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A Delphi study on collaborative learning in distance education

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WHAT'S TECHNOLOGY GOT TO DO WITH IT?

A DELPHI STUDY ON COLLABORATIVE LEARNING IN DISTANCE EDUCATION

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Abstract

Collaborative Learning (CL) is increasingly being used in Distance Education (DE), as it has been identified as an effective solution to known weaknesses such as high average rates of dropout and low quality of learning attainment. Information Technology is a core component of this type of learning as it not only provides the means to collaborate over distance but also has the potential to enable higher learning outcomes. There are a rapidly growing number of technologies in use today and the importance of these to collaborative learning initiatives, and the role they play, is an area of active research in the Information Systems (IS) community. IS educators and practitioners face an increasing challenge therefore to successfully implement CL in DE, precipitated not only from technical advances but also from wider social and organisational concerns. Using a Delphi study, this research is the first to investigate the factors that influence collaborative learning in distance education by surveying the opinions of an expert panel in this area. The aim was to produce an integrated list of the most important implementation factors and to investigate the role technology is perceived to contribute. The findings identified seventeen of the most important factors. These factors cover a range of themes including course rationale and design, instructor characteristics, training, group dynamics, the development of a learning community and technology. The potential of technology however does not seem to be fully realised and newer technologies such as multi-user environments would seem to be of limited use in practice, according to the expert panel.

Keywords: Collaborative Learning, Distance Education, CSCL, Delphi Method, IS Education.

1 INTRODUCTION

Distance Education (DE) is a broad term that refers to delivering a curriculum to learners who are not physically present on campus. Recent technological advances, along with changing learner demographics have triggered a significant rise in the popularity of this type of education. As distance education has evolved, it has become inextricably linked to technology (Garrison 1985) and as such information systems involving communication and information technology have become the underlying core of current and future DE innovations and trends (Lockwood 2001).

In conjunction with the advances in technology, DE is becoming increasingly popular throughout the world (Brandon and Hollingshead 1999; Oblinger 2001; Beldarrain 2006) with its market share growing rapidly (Salas, Kosarzycki et al. 2002). However there are still problems with its practice, including high average rates of dropout and low quality of learning attainment (Bernard, Rojo de Rubalcava et al. 2000). Various causes have been attributed to these problems including: feelings of isolation; lack of two or three way communication; procrastination; and difficulties associated with self-regulation (Bernard, Rojo de Rubalcava et al. 2000). New internet-based learning environments offer ways to overcome some of these shortcomings (Beyth-Marom, Chajut et al. 2003) for example, by providing means for asynchronous and synchronous learning with new technologies being used to foster student interaction and collaboration (Beldarrain 2006). Changes in the pedagogical approach are also happening with a move from instruction-based learning models to a constructivist (rather than being transmitted, knowledge is created, or constructed) or collaborative learning approach (Leidner and Jarvenpaa 1995). Numerous studies have demonstrated the superiority of collaborative learning (CL) over traditional modes of learning (for examples see Hiltz 1988; for examples see Alavi 1994; Leidner and Fuller 1997) and it has been identified as a potential solution to the weaknesses of traditional distance education courses (Bernard, Rojo de Rubalcava et al. 2000).

Collaborative learning emerges through the interaction of individuals with other individuals, knowledge is created though these interactions as individuals ‘exercise, verify, solidify, and improve their mental models through discussion and information sharing’(Leidner and Jarvenpaa 1995). Collaborative tasks can include decision-making, problem solving, report production, or experimental projects. When students work together collaboratively, they not only learn themselves, but they are also contributing to the development of the group (Salas, Kosarzycki et al. 2002). The collaborative learning model assumes that individuals’ learning is enhanced when they create knowledge by actively constructing a representation of the material being taught working on the assumption that ‘individuals learn better when they are forced to discover things themselves, rather than when they are told or instructed’(Leidner and Jarvenpaa 1995). Working in groups is not just a valuable way of learning but also develops the abilities for cooperative work, which is essential in the modern working place. Incorporating collaborative activities into modern distance education courses should produce graduates who can work effectively and efficiently with others, while also understanding the role of modern information technologies in collaboration, communication and knowledge creation.

Computer-Supported Collaborative Learning (CSCL) deals with how technology can be used to support collaborative learning and draws primarily from two contributing fields of inquiry; collaborative learning theory and Computer Mediated Communication (CMC) theory and research (Brandon and Hollingshead 1999). CSCL focuses on frameworks and tools to assist in collaborative learning along with the implementation of actual educational systems, collaborative learning activities and new pedagogical approaches. The use of technology therefore is more than a mere supporting infrastructural component. Technologies that promote communication and interactive can add value to the learning process by enabling the development of higher-order thinking skills, increased involvement, interest and motivation and overall the attainment of higher learning outcomes (Piccoli et al., 2001). Although emerging technologies offer a vast range of opportunities for promoting collaboration, distance education programs face challenges that may influence the implementation of these technologies (Beldarrain 2006).

Clearly, without technology the use of collaborative learning in distance education would be severely restricted however, technology is not the only influencing factor and the organisational processes and human interactions surrounding it are also of crucial importance in the implementation of CL in DE. A number of studies have investigated the factors which are relevant to CL in DE, mostly focusing on specific areas of interest, for example; CL and computer supported groups (Brandon and Hollingshead 1999); student preferences (Beyth-Marom, Chajut et al. 2003); social interaction (Kreijns, Kirschner et al. 2003); issues with CL in DE (Bernard, Rojo de Rubalcava et al. 2000); Computer Supported Collaborative Learning (CSCL) (for examples see Silverman 1995; English 1999; for examples see Beldarrain 2006); success factors of CMC technologies (Tolmie and Boyle 2000); system characteristics (Pituch and Lee 2006) and emerging themes in distance learning (Salas, Kosarzycki et al. 2002). The literature reviewed indicated that several factors impacted CL in DE, although each independent study considered only a limited number of factors. In general, the factors can be grouped into themes such as; course rationale and design; instructor characteristics; leaning community; student characteristics; group dynamics; support and training; assessment and technology. Each of these themes have a number of factors associated with them, however an integrated list of a full range of the contributing factors does not seem to have been previously researched.

The aim of this research therefore was to develop an integrated list of the most important factors, with the aim of establishing the key issues involved in the implementation of CL in DE. Using the factors identified from the literature as a basis (see table 2.3), a panel of experts in the area ratified, expanded and ranked what they believed to be the most important factors. This study further elicited the view of the expert panel regarding their perception of the role technology plays in this type of education in order to explore whether the potential of information technology is recognised and fully exploited in practice.

2 RESEARCH DESIGN

A Delphi survey was chosen as the methodology for this study, as it is a technique for collecting opinions that aim to overcome the weaknesses implicit in relying on a single point of view. By involving a group of experts in the area, the study ensures that the results are not based on a single experience of collaborative learning in distance education. Delphi surveys have the benefits of group interviews without the need to gather the experts together in one location (Clayton 1997). They also allow the participants to express their opinion without undue pressure from others in the group, while the iterative nature of the technique provides the opportunity to clarify or change views based on others perspectives (Clayton 1997; Schmidt 1997). There are a number of permutations of the Delphi method and a ranking type Delphi study, designed to elicit the opinion of a panel of experts through iterative controlled feedback, was chosen for this study. The framework used was based on non-parametric statistical techniques, as outlined by Schmidt (1997), and aimed to answer the following research questions:

RQ1: What are the most important factors that influence the effective use of collaborative learning in distance education?

RQ2: What is the perceived role of technology in this form of education?

2.1 Panel Description

Rather than focus on a homogenous group (such as lecturers) a cross section of expertise was sought. This was to ensure that the factors identified as most important considered a range of perspectives and not just the views of a particular group.

The panel selected was composed of 18 panellists from three geographical regions: Ireland, USA, and UK. They represented collaborative learning through three distinct groupings; nine programme

directors using collaborative learning in distance education courses; five lecturers who are currently using collaborative learning techniques in distance education courses; and four academics with experience in the area of computer supported collaborative learning. Because the success of the Delphi technique relies upon the use of informed opinion, random selection was not considered when selecting the Delphi participants (Wicklein 1993). However, educational qualifications were taken into account, all of the panel were educated to a minimum of Masters Level, with fifteen having Doctorate qualifications.

Twelve universities were represented: Carnegie Mellon University, (United States); Middlesex University, (United Kingdom); New Jersey Institute of Technology (United States); National University Ireland, Galway (Ireland); Oscail, Dublin City University (Ireland); Penn State University (United States); University College Cork (Ireland); University of Edinburgh (United Kingdom); University of Leicester (United Kingdom); University of Hawaii (United States); University of Limerick (Ireland); and The Exploratorium, San Francisco (United States).

Criteria used in selecting the participants were based on their involvement with collaborative learning, distance education and computer supported collaborative learning. The average number of years experience in the area of Collaborative Learning was 7-10 years, with 50% of the panel having over 11 years experience. The panel were also highly qualified in the field of distance education with the average number of years experience 7-10 years and 44% of the panel having over 11 years experience. The average number of CL courses managed or taught was 4-7, as was the average number of DE courses managed or taught. The selected participants are considered to be well informed, leading authorities in their field by their colleagues, supervisors and peers. Overall the panel can be considered highly qualified and well equipped to provide opinions on the factors relating to CL in DE, as qualified by the following section.

2.2 Identifying Experts

The identification of 'experts' for the Delphi panel was based on a multiple-step approach suggested by Olaki & Pawlowski (2004). Initially a knowledge resources nomination worksheet (KRNW) was prepared which included details of the desired background or skill sets required. The KRNW was populated by going through each of the desired skill sets and identifying a key contact in the area. Personal contacts of both the researcher and supervisor were used as the initial contact point in each of the categories. Using the 'snowball' sampling method (Skulmoski, Hartman et al. 2007) the initial contacts were asked to provide recommendations for other potential participants in the study. The qualifications and skill sets of the named experts were ranked according to exposure and experience with collaborative learning initiatives and distance education. As a variety of perspectives were required the experts were ranked based on their experience and to ensure a selection of viewpoints. This provided a list of 46 experts to be invited to partake in the study.

These potential candidates were contacted, by email, and invited to participate in the study. The subject of the study was explained along with the procedure and the commitment required. To minimise non-response, one of the initial contacts introduced both the researcher and the topic of research to a number of the potential candidates, as suggested by Hsu and Sandford (2007). Delphi group size depends on group dynamics rather than statistical power and panels of 10-18 experts are recommended (Okoli and Pawlowski 2004). Of the forty six invitations, eighteen candidates accepted and this was considered ideal, as it would allow the study to start with the top end of the range. During the study two panel members dropped out, leaving a panel of sixteen who completed all stages of the study.

2.3 Survey Rounds

The initial survey was sent on the same day that an expert agreed to serve on the Delphi panel, as recommended by Okoli and Pawlowski (2004), using email as the communication channel. Following

the approach used by Kasi et al. (2008) rather than have the panellists participate in a brainstorming session, a list of potential factors identified from the literature was provided (table 2.3). This list provided the panellists with a structured instrument to begin the Delphi process and contained 28 factors for the initial ratification and discussion.

Factor ID	*Factor*
F1	Students should have prior experience of collaboration technology
F2	Promotive interaction should be encouraged within groups
F3	Students learning style should be conducive to group-work
F4	Tutor should assume facilitator role
F5	Tutor teaching style should encourage involvement and participation
F6	Group members should have adequate interpersonal skills
F7	Technology used should enable synchronous communication e.g. MSN chat and teleconferencing
F8	An appropriate rationale for collaborate learning should be developed
F9	Group work should promote individual accountability
F10	Course content should encourage interaction with both tutor and peers
F11	Tutors should have institutional support for their role
F12	The technology used should be accessible to all participants
F13	Course subject matter should include problem based tasks
F14	A consistent user interface should be provided
F15	The development of a learning community should be encouraged and nurtured
F16	Pre-course evaluation of learner profiles and learner needs should be carried out
F17	Tutors should prepare students to work collaboratively
F18	Social environments should be provided for non-project communication
F19	Course subject matter should encourage opinion diversity
F20	An appropriate rationale for use of Computer Mediated Communication technologies should be developed
F21	Technology used should enable asynchronous communication e.g. e-mail and bulletin boards
F22	Effective technical support should be provided to both tutors and students
F23	Group work should promote positive interdependence
F24	Students learning style should be conducive to sharing information with others
F25	Group size should be kept small (e.g. 4-5 students)
F26	Course subject matter should be discussion based
F27	Tutors should be trained for their role
F28	Group processing discussions should be encouraged

Table 2.3 Initial List of Potential Factors

Each participant was asked to select the factors that they deemed to be important to CL in DE. They were also asked to provide details of any factors that they considered to be important but were not on the original list. Along with the list of potential factors the panel were also sent a short survey outlining a number of technologies currently in use in the area. They were asked to identify those technologies that they currently used for CL initiatives and add any technologies that they use but were not on the original survey. The purpose of this additional questionnaire was to gain a snapshot of the technologies currently in use by the panel.

The results of the initial survey involved the panel removing 9 factors from the original list and adding a further 26. The additional items were reviewed and a new consolidated list of 45 factors was developed. As the target size for the ranking of the factors was around 20 items (Okoli and Pawlowski 2004) a second survey was required to narrow down the consolidated list. The questionnaire was randomly ordered to cancel out bias in the order of listing of the items (Brancheau, Janz et al. 1996). Each panellist was asked to select (but not rank) at least 10 of the most important factors (Schmidt 1997). Due to the nature of the topic and the diversity of the panel, a wide range of opinion on the factors was expected. An analysis of the results of the second survey suggested that opinion was

spread over a number of factors. A cut-off point of 40% was determined the most appropriate level for paring down the list as this ensured that the list contained a suitable number for ranking (less than 20, as suggested by Schmidt (1997) and also ensured that important factors were not dismissed at this stage. This list highlighted the 17 most important factors, from an initial list of 54 potential factors (original 28 plus the 26 added by the panel).

Once this list of most important factors was identified, the first of the ranking rounds was sent out. The aim of this phase was to determine the level of consensus on the ranking of the relevant factors. The pared list, from the second survey, was arranged in random order, and the respondents were asked to rank all the items (Schmidt 1997). Four different randomised versions were produced and divided among the panellists, as suggested by Brancheau et al. (1996). The questionnaire also asked experts to submit comments explaining or justifying their rankings as it is suggested that experts 'should arrive at consensus more quickly if provided with some sort of feedback about the panellists' reasoning' (Okoli and Pawlowski 2004).

The ranked lists were measured using Kendall's *W* coefficient of concordance, as it is recognised as one of the best ways for measuring non-parameter rankings (Schmidt 1997; Okoli and Pawlowski 2004). The values of *W* range from 0 to 1, with 0 indicating no consensus, and 1 indicating perfect consensus. The value of *W* obtained from this first ranking round was 0.148, which suggested weak agreement on the rankings and thus a second ranking round was necessary. As suggested by Okoli and Pawlowski (2004) the second ranking round was listed in order of the mean ranks obtained in the first round. For each item, the following information was provided to the panel: (1) an indication of the current level of consensus (based on the value of *W)* (2), the mean rank of the item; and (3) a column providing details of the views of the other panel members on each factor. Based on this, each expert was asked to revise their rankings for each item, again asking them to explain their rankings and revisions. A separate column was provided for these additional comments.

The response to the second ranking round indicated that the majority of panellists did not wish to change their opinion, with only four of the panel members revising their rankings. However, a number of additional comments were obtained and Kendall's *W* improved to 0.221. At this stage it was decided that further ranking rounds would not be required. Dissensus, or lack of agreement is a valid finding for a Delphi study (Skulmoski, Hartman et al. 2007). The diversity of the panel, and the subjective nature of education, highlighted by the detailed comments obtained in the survey, clearly identified a number of viewpoints on the factors considered most important. The panel had agreed on the most important factors, the lack of strong consensus was on the priority, or ranking, of these factors.

The first ranking round also included an additional questionnaire, which detailed the technologies currently being used by the panel (identified in the first stage of the survey) and asked each member to rate (using a likert type scale) how useful each technology was to collaborative learning.

3 FINDINGS

3.1 Most Important Factors

This study identified the top 17 of the most important factors from a comprehensive list of 54. The following table provides the results of the final ranking round and outlines the factors in ranked order, along with their mean rank and interquartile range (IQR). The IQR shows the range of opinion on the ranking of the factor; the higher the IQR the greater the range of opinion.

Rank	Description	Mean Rank	IQR
1	Instructional design of the activity, activity structure and assessment needs to promote CL	5.80	7.00
2	Tutor teaching style should encourage involvement and participation	6.20	4.00
3	The development of a learning community should be encouraged and nurtured	6.47	8.00
4	The technology used should be accessible to all participants	6.47	10.00
5	Tutor should assume facilitator role	6.67	7.00
6	Personalised, detailed and quality-controlled feedback on assessment work should be provided	7.20	7.00
7	An appropriate rationale for collaborate learning should be developed	7.47	9.00
8	Tutors should be trained for their role	7.53	8.00
9	Promotive interaction should be encouraged within groups	9.13	4.00
10	Group work should promote positive interdependence	10.00	7.00
11	Learning environment should be user friendly and kept simple	10.47	9.00
12	Prior design of collaborative tasks is essential: i.e. design for learning, then e-moderate for participation	10.60	7.00
13	The development of teamwork skills should be explicitly build into the instructional design	10.93	8.00
14	Technology used should enable multiple means of communication	11.07	8.00
15	There should be lots of opportunity for social communications in the early part of the course	11.27	4.00
16	Technology used should enable asynchronous communication	11.87	8.00
17	Tools should support multiple learning styles	13.47	5.00

Table 3.1 – Results of Delphi Ranking Round

By reviewing the comments and rankings for each factor received, it was possible to group them into the themes originally identified from the literature and classify the most important factors within these themes.

- *Course rationale and design* - the design of the activity needs to promote collaborative learning and (#1) there needs to be an appropriate rationale behind its use (#7). Prior design of the collaborative tasks is also considered important (#12) along with the development of teamwork skills explicitly built into the design (#13).
- *Instructor characteristics* – the instructor teaching style should encourage involvement and participation (#2) with the tutor assuming a facilitator role (#5).
- *Learning community* - the development of a learning community should be encouraged and nurtured (#3) and while there should be opportunity for social communications in the early part of the course (#15), this is not seen as high a priority.
- *Assessment* – personalised, detailed and quality-controlled feedback on assessment work is seen as of high importance (#6), but considered relevant to all forms of education and not just CL.
- *Support and training* – tutors should be trained for their role (#8) and this is seen as an important factor. Support, both technical and institutional, is not deemed to be as high a priority and did not make it to the list of most important factors.
- *Group dynamics* - Promotive interaction refers to the quality of interaction among group members and is seen as important (#9) along with positive interdependence, which means that group members must see value in working together for collaborative learning to occur (#10). Group size and the interpersonal skills of the group, are not perceived to be as high a priority and while ratified from the literature did not make it through to the most important factors.

- *Technology* – of high importance is the fact that the technology should be accessible by all students (#4), and while this may be considered obvious, is an essential component to CL in DE. Also the learning environment itself should be user friendly and kept simple (#11). Other technological factors are also considered important: it should enable multiple means of communication (#14), including asynchronous communication (#16) and should support multiple learning styles (#17). While technology factors did come in near the bottom of the final rankings, it is clear that they are still considered highly important as they made up almost 30% of the final list of 'most important' factors.

3.2 Collaborative Learning Technology

The technology questionnaire sent out with the Delphi study further provides a snapshot of the technologies currently in use for CL in DE, and their perceived usefulness. The following table provides a summary of the results.

Technology	% of Panel using this technology	Average Rating
VLE / Online Forums / Bulletin Boards	100%	Extremely Useful
Chat Functions / Synchronous Discussion	94%	Moderately Useful
Computer / Audio Conferencing / VoIP (e.g. Elluminate, Skype)	83%	Moderately Useful
Collaborative document tools (e.g. Google docs, Word comment)	78%	Extremely Useful
Email / Email List Server	72%	Moderately Useful
Wiki Spaces	67%	Moderately Useful
Social Networking Software (e.g. Ning, del.icio.us, wiki, facebook)	61%	Limited Use
Blogs	56%	Moderately Useful
Calendars, Agendas or Schedules	56%	Moderately Useful
Voting	50%	Limited Use
Multi-User Virtual Environments (e.g. Second Life)	44%	Limited Use
Podcasting	44%	Moderately Useful
Group conferencing (with synchronous audio / video) / Video Conferencing	40%	Limited – Moderate Use

Table 3.2 Technology and Collaborative Learning

It would seem that Virtual Learning Environments, including online forums and bulletin boards are of most use to collaborative learning in distance education. The entire panel uses this technology and it received a high level of support on its usefulness. Collaborative document tools are also considered 'extremely useful' by the panel, with 78% of them using this technology. The majority of the technology is considered 'moderately useful' including audio conferencing and email, even though these had a high percentage of usage. It is interesting to note that some of the newer technologies such as Multi-User Virtual Environments and group conferencing appear to have limited usefulness in practice according to the expert panel.

4 DISCUSSION

The Delphi study enabled a group of experts in the area to identify and discuss the most important factors contributing to CL in DE. Using a base list of 28 factors identified from the literature, the panel

suggested an additional 26 factors based on their experience in the area. These factors were ratified and discussed during the rounds of the Delphi exercise, cumulating in agreement on 17 of the most important factors, albeit with differing opinions on the rankings of these factors.

4.1 Most Important Factors

In line with the literature (Brandon and Hollingshead 1999; English 1999; Tolmie and Boyle 2000; Kennedy and Duffy 2004) course rationale and design is considered highly important. Personalised, detailed and quality-controlled feedback on assessment work should be provided as it is also seen as of high importance. The literature also suggests that the rationale behind the use of Computer Mediated Communication (CMC) technologies is considered important (Tolmie and Boyle 2000), however this study did not find it to be a high priority, perhaps because in DE it is necessary to use CMC technologies. While there are a number of suggestions around course content discussed in the literature (Silverman 1995; Brandon and Hollingshead 1999; Bernard, Rojo de Rubalcava et al. 2000) course subject matter was not found to be particularly important by this panel of experts.

The role of the tutor, or instructor, is significant to CL, with 'teaching style' considered to be a 'most important influence' on involvement and participation (Salas, Kosarzycki et al. 2002). The expert panel would seem to agree with this as one of the highest-ranking factors directly related to instructor teaching style, suggesting that it should 'encourage involvement and participation'. Learner-centred courses require the instructor to assume a facilitator role, and again this is suggested as important in the literature (Silverman 1995; English 1999; Bernard, Rojo de Rubalcava et al. 2000). The panel concurs with this agreeing that the tutor should assume a facilitator role, and also receive training for the role. Support, both technical and institutional, is not deemed to be as high a priority and did not make it to the final list of most important factors.

It would also seem that, in line with the literature (Hiltz 1998; Kreijns, Kirschner et al. 2003), the encouragement and development of a learning community is considered highly important to the effective use of CL in DE. While there should be opportunity for social communications in the early part of the course, this is not viewed as high a priority. The importance of the group to collaborative learning has been regularly discussed in the literature (for examples see (Hiltz 1988; Brandon and Hollingshead 1999; English 1999; Tolmie and Boyle 2000; Kreijns, Kirschner et al. 2003); the results of this study would seem to concur with the literature, at least with regard to the importance of promotive interaction and the fact that group work should promote positive interdependence. However, other aspects deemed important in the literature, for example, group size (Tolmie and Boyle 2000; Kreijns, Kirschner et al. 2003), were not supported by this panel. This may be due to fact that the technology available today allows large groups to work quite well. As one panellist pointed out 'perhaps bigger groups enable the work to be sustained when some of the group are inactive for long periods'. Group interpersonal skills were also not deemed to be of major importance, while individual accountability was seen as important but not 'most important' and did not go through to the final list.

Student characteristics are regarded as important in the literature with Bernard et al. (2000) suggesting that that ideally 'developing a profile of the learner's knowledge, skills and experience, as well as their perceived needs' will aid in the design and implementation of effective DE courses. Learner differences involve both the way that students will interact with the technology as well as affect the degree to which they will participate in online collaboration activities (Salas, Kosarzycki et al. 2002). However, the panel did not concur with the literature; they did not consider student characteristics an important factor in the effective use of CL in DE. It was agreed that while students may have a preference for certain learning styles these can be overcome and adapting learning styles to suit course requirements is part of the learning experience itself.

4.2 Role of Technology

The results of this study highlight the importance of technology by identifying five factors as being among the most important factors. Accessibility to the technology has been highlighted as important in the literature (Bernard, Rojo de Rubalcava et al. 2000) and this has been upheld by the panel, placing this factor among the top five most important factors. Enabling asynchronous communication (Silverman 1995) was also considered important enough to make it through to the final list. The panel members themselves added the three other technological factors in the initial phase.

The lower ranking of the technology factors would seem to be due to the fact that it is deemed a supporting role and less critical than good design and tutor characteristics . While not considering the technology unimportant, the point was made that:

> *'with a good plan, and buy-in from teachers, the technology should not matter. Of course there is a need to match the technology to the task – but perhaps we are getting to the position that we are doing this in what seems like an intuitive and natural way. The technologies are (relatively) mature and powerful, so we can achieve our ends with a range of different technologies'.*

While the above comment recognises that the technologies are now relatively mature and powerful, it would seem that technology is not being fully utilised. One factor that had a wide discordance concerned the ability of technology to cater for different learning styles. While the majority of the panel did not consider this to be a high priority, one panel member fully supported this and felt that the rest of the panel was overlooking it.

> *'Tools need to reflect the multiple styles for learning and not assume that students should adapt to purely linguistic ones. This doesn't mean we have to test and understand every student's primary learning style, only that we have to design environments that appeal to multiple styles in a variety of ways'.*

Alavi and Leidner (2001) point out that 'the role of IT in enabling individualized learning methods, while not new, has received strikingly little attention'; this study supports this view and further indicates that the potential of IT has still not been recognised in practice. The potential of technology to provide an individualised, effective learning environment is not recognised or utilised by the majority of this panel of experts. A recent study (Menchaca and Bekele 2008) identified that 'the availability of multiple tools added flexibility to the learning environment' which helped ensure a successful DE programme, as did the use of technology tools that appeal to multiple learning styles. Perhaps as more research identifies the usefulness of these technological tools they will be utilised more fully in practice. From an IS perspective it would seem that in practice, there is suboptimal use of technology in this educational environment. In particular, newer technologies such as multi-user environments, group conferencing and social networks are perceived to be of limited use in practice. These technologies have the potential to enable collaborative learning to take place over distance and as such their perceived lack of usefulness is of concern. If these technologies are to be fully optimised as an enabling factor in collaborative distance education then their educational benefits need to be more strongly highlighted to practitioners.

5 CONCLUSIONS

The motivation behind this study was to develop for the first time a comprehensive list of the most important factors that influence the effectiveness of collaborative learning in distance education. As an Information Systems study the role that technology plays was of particular interest and part of the study included pulling together a snapshot of the technologies currently in use in the area. A panel of experts worked together to ratify and consolidate the factors and the study achieved its aim of producing the integrated list. While the actual rankings of the factors did not achieve strong group consensus the lack of agreement highlighted the diverse views and opinions on which factors are of highest priority. The study highlighted the 17 most important factors and also provided an understanding of the perceived role of technology in this educational area.

5.1 Implications for IS Research

While the study established that technology is among the most important factors, it also highlighted the fact that it is viewed more in a supporting role than as an enabling factor. In particular, the use of technology to support multiple learning methods is an area that is not currently optimising the potential of technology. Further research into the role of technology in collaborative learning might consider how the technology is being used and why it is not being fully utilised in practice.

The perceived usefulness of the technologies could also be further explored, in particular the lack of support for some of the newer technologies. The fact that Multi-User Environments are used by less than 50% of this panel, along with the suggestion that it is of limited use warrants further research. As these new technologies can actually enable collaborative learning to take place, rather than just support it, it is important to establish why they are not being considered particularly useful in practice.

As with any Delphi study, the results are based on a limited number of subjects. While these subjects were chosen following rigorous guidelines, one must be cautious in generalising. The sample is relatively diverse in terms of perspectives on CL in DE and this diversity may have influenced the lack of consensus on the priority of the items. Further research could be carried out with panels of similar perspectives to determine if the results would hold.

5.2 Implications for practitioners

The main aim of this research was to develop an integrated list of the most important factors, relevant to the effective use of collaborative learning in distance education. The opinion of an expert panel provides practitioners with a comprehensive, expert opinion on the factors that are deemed highly important in the area. This final list of 17 factors provides details of the areas to focus on when implementing such an initiative.

Practitioners can also use this study to gain an insight into the role technology plays and gain an understanding of its importance, based on the opinion of experts in the field. The snapshot of the technologies currently in use can provide details of which technologies are perceived to be most useful along with those which are considered of limited use.

Overall the study provides a practical guide for those considering implementing collaborative learning in distance education, along with some motivation for future research for the IS community regarding the suboptimal utilisation of technology in practice.

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