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Interactivity in professional online learning: A review of research based studies

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Over the last few years, the higher education and the vocational education and training sectors have increased the number of online learning courses available for professionals. Yet, research on e-learning opportunities for professionals has not developed at the same pace. This paper describes the results of a systematic search for research based, empirical studies on professional online learning that examined interactivity and other forms of social learning. Based on four selection criteria (online learning course, professionals, interactivity and research study), the search yielded 18 articles. These were examined first in relation to the characteristics and context of the professional online courses under scrutiny, and second in relation to four levels of interactivity focus in the research. The highest level represents studies where the interactivity was planned, supported and implemented successfully, and the lowest level studies where minimal opportunities for interactivity were available. Overall, although some studies were of a high academic and educational quality, there was little evidence of pedagogical innovations that would give this field of educational research and practice a clear direction for the future.

Introduction

Online learning courses for professionals have increased steadily in recent years, with many organisations now offering technology mediated learning opportunities for their employees (Nocente & Kanuka, 2002; Hanson & Clem, 2006; Thomson Corporation, 2004). This development is common in Anglo Saxon countries like the US, Canada, the UK and Australia (Schmeeckle, 2003; Atack, 2003; Brosnan & Burgess, 2003; Freeman & Bamford, 2004) and is also growing in Europe (Conole, Hall & Smith, 2002) and Asian countries (Kaur & Ahmed, 2006). Given the provision of total flexibility for continuous learning, in terms of access, time and place, e-learning opportunities for professionals are anticipated to be successful. In theory, professional online courses are expected to allow people to engage in further learning relevant to their profession, while managing their other work and personal commitments. Yet, some research suggests the opposite, reporting high attrition rates (Frith & Kee, 2003) and sometimes completion rates reaching only 25% (Rossett & Schafer, 2003).

The higher education and the vocational education and training sectors have been particularly keen to respond to this new, professional market, perhaps because they have also been under increased pressure to become more industry and customer focused. Many professional associations and large organisations have also embraced the challenge and embarked on the development of professional courses that address the need for continuous updating of specific knowledge and skills. Across providers, there are widespread expectations that professionals will adopt e-learning with enthusiasm and be successful in this new learning environment. According to Bonk and Graham (2006), educators and professional learners alike have discovered the advantage of combining classroom and workplace environments in a form of blended learning. Yet, while a blended or embedded approach to professional learning has the potential to address the issue of relevance of what is learnt, relevance can still be perceived in different ways by the learners themselves, as documented in Maor and Volet's research (2007). Also highlighted in their research are the many challenges and barriers that may emerge at the intersection of work, home and study environments. Their review of the literature highlights that corporations (Berge, 2002) and tertiary institutions (Smith, 2003) alike seem to be lacking experience and maturity in their conceptualisation of online courses for professionals.

Among the most salient weaknesses reported in the literature were unclear learning objectives, lack of awareness and thus lack of accommodation of the nature of professional work and needs, insufficient instructional support and poor conceptualisation of learning opportunities in terms of fostering productive interactions between learners and providers. More generally, a lack of theoretical understanding of fundamental principles of learning relevant to professional online learning, in particular the value of a social constructivist approach was apparent. The range of barriers experienced by professionals in online learning and the apparent paucity of theoretically based research on professional online learning have stressed the need for undertaking a closer examination of existing research on the topic. Furthermore, while the application of social constructivist models to the design of technologically enhanced learning environments is gaining momentum and attracting a substantial amount of research into traditional university student populations, little is known about the extent to which professional online learning is also part of this trend. The intention of this article is therefore to address this gap in knowledge. It reports the process and outcomes of a systematic review of research studies on professional online learning that paid particular attention to elements of interactivity. Interactivity was essential in our search because it is well established in the online learning literature (Saba, 2000; Palloff & Pratt, 1999) that interactions between peers and between teacher and learners during an online course are critical factors towards successful outcomes and quality of online learning.

Professional online learning is no doubt a worthy topic for research and a whole series of questions may be asked about the characteristics of the courses under study as well as the nature of the research that was carried out. Six questions are addressed in the present paper:

- Which groups of professionals are targeted for online learning courses, which types of organisations are offering such courses, and who is undertaking the research?
- What is the evidence of collaboration between industry-based e-learning providers and university researchers in studies on professional online learning?
- What online technology is typically used in professional online learning and what type of learning content is targeted?
- To what extent has research on professional online learning examined how to foster interactivity and the creation of communities of learners?
- What main research questions have been addressed in regard to interactivity and what are the critical findings?
- What is the theoretical underpinning of research examining interactivity and what research methods have been used?

The paper is divided into three parts. The first part reports our systematic search for recent research studies on professional online learning through major databases and academic journals, using four criteria. Each article had to be the report of a *Research study* on an *Online learning course,* where participants were *Professionals,* and where there was an element of *Interactivity* in the design of the instructional approach. The second part examines the characteristics of the professional online learning course reported in the 18 articles that met the four criteria for retention. Finally, the third part concentrates on the research aspects of each article. It presents our analysis of the extent to which the selected research studies had investigated issues of interactivity and the creation of communities of learners. The final conclusion highlights the small number of theory based empirical studies in the field. It points out that most of the empirical work on professional online learning reflects trial and error approaches with limited direction to guide instructional design, implementation, and future research.

Literature search for research studies on professional online learning

The aim of this search was to examine the nature and scope of recent research studies on professional online learning, selecting only those articles where the instructional design included an element of

interactivity. The search was limited to articles published in an English language academic journal between 2000 and 2005.

Criteria for conducting the search

The four criteria selected for the search were aimed at maintaining a close focus on the chosen target group (professionals), mode of study (online) and specific instructional approach (interactivity). The research based criterion (research) was necessary in order to discard descriptive accounts of course development with no research component.

1. *Research study.* The article had to report an empirical investigation. Although non-empirical studies and literature reviews could be research oriented, these were not retained in the selection of articles for analysis. Articles that simply described how an online course was developed were also discarded, even those that added a few quotes on how participants evaluated the experience. In other words, articles that were retained had reported at least a research aim and an indication of how the data had been collected. Whether or not the research had a theoretical basis was not used as a selection criterion.
2. *Online learning course.* The research reported in the selected articles had to relate to a contained course, unit or module of study to be completed within a given timeframe. Providers of such courses could be educational institutions but not exclusively so, reflecting the importance that employers and professional associations give to continuous professional learning. Articles reporting research on professional forums on the Internet and discussion websites for professionals, sometimes with cases to be discussed among professionals, were not retained.
3. *Professionals.* The term 'professionals' was defined as people who had completed their initial professional or vocational education. They would be typically working and undertaking further learning at the same time in a specific course, which could be aimed at re-training or upgrading professional knowledge and skills.
4. *Interactivity.* As discussed earlier, learning interactions online are important regardless of whether the course is offered fully online (Hendriks & Maor, 2004) or in a blended learning format (Rovai & Jordan, 2004).

These criteria were used in combination for all searches through databases. We started with only two notions, *professional* and *online learning* (used jointly), in order to gauge the magnitude of material related to online learning courses for professionals in the literature. As expected, this generated thousands of hits, typically material describing course development and anecdotal evidence of success. The search was narrowed by including the notion of *interactivity.* Finally, the material generated was closely examined to establish the extent to which the article reported *research* on online learning processes and outcomes. Each notion led to the generation of a range of keywords that were used in various combinations depending on which database was searched.

Every effort was made to clarify what would be evidence that the criteria were met. On a number of occasions, the researchers had to discuss whether or not the information available in an article was sufficient to warrant inclusion. Using professional judgment for making a decision has its own limitations, but it was consistent with the exploratory nature of research. In this particular case, professional judgment involved the achievement of consensus between three researchers. Reliance on multiple perspectives to add rigour to an inquiry is treated by Denzin and Lincoln, (2000, p. 5) as an alternative to validation.

Literature search process

We started our search by focusing on educational literature databases, such as the ERIC database, *PsychINFO* and *PsychARTICLES.* To ensure that all papers from relevant journals were considered, we began with databases, such as the digital library of the Association for the Advancement of Computing in Education (AACE) and the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) proceedings, followed by vocational education databases, such as the one produced by the Australian National Centre for Vocational Education Research (NCVER), and finally checked some specialised journals. A detailed description of the search process can be found in Table 1. Column 1 lists the databases that

were searched; column 2 presents the keywords that were used; column 3 specifies the criteria against which the articles were checked; and columns 4 and 5 present the results.

It should be noted that the process always comprised an initial computer search followed by researchers' double checking process through independent careful reading of all abstracts and often full articles. This means that many articles initially identified against keywords through computer searches were discarded later by the researchers if they did not fully meet the criteria. Furthermore, while the three criteria (*professionals, online learning, interactivity*) could relatively easily be explored with keywords, this was not the case for *research study.* Therefore each article selected on the basis of the first three criteria, was subsequently examined by the researchers, in order to determine whether or not it met the selection criteria for *research study.* The final decision was made through discussion and consensus.

Table 1: The search process

Search	Search process: Keywords and criteria	1st round search	2nd round elimination	Search
ERIC Database	1st search	Checked against four criteria	5 found	2 accepted
	2nd search	Checked against four criteria	6 found	2 accepted
AACE	1st search	Checked against four criteria	7 found	3 accepted
NCVER	1st search	Checked against four criteria	0 found	
PsychARTICLES PschINFO	1st search	Checked against four criteria	0 found	
ASCILITE	Conference paper titles and abstracts were searched against four criteria		2 found	2 accepted
Individual journal search	A total of 56 journals were searched, with a focus on communication, education, pedagogy, technology as well as specific professions.	Where journal sites provided search engines, a keyword search was conducted using a combination of the same keywords used in the database searches. Articles were then checked against the criteria.	18 articles found out of 10 journals	10 articles accepted from 7 journals

From the ERIC search the focus of the articles that emerged included design guidelines for online courses, needs assessment surveys and reports, technology training issues, descriptions of experiences learned from online training, analysis of benefits, challenges or barriers to online learning, and advice for choosing courses. Relying on ERIC database may have brought limited results but as a recent note of caution suggests the "path towards this form of recognition may be quite lengthy" (Atkinson & McLoughlin, 2005, p. 1). In addition, there were many non-relevant articles; therefore we had to conduct a more selective search.

The results from the second keyword search were then checked using the following criteria: whether the paper described an online training course for professionals, whether that course included some element of interactivity, and whether the paper reported a research study related to participants' learning in that course. To our surprise only four ERIC articles met this combination of criteria. Many were not retained because they did not include an empirical work. Some articles, although research focused, either did not target professional learning through the medium of an online course or they did not meet the criterion of interactivity. To help overcome any deficiencies in the ERIC search, *Google Scholar* was also consulted. The same procedure described above was used to search the AACE digital library.

The limited results obtained from the two large general education databases led to a search through a large, more specific vocational-oriented database. The National Centre for Vocational Education Research (NCVER) is Australia's main provider of Vocational Education and Training (VET) research and statistics, and well known internationally for its comprehensiveness. Twenty articles were initially selected but none met all four selection criteria. We further searched the NCVER database for alternative theme headings under, for example, careers and pathways, group training, teaching and learning, delivery and work changes; however, we had limited success. In the end, the NCVER database yielded no research articles that met all the selection criteria.

Overall, our search through the PsychARTICLES and PsychINFO databases did not yield any article that met the four criteria. Although these databases comprise a large number of research articles (Research study) related to computer mediated (Online learning course), collaborative learning (Interactivity), none of them also met the criteria related to the *specific* group of learners (Professionals).

Finally, we complemented our search through databases by a close examination of several individual academic journals, for example, the *Journal of Workplace Learning,* the *Journal of Continuing Education in the Health Professions, Learning and Instruction* and *Distance Education* among others. These were chosen because relevant studies had been published in these journals, or they were recommended by colleagues working in the field, or and they were known to us and our academic network. A total of 35 articles was eventually retained for close reading, and ultimately reduced to 18. On the basis of this comprehensive search through thousands of articles, we came to the conclusion that while the development of computer mediated training courses for professionals seems popular and on the increase, research in this area still appears limited. Furthermore, while a substantial proportion of the literature on computer mediated learning in formal educational contexts (schools, universities) is now dedicated to investigating the educational value of interactivity and various forms of social learning activities, this is not yet the case in the field of professional learning. The literature related to professional online learning appears still dominated by descriptive reports of the development of courses and anecdotal evidence of their success.

The 18 articles that met all four selection criteria in the final round are now examined, first in regard to the characteristics and context of the professional online learning courses, and second in regard to the research focus of the empirical work.

Characteristics and context of professional online learning courses

As we searched the literature, we were hoping to find some good examples of genuine collaboration between universities and industry or organisations that were interested in continuing education for their employees. We were also hoping to find some creative research related to professional online learning. With a few exceptions, these articles did not fulfil our expectations. An overview of the characteristics of the professional online learning courses reported in the 18 articles is presented in Table 2. Reading across the table, the reader can identify the professional group, the online technology and the content of the course. The analysis of the characteristics and context of the professional online learning courses reported in the 18 articles aims to address the first three questions presented in the introduction.

Overview of the online learning courses offered to four groups of professionals

As documented in the table, half of the professional online learning courses reported in the selected articles were aimed at health professionals (Articles 1 to 9), most often in continuing medical or health education. This involved physicians, nurses and other health care professionals. Four studies (Articles 10-13) were conducted in the field of business, and another three (Articles 14-16) in the field of educational technology. One online learning course (Article 17) targeted the police force and another one (Article 18) law enforcement personnel. The characteristics and context of the courses offered to each the four professional groups will be examined in turn.

Table 2: Characteristics of professional online learning courses described in the 18 journal articles

Publication	Professional group	Online technology	Course content

Health professions			
1. Brosnan & Burgess (2003)	16 health and social care services registration and inspection staff.	Asynchronous discussions, *WebCT.*	Health, education, and social care services.
2. Liaw et al (2002)	112 medical professionals, including clinicians, GPs and selected experts using Health Communication Network.	Internet based program; *TopClass* and email.	Complex clinical cases in medicine.
3. Honey et al (2004)	21 postgraduate nurses enrolled for Clinical Scholarship.	On campus and online component, web based environment developed in house.	Contemporary nursing knowledge.
4. Conole et al (2002)	20 medical practitioners across Europe supported by 5 tutors and 1 project manager, 7 withdrew.	Online resources: CD, website. Synchronous and asynchronous communication.	Best practice in Neonatal medicine.
5. Atack (2003)	57 registered hospital and community nurses.	Online discussion forum, email and CD.	Knowledge of case management, communication and supervisory skills.
6. Atack & Rankin (2002)	57 registered hospital and community nurses	Asynchronous discussions and CD.	Health care relationship.
7. Curran et al, (2000)	52 physicians; 30 volunteers in experimental group. 22 in control group.	Hybrid delivery system: Web and CD technologies.	Continuing Medical Education; dermatology.
8. Curran et al (2003)	Family physicians/ general practitioners, from urban and rural areas. Number unknown.	Web portal, *WebCT,* multimedia and online resources.	Management of whiplash, back injuries and Telehealth.
9. Sargeant et al (2004)	35 family physicians for phase 1, 8 interviews.	Asynchronous discussions and multimedia programs.	General medicine
Business			
10. Freeman & Bamford (2004)	2438 business professionals working full time with workplace mentor. Not all used the online chat.	Blend of print learning resources, online chat and asynchronous threaded discussion forums.	Unclear
11. Thompson (2004)	2 learner instructors, 1 business leader, 1 project manager interviewed. Total number unknown.	Virtual synchronous classroom.	Unclear
12. Bird (2001)	University students from diverse cultural backgrounds. Total number unknown.	*WebCT,* asynchronous bulletin board and face to face.	Management by work based learning
13. Slotte & Tynjälä (2005)	12 Finnish and 5 Chinese HRD practitioners, multi-national company.	Synchronous web-based tools.	Adult education, human resource development.
Educational technology			
14. Orey et al (2003)	10 participants, only 3 included in this research: 1 housewife, 1	Live virtual classroom, coaches, chat and bulletin	Online self paced technical training

	mechanic, 1 plumber.	board.	program; competency based.
15. McConnel (2002)	Professional trainers, adult continuing educators, teachers, developers, number unknown.	*WebCT*	E-learning theory and application of networked learning.
16. Rovai, (2001)	20 college graduates in education; mixed K-12, postsecondary and corporate trainers. USA and other countries.	*Blackboard* e-learning system, asynchronous collaborative tools, discussion board.	Online teaching course; exploring tools to create virtual learning environments.
Police, law enforcement			
17. de Laat et al (2000)	8 police officers; policy makers and criminal investigators.	*Web Knowledge Forum.*	Work processes used in criminal investigation.
18. Schmeeckle, (2003)	101 jail management trainees, using computers at work.	Online and multimedia.	Jail management training

Online learning courses for health professionals
The relatively high proportion of online learning courses for health professionals may suggest that continuous knowledge updating is critical in this particular field of practice. In light of the interactivity criterion, this may also suggest that a key feature of continuing medical and health education is to encourage practitioners to share their experience and learn from each other. Alternatively, and in light of the fact that any missing criteria in our search would exclude an article, this may indicate that continuing education in the health professions has attracted more research than other fields. This finding appears consistent with the substantial body of research based studies on professional development in medical and health related fields in the literature, and possibly the fact that many health practitioners are required by professional boards to engage in structured forms of continuing education in order to maintain their registration.

In our review, health related faculties of universities emerged as the main providers of e-learning courses for health professionals and in most instances they also conducted the research. There were three instances (studies 1, 3, 4) of collaboration between experts from the health profession and experts in educational research, but both groups were from the university sector. In four studies (2, 7, 8, 9) the educational specialists were from the health professional education sector within the hospital.

In regard to the use of technology, column 3 shows that the most frequently mentioned interactive e-learning tools were asynchronous web forum discussions. Six of the nine studies also reported the use of CDs or multimedia in order to present case studies or to demonstrate complex content knowledge. These findings highlight that technology was not used optimally to promote interactivity in the learning process. Only one study (study 4) combined asynchronous and synchronous discussions and two other implemented a form of blended learning that combined on campus and online components. The type of content knowledge fostered in these online courses for health professionals (column 4), varied widely, ranging from quality management of health care services, complex clinical cases, contemporary nursing knowledge, health care relationships, cultural differences in medicine, best practice in neonatal medicine and Telehealth.

Online learning courses for business professionals
The second largest group contains four studies in the area of business and finance. One article reported a study with over two thousands participants involved in professional development. However, it was not clear how many of them participated in the online forum that formed the basis of the research. In contrast, the smallest study had only 6 individuals. The 4 studies represented four different countries, namely Australia, the UK, Finland and Canada, and as in the health profession, the e-learning providers and the research groups were from the same university, with one exception. The Finnish study had minimal collaboration by involving university tutors who facilitated the discussion throughout the course and the company supplied three tutors in the workplace, while the Canadian study involved a joint venture between a multi-national

consulting firm responsible for the development and implementation of the e-learning course and a university in charge of conducting the research. These studies were two examples of collaboration between industry and higher education in the business profession to promote professional online learning.

Interestingly, and unlike the studies with health professionals, the technology (column 3) in three of the four studies involved some synchronous discussions. The last study involved blended learning with a combination of asynchronous discussion and face to face meetings. The greater use of synchronous technology in the business professional development courses, in comparison to the health professional development courses, may suggest that real time interactive technologies are more typical of the business world, although caution should be exercised in generalising from these findings, given the very small number of studies selected for this analysis. Only three of the four studies specified the type of content knowledge introduced in the online courses (column 4), and most seemed to focus on workplace learning.

Online learning courses for educational technology professionals
The third group comprises three studies aimed at educational technology professionals working in a range of work or community settings. Two studies (a UK one and a US one) combined e-learning providers and researcher groups in an attempt to promote teacher use of technology. The US e-learning provider had attracted participants from several sectors of education and even some international participants. In contrast, the second US e-learning provider was industry based and had teamed with a university for the research component of the project.

Diverse technologies (column 3) were used, including live virtual classrooms, coaches' chats, bulletin boards, as well as the use of *WebCT, Blackboard* and asynchronous collaborative tools. The variety of technologies may reflect the fact that these e-learning providers had an education background and were experimenting with interactive technologies. This is supported by information on the content of the courses (column 4), which addressed issues related to online learning itself, for example, self-paced technical training program, e-learning theory, application of networked learning, as well as the exploration of various tools for creating virtual classroom environments.

Online learning courses for police and law enforcement professionals
The last group comprises two studies with police and law enforcement personnel. In both cases the e-learning provider was industry based. The first online learning course, designed for policy officers, policy makers and criminal investigators was offered by the Education Centre of the Dutch Police Force in collaboration with education researchers from the University of Nijmegen, who provided the research component. The second course designed for jail management trainees was offered by the Law Enforcement Training Centre in Canada. It is unclear from the paper who conducted the research.

The technology used by these industry based e-learning providers included web knowledge forums and online discussions. The content of these courses addressed, respectively, fields of criminal investigation and jail management.

Key features of professional online learning courses

Looking across groups and studies, a few patterns emerged. First, only two studies (2, 8) reported a joint effort between industry and university to design and implement a professional online learning course. In three other studies (11, 14, 17), there was collaboration between an industry based e-learning provider and a university group, the latter only involved in the research component. In one study (13) the industry provided three tutors, and in another study (18) there was no university involvement. Both e-learning providers and researchers were from the university sector, often from the same faculty.

Since the majority of the studies with health professionals were from Canada, one possible interpretation is that professional, health related education in that country is not only active but mainly university based, which would explain the fact that the e-learning provider and researcher group tended to be confounded. In contrast, the two police and law enforcement studies were both industry based, with in one case a university serving as a research consultant and the other no university involvement. Other forms of collaboration emerged within university contexts, with in 7 cases evidence of a joint effort between a professional faculty being the e-learning provider and a research centre or educational institute taking

responsibility for the research.

Second, we found little evidence of attempts to offer professional online learning courses to international participants. All studies except three (studies 4, 13, 16) catered for professional groups located locally or nationally. This suggests that even though technology enables a globalisation of professional education, courses are still designed for local participants. It is reasonable to assume that obtaining formal accreditation by a local university and/or a professional education board or college from within the local professional industry, plays a critical role in the selection of courses.

Third, and not mentioned in Table 2, is the issue of degree of relevance of professional online learning courses to the daily practice of individuals. Looking at the course content across studies one can notice that the majority of courses tended to aim at the development of general knowledge and skills, with limited opportunities for participants to use their specific work environment and experience as a resource in their study or vice versa. In addition to the health related studies only three studies (13, 17, 18) point to a relationship between the content of the course and participants' current work environments. The Finnish study with business human resource development practitioners working in a large multi-national company provides a good example of a university course designed to address real life, work based issues faced by professionals in their daily practice.

The fourth aspect concerns the issue of the degree of support provided by the work environment to assist employees to engage in professional online study. A close examination of the nine courses for health professionals suggests that participants were generally given some time to work on the course during work hours. Nurses in particular appeared to have access to web based learning facilities in the work context. However, in one particular study (6) where access was investigated, it was found that in practice, only eight per cent of the nurses accessed the course from work only, 26 percent from home and work and 67 percent from home only. Similarly, in the continuing medical education course, the majority of participants indicated that they accessed the course from home. This stresses the challenges faced by workplace learners who experience not only lack of time but also lack of support in the work context. Addressing this issue in the work context may bring significant benefits, because, as argued by Brosnan and Burgess (2003, p.27), professional online learning courses are expected to generate considerable social energy, 'in part due to the diverse mix of professionals involved and their willingness to share and examine their broader professional concerns with the rest of the participants'. Despite limited time to work on courses at work, there was evidence that health professionals tended to experience supportive work environments where they felt encouraged to share their knowledge.

The studies with business professionals showed diverse levels of support from the work environment. In one study (10), learners had a workplace mentor who collaborated with part time academics from the same organisation, and could participate in the online discussion. In the other studies, workers appeared to struggle in order to combine learning and work with little corporate support and reported experiences similar to the media professionals interviewed in Maor and Volet (2007).

In the next section, we turn to the research aspects of the 18 selected articles, with a focus on interactivity and the creation of communities of learners. The major research question and critical finding of each study are identified and discussed in relation to the degree to which interactivity had been deliberately fostered, investigated and achieved in the online learning course under investigation. This section addresses the last three questions presented in the introduction.

Interactivity in professional online learning

In reviewing the vast body of literature on professional online learning, we wanted to establish how research based empirical studies had investigated the issue of interactivity and the creation of online communities of professional learners. As mentioned earlier, this review has highlighted the very limited number of studies that examined interactivity and other forms of social learning in the online environment. This final section concentrates on this last aspect. The levels of interactivity ranged from the highest level (level 1) in which the interactivity was planned and implemented successfully, to the lowest level (level 4) in which there were minimal opportunities for interactivity. Table 3 outlines the key features that characterise each level, the list of studies that were categorised at that level, with their major research

questions and critical findings.

Level 1 comprises four studies (4, 16, 1, 15) where the main research focus was to establish the value of designed interactivity to create a community of learners, and a substantial amount of interactivity was actually obtained. In each study, a structured instructional design had been used to promote interactivity and this was effective. As documented in Table 3, the critical research findings of the four studies revealed the importance of fostering a sense of community and belonging, as well as paced collaborative learning activities. Somewhat surprisingly, the conceptual underpinning of these studies varied in terms of depth and degree to which the research questions and methodology were grounded in theory. One study explicitly tested a theoretical model (1), while others simply referred to social learning, problem based learning or collaborative learning concepts. All four studies involved qualitative analyses of online learning discussions, two of them combined with questionnaire data and two with interview data.

Level 2 (a and b) comprises 7 studies that attempted to design interactivity in order to create a community of learners with more or less success, most (2a) with structured support (7, 2, 3, 9, 12, 13) and one (2b) with unstructured support (11). As documented in Table 3, the typical research questions addressed in these studies involved the investigation of a particular aspect of interactivity in professional online learning, for example, the function of asynchronous computer conferencing, participants' views of what encourages online discussions or the degree to which technology, workplace context and assumptions about learning influence what happens in a virtual classroom. Similar to the Level 1 studies, the extent to which the theories of learning mentioned in each article actually provided the conceptual basis for the research design and research questions varied widely. Social constructivist theories of learning were mentioned in a few studies (2, 3, 11, 12, 13) but without explicitly leading to theoretically derived research questions. Also similar to Level 1 studies, all included analyses of online learning discussions, two combined with questionnaire data and six with interview data.

Level 3 comprises three studies (8, 17, 18) where opportunities for interactivity were made available in a professional online learning course. In these three cases, an empirical study had been designed to examine the participants' interactions and online, collaborative learning activities, to examine how members of a community use a web knowledge forum, and how their engagement compared with face to face instruction. In contrast to the level 1 and 2 studies, there was no attempt, as part of instructional design, to foster interactivity. Consequently the research focus was different. In these three studies, the opportunities for interactivity in the professional online learning courses were researched in terms of participants' critical reflection, interaction, and debate (8), participants' type of use of *Web Knowledge Forum* (17), and in terms of quality of learning in comparison to face to face classroom instruction (18). In Study 8 results were disappointing, despite the deliberate focus on interactivity, with the discussion primarily generating independent messages and minimal interaction between learners. All three studies at level 3 used questionnaire data, combined in two cases with some analyses of participants' online discussions and in one case (8) with additional interview data.

Finally, Level 4 comprises four studies (5, 6, 10, 14) where minimal opportunities for interactivity were available. The research questions reflect an implicit assumption that online learning implies interactivity but promoting interactivity was not embedded in the instructional design. Two studies (5, 6) examined the impact of online learning on clinical practice, one (14) investigated what influences participants' engagement in online learning and another (10) the impact of anonymous participation. Consistent with the minimal opportunities for interactivity, only one out of these four studies analysed participants' online discussions. Three of the four studies included questionnaire data, and two interview data.

Looking across studies revealed major differences in degree to which interactivity had been fostered in professional online learning courses with only a few studies where interactivity was planned, supported and implemented successfully. This was reflected in the instructional designs of the professional online courses, and accordingly, in the research questions, theoretical underpinning and methodologies.

Table 3: Overview of major research questions and findings

Degree to which interactivity		

and a community of learners were fostered in the study	Art. No.	Major research question *Critical finding*
Level 1 *Designed interactivity* to create a community of learners *Structured* support Achieved	4	How effectively do online courses support learning? *Through fostering a sense of online community.*
	16	How can an online instructor create a virtual learning environment that promotes a sense of community? *Through creating a sense of community.*
	1	How can an online learning course offer an environment within which a productive learning community is formed and subsequently flourishes? *Through three modes of belonging: engagement, imagination and alignment.*
	15	How can an online learning group negotiate its way through a problem? How does the group sustain itself? *Through milestones and collaborative work.*
Level 2 a *Attempt to design interactivity* to create a community of learners *Structured* support Partially achieved	7	What function does asynchronous computer conferencing play in facilitating collaborative learning and establishing a learning network? *It makes collaboration and communication more effective.*
	2	According to participants, what encourages online discussions? *The creation of group knowledge and a knowledge network encouraged online discussion.*
	3	What can be taken as evidence that an online community has been created? *Engagement and developing of collaborative, shared knowledge.*
	9	What learning preferences are related to opinions about online continuing medical education in comparison to face to face? *They valued interaction and having a facilitator and a perception of social comfort.*
	12	What type of community of practice can be formed in a workplace context? *No sense of "community" was generated within that workplace.*
	13	What is the main prerequisite of productive collaborative learning? *Effective communication.*
Level 2 b *Attempt to design interactivity* to create a community of learners *Unstructured support* Partially achieved	11	How do technology, workplace context and assumptions about learning influence what happens in a virtual classroom? *Practice of belonging to a community does not seem to be transferable across work and formal learning environments.*
Level 3 *Opportunities available* for interactivity Some collaborative learning achieved	8	What are the characteristics of participants' interactions and collaborative learning in a web-based continuing medical education course? *Minimal learner-to-learner interactions.*
	17	How do members of a community of practice use a *Web Knowledge Forum*? *Participants accessed and discussed a lot about work related problems within the web-knowledge forum but needed more structure and support, they read more than they contributed.*
	18	How does the learning and motivation of trainees differ in online and face to face classroom instruction? *There was no difference between the two-both effective in meaningful*

		learning.
Level 4 *Minimal opportunities* for interactivity	5	What is the impact of online learning on nursing clinical practice? *The nurses reported improvement in their clinical practice and bringing their learning into their practice*
	6	What is the nurses experience with web based learning? *Most nurses found the course highly satisfactory.*
	10	What is the impact of anonymous participation on the development of learning identity and a learning community in online learning? *Anonymity reduced quality, there was no evidence of a learning community.*
	14	What influences students' engagement in a self paced technical training program delivered at a distance? *Interaction with the coach influenced the level of engagement and they wanted more, moderated discussion.*

Conclusion

The systematic literature search reported in the first part of this paper highlighted the limited number of theory based studies in the area of professional online learning that are using either qualitative or quantitative methods of analysis. Four selection criteria were used to conduct the search and to provide a structured overview of the selected articles. Instead of using statistical analysis to determine commonalities and differences across studies, the three researchers used their own judgment and resolved any discrepancies through discussion.

The small number of research papers on professionals who enthusiastically adopted e-learning suggests that collaboration between higher education institutions and industries is still in its infancy and needs encouragement and professional support. Evident also was the need for more research to provide both theoretical frameworks and pedagogical innovations. The review of the research aspects of these studies revealed a variety of research questions, methods and results but at the same time limited insight into the characteristics and conditions of the quality of professional online learning.

The element of interactivity was the threaded link throughout the 18 articles, although evidence of high levels of successful interactivity was limited. Organising the studies into four levels of interactivity revealed the large variance among studies. At the highest level there were research based studies in which the design and implementation involved a substantial focus on fostering interactivity. This resulted in the creation of a genuine community of learners. At the second level were attempts to design and implement interactivity with some partial achievement. At the third level were studies where opportunities for interaction and some collaborative learning had been introduced and sometimes realised. Finally, at the lowest level were studies showing minimal attempts to foster interactivity. Consequently almost no interaction occurred.

At the highest level, studies typically contained research questions that were grounded in theoretical assumptions. Each of the four studies at that level were found to be of a high quality in terms of research design, however these studies did not necessarily reveal much pedagogical innovation. At the other levels, the questions that were addressed often had an unclear or under elaborated theoretical underpinning, which seemed to be addressing a readership of practitioners rather than researchers. Building a theory-practice link will therefore be critical in future research, in order to generate a body of knowledge that can assist the development of effective pedagogical models for professional online learning.

A small number of studies emphasised the contextualised link between the industry and the university that dealt with how the collaboration took place. However, there was limited information on the practical aspects of this collaboration. It was also interesting to note that the majority of research studies were from the health profession. Our review suggests that the commitment of the health professional education sector to research demonstrates innovations in this field and the promotion of continuing medical education. We had

expected to be able to discuss how the research findings could improve practice and create better learning environments in order to foster interactivity and promote communities of learners. To our surprise, most of the research studies appeared to be still engaged in trial and error processes in relation to both technological and pedagogical aspects of learning communities.

Finally, the systematic examination of a set of selected, research based studies on professional online learning revealed that although the adopted theoretical frameworks were mostly derived from social constructivism, the professional online courses under research scrutiny had not been designed explicitly to foster knowledge sharing and the creation of communities of learners. It is clear that like in the formal education sector, workplace learners require structure, support and teachers' moderating role in order to engage successfully in such activities. Further theoretically based research on professional online learning is needed, and more specifically, studies that examine the educational value of computer mediated interactivity and other forms of social learning activities.

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