the second cohort because the experience was not as novel as with the first cohort. This list of factors illustrates that there are numerous potential confounding variables to be considered in assessing student achievement. It is notable that age and sex were not associated with differences in achievement, suggesting that the learning methods were useful across the age and sex range. It is only possible to speculate about the range of other variables that might have influenced students' achievement, for example the time that students could devote to study rather than other professional and personal responsibilities; ability; previous

academic attainment; interest and motivation and so on. The presence of so many confounding variables is a methodological problem for educational evaluation. However, it is welcome that student achievement is not only determined by the method of study, particularly if the other factors that influence achievement independently of method of study include students' ability, motivation and effort.

Methodological implications

Web-based delivery of courses opens up new possibilities to observe the behaviours of students and tutors when activity is routinely recorded within a virtual learning environment. We were able to examine the frequency with which individual students: accessed learning resources; read discussion postings; and contributed to online discussions. Thus we could examine relationships between these behaviours and course outcomes including retention and assignment marks. The implications for educational research are far reaching. We have reported a qualitative analysis of face-to-face seminar interaction elsewhere (Gibson et al., 2006).

However it is not possible to measure the behaviours of students in face-to-face settings in the detail with which we could measure online interaction. It would require enormous and intrusive research resources to record each student's contribution to a face-to-face discussion in order to provide equivalent information to that routinely available in the log of a virtual learning environment. This study demonstrates that data about students' behaviour routinely recorded in virtual learning environments enables testing of hypotheses about associations between student behaviours and achievements. There is scope for the technology to provide even more information, and more efficiently. The

virtual learning environment recorded selective information. While it was possible to measure hits within WebCT, many of the learning materials, for example streamed video clips, were held outside WebCT and therefore although overall usage of such resources can be measured, usage cannot be attributed to individuals. The WebCT hit was a reliable indicator of access to the system but did not measure what students did while online. There was no valid way of assessing how long students or tutors were online or how long they engaged with learning resources. Data about tutor and student use of the system had to be collected as the course progressed, because the version of WebCT available only provided the cumulative totals of hits, reading, and posting. As systems develop new opportunities should arise for examination of students' use of learning materials. This information could provide further opportunities for research at the level of individual student behaviour.

Strengths and limitations

This is the first study of which we are aware to directly compare online and blended learning that is not related to a particular clinical skill. The context of the introduction of a choice between purely online and blended routes within the Core Research Methods course enabled us to examine students' choices and progress. One of the limitations of an observational study such as this is the limited control of potentially confounding variables. While these problems can be controlled using a randomised design, it would not be practical or ethical to randomise students to one or other route. Most of the variation in assignment marks between the online and blended groups could not be explained by the variables measured in the study. Although the virtual learning environment routinely recorded data on many user behaviours, there is still much

information that the system could not record validly, such as how long users spent working on the learning resources. The data were collected from two cohorts of postgraduate students attending one postgraduate research methods course at one University using the latest technology, and it may be difficult to generalise specific findings given the contents of our course. However the findings that increases in engagement with the course were associated with increased assignment marks are intuitively plausible.

Conclusions

In a web-based postgraduate research methods course, student attainment can be at least as successful through online discussions as face-to-face seminars. Indeed, students studying purely online appeared to perform slightly better than those following a blended route, although factors other than method of learning account for most of the difference. Increases in online activity were associated with higher assignment marks. Face-to-face seminar students who registered more hits in WebCT achieved higher marks in the assignments. Online discussion students who read more postings achieved higher marks and the highest average mark was obtained by the group who posted most often to the online discussion.

The data collected routinely in virtual learning environments provide opportunities for educational research not possible in face-to-face settings. The relationship that we have demonstrated between student achievement, the use of web-based resources and engagement in on-line activities indicates the importance of designing learning materials that promote interaction between participants. The technologies that enable development

of web-based courses also provide opportunities for educational research. Studies of student behaviour and associated behaviour that would not have been feasible in face-to-face environments are now possible in online education. The potential is to develop an evidence based approach to web-based education.

Acknowledgment

The authors gratefully acknowledge the General Nursing Council Trust whose funding made this study possible.

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Table 1: Characteristics of Core Research Methods students by choice of discussion method

		Discussion method					
		Face-to-face (n = 69)		Online (n = 45)		Overall (n = 114)	
		No.	(%)	No.	(%)	No.	(%)
Cohort	2002-2003	38	(64%)	21	(36%)	59	(100%)
	2003-2004	31	(56%)	24	(44%)	55	(100%)
Gender	Female	49	(58%)	36	(42%)	29	(100%)
	Male	20	(69%)	9	(31%)	85	(100%)
Location	Greater Manchester	42	(62%)	26	(38%)	68	(100%)
	North West	22	(59%)	15	(41%)	37	(100%)
	Other	4	(57%)	3	(43%)	7	(100%)
	Not known	1	(50%)	1	(50%)	2	(100%)
Programme	Clinical Nursing	9	(43%)	12	(57%)	21	(100%)
	Collaboration on Psychosocial Education	36	(75%)	12	(25%)	48	(100%)
	MPhil/PhD	7	(41%)	10	(59%)	17	(100%)
	Nursing Studies	17	(65%)	9	(35%)	26	(100%)
	Other	0	(0%)	2	(100%)	2	(100%)
		Mean	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
Age		38.8	(7.9)	38.1	(9.4)	38.5	(8.5)

Except where indicated, entries are number (percentage) of students within row category.

Table 2: WebCT activity for Core Research Methods students by choice of discussion method

	Discussion method					
	Face-to-face (n = 67)		Online (n = 44)		Overall (n = 111)	
	Median	**(IQR)**	**Median**	**(IQR)**	**Median**	**(IQR)**
Non-discussion hits in WebCT	121	(80-160)	183	(117.25-233.5)	135	(91-189)
Discussion messages read	20	(3-77)	200.5	(101.5-362.5)	53	(7-178)
Discussion messages posted	1	(1-9)	35	(18.25-46)	8	(1-32)
All hits in WebCT [a]	136	(97-242)	438	(306.5-593.25)	240	(111-410)

[a] All hits in WebCT = Non-discussion hits in WebCT + Discussion messages read + Discussion messages posted

Table 3: Assignment marks for Core Research Methods students by choice of discussion method

		Discussion method								
		Face-to-face			Online			Overall		
		No.	Mean	(SD)	No.	Mean	(SD)	No.	Mean	(SD)
Cohort	2002-2003	35	53.3	(12.0)	20	59.8	(8.6)	55	55.6	(11.3)
	2003-2004	28	55.8	(9.7)	21	61.8	(8.9)	49	58.4	(9.8)
Gender	Female	47	54.8	(10.5)	33	60.5	(8.9)	80	57.1	(10.2)
	Male	16	53.3	(12.8)	8	62.0	(8.3)	24	56.2	(12.1)
Location	Greater Manchester	38	55.7	(10.5)	24	61.3	(8.9)	62	58.0	(10.2)
	North West	20	51.3	(12.4)	14	59.1	(9.2)	34	54.5	(11.7)
	Other	4	59.3	(6.9)	2	59.5	(0.7)	6	59.3	(5.4)
	Not known	1	47.0	(-)	1	67.0	(-)	2	57.0	(14.1)
Programme	Clinical Nursing	9	54.6	(8.2)	12	59.3	(8.6)	21	57.2	(8.6)
	Collaboration on Psychosocial Education	32	52.7	(12.1)	10	60.1	(8.8)	42	54.4	(11.8)
	MPhil/PhD	6	58.8	(15.9)	9	67.6	(6.9)	15	64.1	(11.7)
	Nursing Studies	16	56.1	(7.8)	8	56.6	(5.8)	24	56.3	(7.0)
	Other	0	-	-	2	59.5	(17.7)	2	59.5	(17.7)
Overall		63	54.4	(11.0)	41	60.8	(8.7)	104	56.9	(10.6)

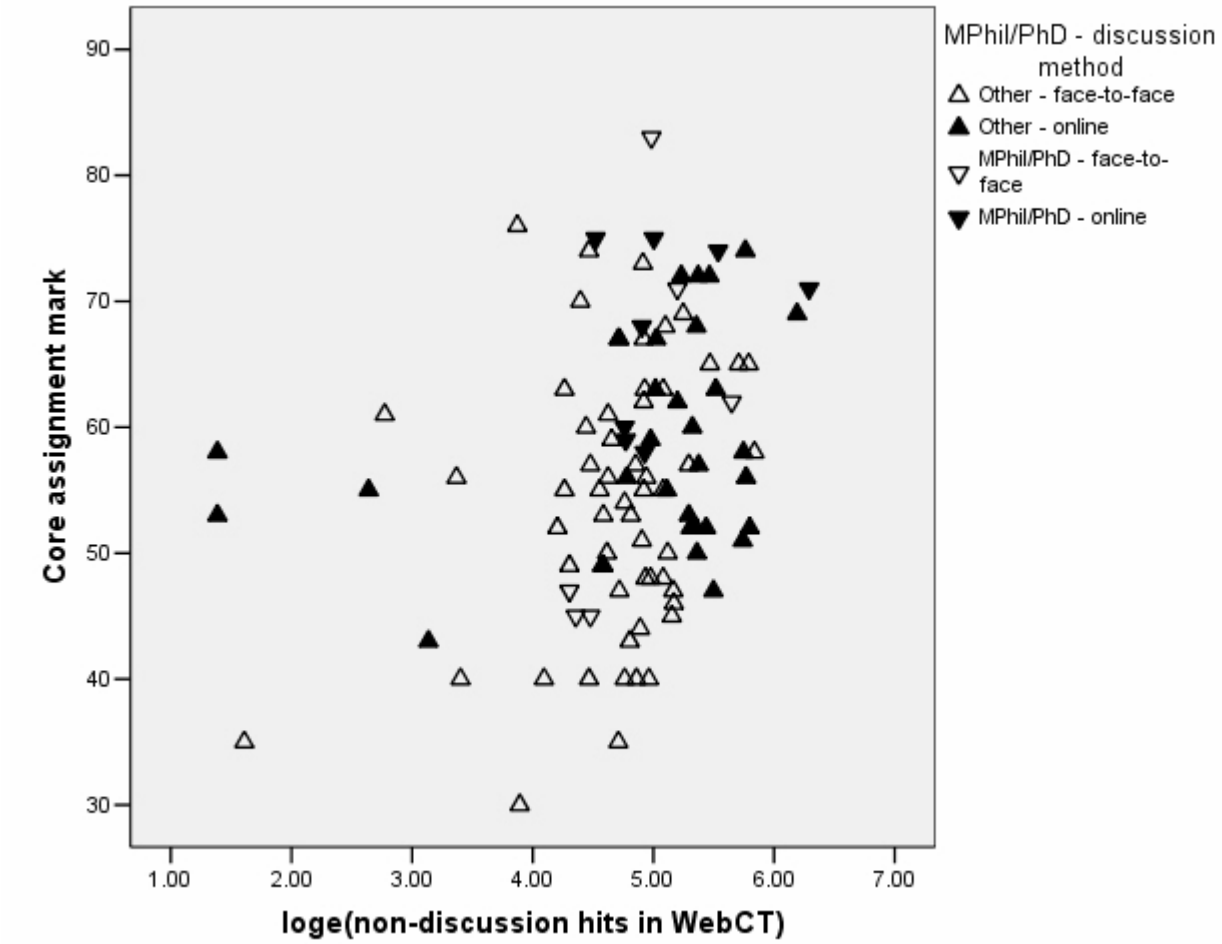
Table 4: Regression models to examine associations with assignment mark for Core Research Methods students

Explanatory variable	Simple regression				Multiple regression (n = 102)		
	No. of students	Coefficient	95% CI	*P*-value	Coefficient	95% CI	*P*-value
Discussion method	104	6.38	2.34 to 10.43	0.002	4.35	-0.99 to 9.68	0.109
Cohort	104	2.71	-1.40 to 6.83	0.194	-	-	-
Gender	104	0.97	-3.94 to 5.88	0.696	-	-	-
Location (Greater Manchester) [a]	102	-2.78	-7.03 to 1.48	0.199	-	-	-
Programme (MPhil/PhD) [b]	104	8.36	2.70 to 14.02	0.004	6.60	0.90 to 12.29	0.024
Age	104	-0.14	-0.38 to 0.10	0.259	-	-	-
$\log_e$ (non-discussion hits)	102	1.19	1.22 to 5.95	0.003	2.839	0.07 to 5.61	0.045
$\log_e$ (online messages read)	103	1.14	0.12 to 2.16	0.029	-0.53	-1.89 to 0.84	0.445
$\log_e$ (online messages posted)	103	2.36	0.97 to 3.75	0.001	0.79	-1.50 to 3.09	0.495

[a] Dummy variable for living in Greater Manchester: 0 = No, 1 = Yes; in a preliminary model comparing Greater Manchester, North West region and other, none of the coefficients were significant

[b] Dummy variable for MPhil/PhD programme: 0 = No, 1 = Yes; in a preliminary model comparing COPE (reference category), Clinical Nursing, MPhil/PhD, Nursing Studies and Other, only the coefficient for MPhil/PhD turned out to be significant ($p = 0.002$)

Figure 1: Plot of assignment mark by logarithm of non-discussion hits in WebCT for Core Research Methods students



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Response to reviewers

Online v face-to-face discussion in a web-based Research Methods course for postgraduate nursing students

Dear Ian,

Here are our responses to the reviewers' comments, bearing in mind your advice to pay particular attention to Reviewer 5. Comments from the reviewers are shown in italics.

Best wishes,
Malcolm Campbell
(on behalf of the other authors)

Reviewer 1

Reviewer #1: As more institutions in the UK are using virtual learning environment to replace or supplement face to face teaching research into the impact on students is of increasing importance. An examination of the use of networked communication tools to replace or support face to face seminars would be of interest to nursing and midwifery educators.

In order to make this study suitable for publication it would be necessary to fully develop your literature search and demonstrate how this paper adds to what is already known.

Reviewer 5 asked for the literature review to be shortened (please see that reviewer's comment 2), and we have done so.

The design of the study may not be robust enough to support the conclusions that were reached. Discussion of the characteristics of the online and face to face group need to be extended. How did the assessment relate to the discussion?

The study design (a two-group non-randomised trial) was necessarily observational in that students were freely able to choose whether to supplement their online learning with either face-to-face seminars or online discussions with course tutors. We recognised that our conclusions would be tentative, given the unique nature of the course, the intake of students and the academic and support staff at our School.

Table 1 compares available characteristics of students opting for face-to-face or online discussions, and the table is interpreted in the **Results** section.

It would be of more interest to know how they developed their discussions in the two settings. Is the quality of interaction better and why?

It may be advisable to get some advice on the use of statistics in this context.

This would be outside the scope of this paper, as it would require a detailed qualitative analysis of tape-recorded face-to-face sessions and messages sent to discussion board topics, which we have already done in a separate qualitative paper, now referenced within the paper (page 21): Gibson, W., Hall, A., Callery, P., 2006. Topicality and the structure of interactive talk in face-to-face seminar discussions: implications for research in distributed learning media. British Educational Research Journal 32 (1), 77 - 94.

Reviewer 3

Reviewer #3: This is a timely paper with the use of virtual learning environments are providing exciting opportunities for education. The paper is clearly structured and identifies interesting areas for discussion.

No action required.

Reviewer 4

Reviewer #4: The effectiveness of on-line instruction needs to be demonstrated, as it is a mode of increasing popularity. As you point out there are considerable variables that influence the outcomes of this method of instruction. Your research has provided evidence for similar outcomes in your study design. Questions remain however. What are the reasons individuals choose a particular format? If not given a choice, will an instruction mode less preferred by a student, unfairly limit her opportunities for success in a course? Does familiarity / experience with on-line course modes impact on an individual's selection of the Web-based option? Given the small numbers in the chohorts of your study, your results cannot be definitive, but encouragement for further research with a larger number of subjects and more characteristics of the same. A revised manuscript would address these variables and describe in more detail future studies.

All students were made aware that the teaching materials for the Core Research Methods course would be accessed online. Students were given a free choice in the method they preferred for discussions (face-to-face or online), but we did not ask students why they chose a particular method. This was their first exposure to research methods in an intensive introductory course, and it was also their first experience of online teaching and learning, as it was ours.

Reviewer 5

Reviewer #5: At the request of the Editor I have reviewed this paper with the benefit of having seen previous reviews, which provide contradictory recommendations. My judgement is that this is an interesting and timely paper, overall, with thoughtful and pragmatic methods. It is worth publishing but with major revisions to help clarity, make it briefer and bring its conclusions more to the point.

We found the comments of this reviewer incredibly helpful, and they allowed us to revise the paper with much better focus on the main comparison of interest in the study: whether there were differences in performance between students on our Research Methods Core course unit participating in online discussion seminars and those participating in face-to-face discussion seminars, and factors that were associated with performance.

1. Title: The title is misleading because comparing online and face-to-face learning infers a comparison between a web- and a classroom-based course. The title should reflect the paper's aim, which is to compare the effect of on-line vs. face-to-face seminars offered as an adjunct to a web-based course. Also, the fact that it is a research methods course is not as relevant as the sample is, so the title should also include postgraduate nursing?(healthcare) students. In sum, a suggested more accurate and clearer title could be "Online vs. face-to-face discussion as an adjunct to a web-based course for post-graduate nursing students." or "Online vs. blended learning for qualified nurses: comparisons and predictors of student retention and performance."

This was a very good point – we have changed the title accordingly to "Online v face-to-face discussion in a web-based Research Methods course for postgraduate nursing students". We prefer this to using a word such as "adjunct", because it makes it clearer that the discussions were integrated into and formed a central part of the course.

2. Background: It is rather long-winded and needs to clarify terms such as "asynchronous" vs. "synchronous" communication, "distributed learning", "interactive modelling" etc. for readers who are not familiar with internet/web-based delivery.

The literature review has been shortened and terminology has been clarified as requested (pages 5, 6 and 7). The terminology has been standardised, so that the course is referred to as "web-based", while the term "online" is used to refer to activities conducted online and to distinguish between face to face and online discussion groups.

3. "Effectiveness" to be replaced with the words such as "value" or "effect" or "outcome".

The word "effectiveness" has been appropriately replaced by "effect" at the end of the **Introduction** (page 7, last paragraph) and start of the **Methods** section (page 8, paragraph 3).

4. Objectives: The paper should re-focus its objective in line with the fact that it studies a very important aspect of "blended learning", i.e. whether adding face-to-face seminars to a web-based course has a better educational outcome than having an exclusive online delivery where the seminars, in addition to the teaching materials, are also online in the form of asynchronous discussions.

Again, this is very apposite. The objectives have been rewritten in this form in the **Abstract**, at the end of the **Introduction** (page 7, paragraph 3; page 8, paragraph 1)and formally at the start of the **Methods** section (page 8, paragraph 3).

5. Research aims: the authors should provide a clear outline of all educational outcomes studied (and which one was the primary one) and all the predictors used in the regression models (as it is, they only refer to "online activity"); also need to clarify a this point how they measured online activity.

The educational outcomes have been clarified in the **Methods** section in an "Outcome measures" paragraph (page 9, paragraph 2). Assignment mark was the primary measure; completion and pass/fail were secondary measures, but very few students failed to complete or failed to pass, reducing the usefulness of these measures.

All the predictors used in regression are listed in the "Data analysis" subsection (page 13, paragraphs 2-3) and are also shown in Table 4.

The measures of online activity within WebCT have been clarified in the "Data collection" paragraph (page 11, paragraph 3 - page 12, paragraph 1).

6. Design: need to explain a bit more about the design: why it is an observational and not a cohort study? what do they mean by "naturally occurring experiment"? (e.g. what specific conditions were left uncontrolled for it to be natural experiment and not a true one, etc.).

The study design may be described as a cohort study, participants being followed from entry onto the Core Research Methods course unit until their course assignments, but we feel it is better defined as a non-randomised or quasi-experimental) design. It is not a true experiment because the students were free to choose their "intervention", whether to participate in face-to-face discussions or online discussions when reviewing course material. We have edited the **Abstract** and **Methods** section (page 9, paragraph 1) accordingly.

7. Sample: It is more the background of students rather than the course we are interested in. The authors should clarify the following: were all the students nurses? were they all qualified? were there any other healthcare professionals? how long was the course? were the students full or part-time? how long were the face-to-face discussions over what period of time? did a tutor participate in the asynchronous discussions along with the students? did the students access the web-based materials and online discussions individually or in groups? from home or in a public access workstation at the university?

Details of the programmes of study and the student body have been given in page 10, paragraph 1. The majority of students were UK-based, almost all would have been qualified nurses, and the vast majority were studying part-time, attempting to juggle an intensive postgraduate course with full-time nursing duties.

Details of the methods of student access and discussions have been added to the **Methods** section. Students were expected to access 10 weeks of course material individually from wherever they wished (this could not be measured and a student could access the course from more than one location, though from an analysis of

server logs we can ascertain that 64% of all staff and student usage took place away from the University) but discuss each week's material with two tutors (one qualitative, one quantitative), either in a face-to-face seminar on a Monday or on the discussion board during the course of the week.

8. How student performance was assessed is important because it is the basis for the study's outcome: it should be transposed under "data collection" and clarify: what was the essay about? what was the pass/fail cut-off point? how was it marked (by whom, how may markers, blind to each other, etc)? how was it submitted? (online or on paper?) did the overall mark come from the essay only, or was aggregated with the portfolio? if the portfolio was taken into consideration, then provide the same information as for the essay, otherwise omit.

The requested details on the assignment have been added in a new paragraph in the **Methods** section headed "Outcome measures". The essay was a formal research proposal in an area of the student's choice, submitted on paper, and marked by two course leaders blind to each other's marking. The portfolio was not marked – it was only taken to be "proof of attendance" – and as it did not contribute to the main outcome measure (assignment mark), the portfolio has been omitted from the paper, as suggested.

9. Presenting the student sample under the two yearly intakes is confusing (because the paper does not compare these two groups); it should be considered in the same way as gender, location and programme of study. Therefore, tables 1, 2 & 3 should be re-done for the overall sample (not split into years) with table one including rows for years 02-3 and 03-4 as one of the sample characteristics. In the text, all comparisons between years should be phrased in the same way as for gender, location and programme of study.

Yearly intake has now been treated as the other explanatory variables. As suggested, Tables 1, 2 and 3 have been changed to display results with the two cohorts pooled.

10. The presentation of results under "retention" is confusing; do the authors study drop-out rates or pass/fail rates? If there were no significant differences between the two discussion methods (on any outcome measure), then there should not be any reference to differences between the two discussion groups based on numbers only rather than p or CI values.

Drop-out and pass/fail were not considered to be primary outcomes for the study, although they are naturally important to the student, and for the course as a whole to demonstrate that the course did not have pedagogical problems. We expected relatively few students to drop out or fail, but felt it important to say that most students did indeed get through successfully. We have re-written the "Retention" paragraph in the **Results** section to state the numbers and percentages for the Core course more clearly (now that the optional modules have been omitted). We feel that these demonstrated that the course "worked" as a teaching and learning unit, since the vast majority of students demonstrated an awareness and understanding of research

methods in their assignments. Regarding the reporting of non-statistically significant results, it is important to be even-handed in reporting significant and non-significant findings to give the full picture and avoid selecting reporting (eg Lang and Secic, 1977, p 73). There were minor differences in both drop-out and pass rates between face-to-face students and online students, and it was important to determine whether there was evidence that these differences were real or due to chance.

Lang T.A. and Secic M. (1997). *How to Report Statistics in Medicine*. American College of Physicians, Philadelphia.

11. Tables 1, 2, 3 and 4 should demonstrate how online and blended learning groups compared (therefore, "online" and "face-to-face" should appear as columns); since the non-core modules had little bearing in the outcome of the study, should either be omitted from the tables or grouped under one category (e.g. optional modules).

Tables 1, 2 and 3 have been changed to compare "online" and "face-to-face" students and data for the non-Core modules have been omitted from the tables, as suggested. Findings for and comments on the non-Core modules have also been taken out of the **Results** section.

12. Table 5 should include all factors considered in the regression model, not only the online activity, and all the outcome measures (retention, pass rates, etc) and not only assignment mark.

Table 4 has been extended to show simple regression results for all available explanatory factors potentially associated with the primary outcome variable assignment mark. Inclusion of other outcome variables would require additional simple and multiple regression models. We did not consider attempting to fit logistic regression models to predict whether a student completed the course or whether a student passed or failed. Out of the 104 students sitting the course over the two years, too few students either failed to complete (7) or failed to pass (6). Peduzzi *et al* (1996) suggest having 10 subjects per explanatory variable per outcome category.

Peduzzi P., Concato J., Kemper E., Holford T.R. and Feinstein A.R. (1996). A simulation study of the number of events per variable in logistic regression analysis. *J Clin Epidemiol*, **49** (12), 1373-1379.

13. The conclusion needs to be more succinct about which factors predict which outcomes in online and in blended learning, and recommend specific further research on the subject e.g. by randomly allocating students to planned vs. ad-hoc online discussions, or having students in a classroom with computer terminals vs. home-access etc.

The conclusion has been edited to present a more succinct summary of the factors that predict outcomes. Research opportunities in online education are discussed.

Online v face-to-face discussion in a web-based Research Methods course for postgraduate nursing students

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