

Group interactive learning with group process support technology

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Abstract

An effective seminar is about discussion, exchanges of ideas and developing understanding; but is this always achieved? This paper evaluates a pilot study into whether group process support technology has the potential to improve the learning experience of students in seminar groups by increasing participation and focusing debate. The trial involved 86 undergraduate students. The technology consists of wireless handsets, a PC and data projector. The use of the technology was varied to increase our understanding of how it could be used effectively. The Pilot Study received a positive evaluation by both the tutor and the student group. The results are encouraging, and the paper concludes by establishing further research issues, how this application of technology can be developed and briefly describes how the technology has been subsequently used in the University of Glamorgan Business School.

Introduction

It is a truism that the student population is increasingly diverse in background, experience and ability. This must influence teaching strategies, as we strive to achieve quality learning in a changing environment. A key teaching arena is the seminar or tutorial, which can provide excellent opportunities for face-to-face discussion; but contact time is limited and it is essential that the learning experience in seminars is focused to meet the needs of the tutor and of all the students. Case based materials can be valuable in seminars to improve the understanding of concepts through evaluation and discussion. In these circumstances, the importance of providing students with opportunities for choice, independent learning and to promote talk that is exploratory (Mitchell and Mitchell, 1997) is crucial. Equally Abercrombie and Terry (1978) argued that it is crucial to establish an environment in which all students can listen and speak. However, a number of problems are commonly experienced with case study based seminar teaching. These include difficulties for the tutor in assessing the level of

understanding of each student, a lack of participation by some students, the tendency for other students to dominate discussion, and difficulty in ensuring that discussion is focused on issues relevant to the specific learning objectives. (Anderson, 1997).

The paper considers how one form of technology may have the potential to improve the learning experience of each student in case study based seminars. The technology consists of wireless handsets, a PC and data projector. A pilot study was undertaken, in order to explore its value in focusing debate and increasing participation. The analysis is exploratory, considering both student and tutor practice and reactions, and the extent to which the technology is capable of addressing the difficulties of case study based seminar teaching set out above.

The results at this stage indicate a positive reaction by most students to this type of seminar. The advantages were wider student involvement, more focused debate and a greater degree of collaborative learning. Since the Pilot Study, we have used the technology on undergraduate and postgraduate courses as a result of positive indicators from the findings and requests from students. Vygotsky's theories of learning, especially his work on the social nature of learning, have provided a basic framework within which to understand how student interaction can facilitate learning and problem-solving in groups (Vygotsky, 1986; Feuerstein and Jensen, 1980). More recently, the concept of "situated learning" has emerged with roots in anthropology, cultural psychology and cognitive science. (eg, see Littleton and Light, 1999; Dant, 1991). This philosophy recognises that human cognition and learning are involved with processes of dialogue, interaction and inter-relatedness between people in a social context. That is, "*learning and thinking are always situated in a cultural setting...*" (Bruner, 1986).

Group process support systems in an education setting

Group Support Systems (also known as Electronic Meeting Systems or Group Decision/Process Support Systems) have hitherto been mainly reported in applications aimed at aiding decision-making processes in groups. In this paper we will use the generic term Group Process Support System (GPSS). Since the early 1980s a number of experimental applications of GPSS have appeared in the literature (see Fjermestadstar and Hiltz, 1998 and Stevens, 1995 for reviews of applications). A foundation for the study of group decision support systems has been presented by DeSanctis and Gallupe, (1987). Overall, the results have been inconclusive, with a tendency to find insignificant differences in terms of quality of decision outcome, between unsupported and supported face-to-face groups. However, somewhat more promising results have been reported for groups supported by a network of computers engaged on idea generation tasks (Nunamaker, Dennis, *et al.*, 1991). A number of researchers have pointed out that reasons for these inconsistent or inconclusive results from GPSS research may include the use of ad-hoc groups lacking a history of working together; the use of contrived tasks in laboratory settings rather than real tasks in organisational settings; the frequent use of small groups of four or less participants, with few reports of larger group research (Stevens, 1995; Reagan-Cirincione, 1994).

These results from groups engaged on decision related tasks have influenced our thinking in terms of potentially fruitful areas of application in the classroom. During teaching and learning in groups, tutors typically face the problem of discovering how individual students are progressing, both in terms of knowledge and of understanding. Tutors may interact with learning groups as a way of gauging progress, but typically lack ways of gaining immediate feedback from all but a minority of students. Information relating to student progress is commonly obtained from post assessments, which follow the teaching of crucial elements of a curriculum. These probes are, therefore, "off-line" to the actual teaching and learning process in the classroom. Skilled tutors will try to monitor student progress by generating debate during classroom sessions not only to assess levels of understanding, but also to aid the learning process itself.

Studies by Briggs *et al.* (1993), Brandt and Briggs (1995) Craven (1994) and Gear (1993) suggest that a GPSS can produce better student responses than traditional classroom discussions. The researchers decided to undertake a pilot study in a classroom situation where group debate is traditionally encouraged: analysis and discussion of business cases in degree level education. Having made this choice of application, it was necessary to select a technology to aid the on-line process. We decided that it was important to maintain a group focused debate, and so a handset based approach used in conjunction with a single large feedback screen was selected in order to minimise the intrusive aspects of a technology. However it is noted that networked PCs have been used with large student groups: Leidner and Fuller (1997) have reported that the students in such a situation showed more interest in the material, and perceived themselves as learning more than students working on their own.

Establishing the context

The Pilot was based on the University of Arizona framework (Nunamaker *et al.*, 1991) which considered group size and composition, type of task, context and the role of technology. Student groups were selected from the undergraduate program in Business Studies to work on pre-seen case studies in a 1hr seminar. Tasks varied from simple decision-making to the discussion of controversial issues connected with the cases. The study of business cases can be a valuable teaching aid, allowing students to put into practice issues covered in a course by analysing real life experiences. MacLennan (1974) has suggested that there are four stages when using a case study as a teaching aid:

- i. tutors set the scene and indicate the objectives of case evaluation
- ii. students study the case in their own time
- iii. students in a seminar session may be split into small groups to share their knowledge
- iv. feedback from each of the groups and the discussion and clarification of key areas.

This traditional approach has been used with students in the Business School, but problems have arisen as the student group becomes more diverse. Based on experience,

it had become apparent that not all students take an active role in the evaluation of cases in debate for a number of reasons including: lack of confidence; lack of interest; lack of involvement and lack of preparation.

Anderson (1997) interviewed university students to discover what they saw as key features in promoting active learning within seminars. They included students investing effort in discussion and creating a good atmosphere, students' own self-esteem and confidence, the nature of the subject being discussed and the tutor's skill in facilitating debate.

The use of group process support to aid the debate of case studies has the potential to address these issues, and to allow all students to contribute at different levels. This may also help to develop confidence, as well as to motivate and involve some reticent students.

Overview of the technology

"Teamworker" a GPSS system, comprising hardware and software, has achieved some success as an aid to decision-making in a number of applications in both the private and public sectors (see Gear and Read, 1993; Read, Gear and Devold, 1998; Read, Gear and Townend, 2000). It has also been tested in education with final year degree students studying pharmacy in order to aid the development of professional skills (Irving and Hunt, 1994). The technology was easy to use in a group, stimulated a targeted debate of key issues, enabled the monitoring of individual and group performance on-line. It is a user-friendly technology, with virtually no learning time requirement.

"Teamworker" comprises a set of handsets, each having a numeric keypad with the digits 0 to 9. On pressing a key, a handset sends a signal to a receiver. The receiver is linked to a notebook PC, loaded with GPSS software. The PC is normally linked to a data projector to provide a feedback screen display for the whole group (see Figure 1). The software enables a series of issues or multiple choice questions to be displayed to the group at appropriate points. In addition, ad-hoc questions generated during the session can be displayed. Responses can be shown graphically to the group. These displays show the differences of opinions from group members, and normally maintain individual anonymity of response (see Figure 2 for a sample question and response screen). All responses are saved in a session file, allowing students and tutors to analyse the results of the debate in follow-up work.

Methodology

One of the researchers was the tutor using the technology in order to guide the analysis and debate. The tutor, and the students themselves, were thus part of an action research activity, in which the introduction of the technology represents an intervention into "normal" practice (McNiff, 1988). Sherman and Webb (1998) feel that events can be understood only if they are seen in context and it is important that a researcher immerses her/himself in the setting. In this sense the intervention is an

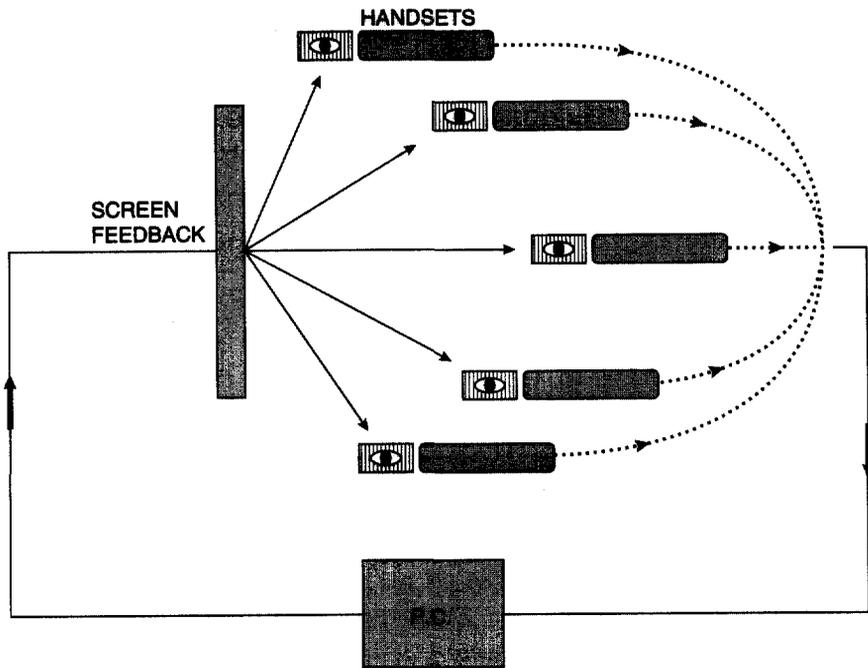


Figure 1: The on-line feedback system for group work

experimental manipulation with the goal of finding improved methods of running business case sessions with student groups.

The tutor involved had a great deal of experience in seminar work and was aware of the issues that needed addressing. A conscious decision was made at the start of the research not to use a control group in the Pilot Study. Many of the student groups were final year and it was seen as unethical to experiment with their learning experience. Instead the tutor's previous experience of case-based teaching was used as the base line.

A variety of data collection methods were used to obtain a foundation on which to base further research and application. These included: non-participant observation; tutor field notes; informal discussions with students; evaluation questions and responses to the questions during the session itself. The research questions were:

- Do students and tutors perceive an added value in the use of the on-line technology?
- Would the technology effectively support the seminar's learning objectives?
- Are particular ways of utilising the on-line technology more appropriate than others in a seminar setting?

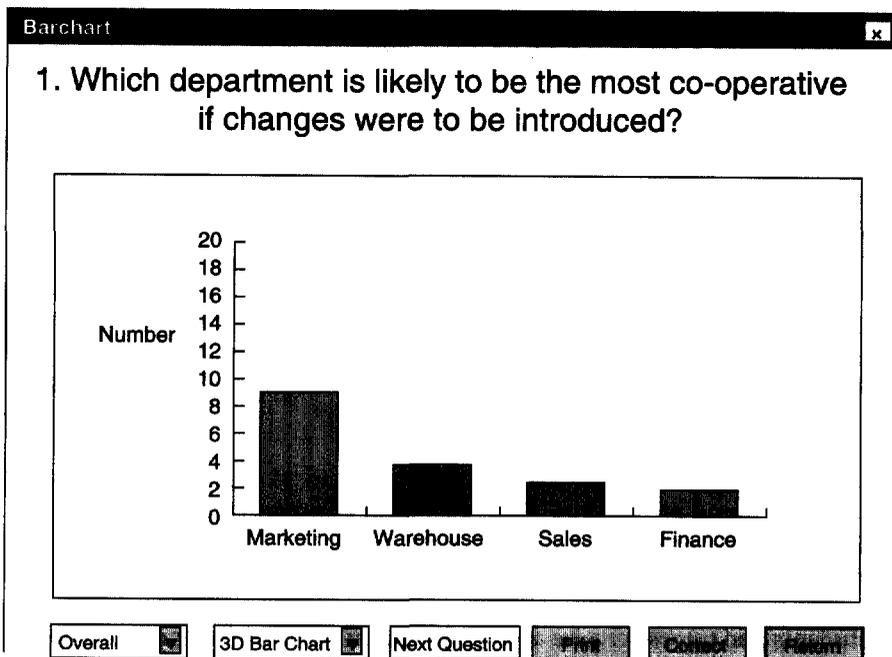
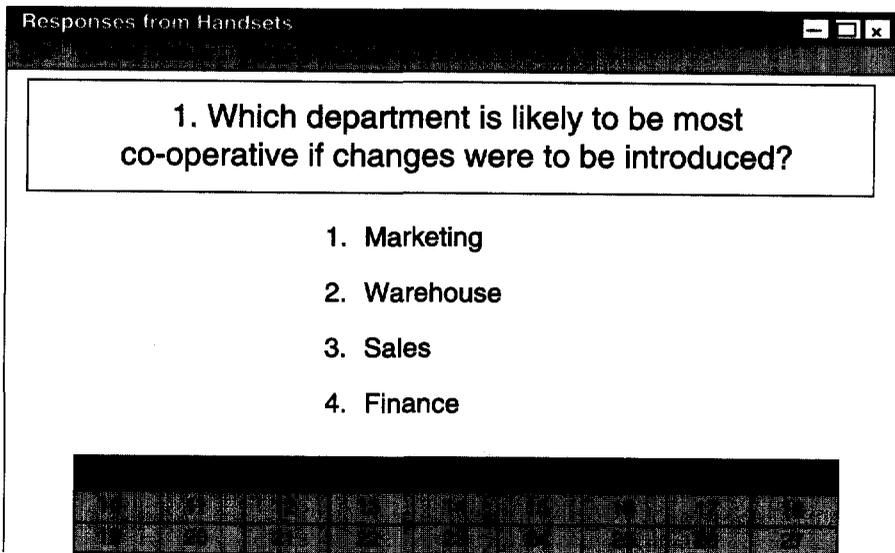


Figure 2: Sample question and response screen

Other concerns were:

- Would the questions lead to an over-simplification of the case?
- Would the students participate more or less and what form would the participation take?
- What exactly would the role of the tutor be in this new situation?
- Would the technology have an effect on teaching style?
- Would the technology be too dominant?

Applying the framework

The initial Pilot consisted of four one hour seminars and were absorbed into the normal teaching programme. The diverse sample included business information management students; business studies students from a range of awards; combined studies students; part-time students; mature students and overseas students. The majority of students were in the 18–23 age group. The aim was to produce a practical assessment of the use of “Teamworker” in the classroom, and if the findings were significant to develop a plan for further research. Consideration was given to a range of variables including group composition; room layout; case study experience; group size and hands *et al.*, location.

Table 1: A breakdown of the trials by groups and handset allocation

Trial	Level	Group Composition	No. of Students	Allocation of Handsets
1	Final Year MIS option	Full-time business studies students; part-time students; mature students; Erasmus students.	18	“Individual Use”
2	2nd Year Compulsory module	Full-time BIM students; mature students; Erasmus students.	32	“Team Use”
3	Final Year Compulsory module	Full-time BIM students; mature students; part-time students.	18	“Individual Use”
4	Final Year Compulsory module	Full-time BIM students; mature students; part-time students.	18	“Team Use”

The tutor had taught all the students for at least one semester, and her experience of the groups is summarised below and illustrates the diversity of the sample.

Trial 1

This group was the most disparate. The module has no pre-requisites and any final year student from the undergraduate scheme can select this module. This was the only seminar in which they met and group dynamics had not been established.

Trial 2

The majority of the students in this group was on a specialist award and accustomed to working together. The group split naturally into teams of 4 or 5 students based on established work and social relationships. Some latecomers had to join a team with which they were less familiar and were unsettled by this.

Trial 3 and Trial 4

The students had studied together for a minimum of 2 years and were used to working collaboratively. The same students were used in two sessions, but the sessions were organised in different ways. Certain students had tended to dominate this group in the past and it had become an unwritten rule that they would speak for the group. In Trial 3, students were given a handset each. In Trial 4, students were put into teams of 4 or 5 students and traditional groupings were deliberately broken. All the students had some level of work experience and were quite familiar with case studies as a learning tool.

Procedure

Session design

Students were given a business case to study before the seminar and asked to prepare material on issues in advance. The seminar objectives were to encourage the students to critically analyse areas under discussion in the case and to suggest improvements based on the points raised. The software is flexible and allows the tutor to build question files that test a range of skills and issues. Questions in different formats (eg, "open ended"; "Likert scale"; "off the wall") concerning the case were prepared by the tutor, and entered into the software. The questions were designed to both test the student's knowledge of the case, and to facilitate debate. (See Figure 3 for example questions).

Apart from experimenting with teaching material, the Pilot also allowed us to test room design and the allocation of handsets to "individuals" or "teams". Although the interactive technology would play a key role, face to face communication within the group was thought to be vital, and so careful attention was given to this aspect, based on tutor experience of room layout. Prior knowledge of the group proved to be very useful: eg, where to sit nervous and dominant students or to how to split up certain groups of students if appropriate.

Trial 1 and Trial 3 ("Individual Use")

The tables were organised into a rectangle, thus allowing the students to see each other, the screen and the tutor. Each student was given a handset. The tutor was at the front of the room to highlight points on the screen and direct discussion if required.

Trial 2 and Trial 4 ("Team Use")

The tables were organised into groups allowing 3–5 students in each team. Each team was given one handset. The students were able to work in small teams but could clearly see the screen for plenary debate. The tutor was based mainly at the front but could easily move amongst the groups. In order to compare the difference in group dynamics, the team handset sessions were organised in two ways. The Trial 2 students selected their own teams and Trial 4 were randomly put into teams.

Sample Question Formats

Question Number : 1

The company is a good place to work

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

Question Number : 2

Comment on the quality of information in the Organisation

1. Excellent
2. Good
3. Satisfactory
4. Poor
5. Appalling

Question Number: 3

What are the major strengths of the organisation?

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.

Question Number: 4

Which Manager is the most effective?

1. Sales Manager
2. Finance Manager
3. Warehouse Manager
4. Marketing Manager

Figure 3: Sample question file

The seminar sessions

Each seminar began with a brief explanation of the technology: a demonstration question was used to acquaint the students with the system. The format of the seminar was then introduced, questions were asked, opinions fed back via a screen and areas of

importance were debated focusing attention on differences of opinion (Figure 4 illustrates the process). At the end of each trial, an evaluation of the session was carried out by on-line questionnaire, tutor reflection and informal discussions with the students.

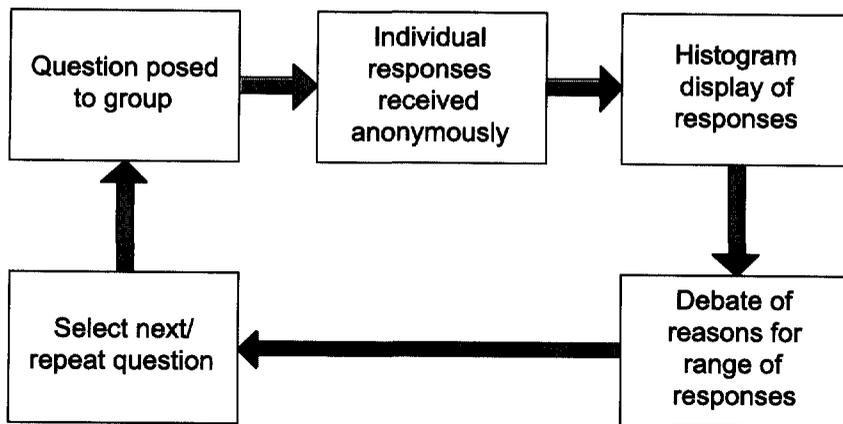


Figure 4: *The Feedback process to facilitate debate*

Reflecting on the pilot study

Tutor perceptions of student experience

This section reports on the tutor's perceptions of the trials. In all the sessions, the students seemed quite relaxed about the technology and were very interested in the feedback screens. Anonymous answers were beneficial: students felt they could express an opinion without being judged, either by the tutor or their peers. They (particularly in the "individual use" handset sessions) appeared to be more comfortable presenting their own ideas via the system and students were focused and attentive.

In previous seminars, without the use of the technology, students tended to work on their own and not discuss points with each other. It was hoped that the technology would encourage wider discussion. The sessions were animated and the students demonstrated a good understanding of the cases by providing thoughtful, relevant and appropriate responses to the questions. Certain students who always contribute behaved in the usual way. Quieter students responded via the technology but were still reluctant to discuss their responses unless encouraged to do so by the tutor. The overseas students in Trial 2 played a more active role and came to find the tutor after the session to state that it was the best seminar for them so far—they felt able to contribute in ways not previously possible.

On reflection, all the sessions operated successfully as vehicles for student participation. The questions did not lead to an over-simplification of the case, but ensured focused debate that developed well beyond simply selecting a number on the handset. It was

useful to reflect on which questions worked best from a teaching perspective. Overall, from a tutor's point of view, all students were able to participate and focused discussion was generated in every session.

It is premature to make claims about learning outcomes at this stage of the research. This would have to be assessed over a longer time-scale. However, two of the seminars were linked to an assessment and the sessions appeared to help clarify difficult issues in the cases.

Student perceptions

After each seminar, the students were asked to answer some reflective questions on their experience of the seminar and the use of the new technology. The handsets were used for this purpose, encouraging honesty of response. The questions covered a range of issues from general reactions to the seminar to technology and future use. A study of the figures shows that all the students were happy with the sessions, and found the level of participation and number of ideas generated greater than normal (Figure 5). They also all found the technology easy to use, and found it easy to contribute to the debate. However, a minority of students disagreed that the influence of individual personalities was low. All of the students felt that it would be useful to use the technology for other sessions involving the analysis of business cases. If we consider this in more depth, three themes were addressed by the evaluation questions.

Participation

All students agreed that the level of participation was greater than in a seminar without the technology. Over 70% felt that the level was much greater than normal and the remainder felt it was greater.

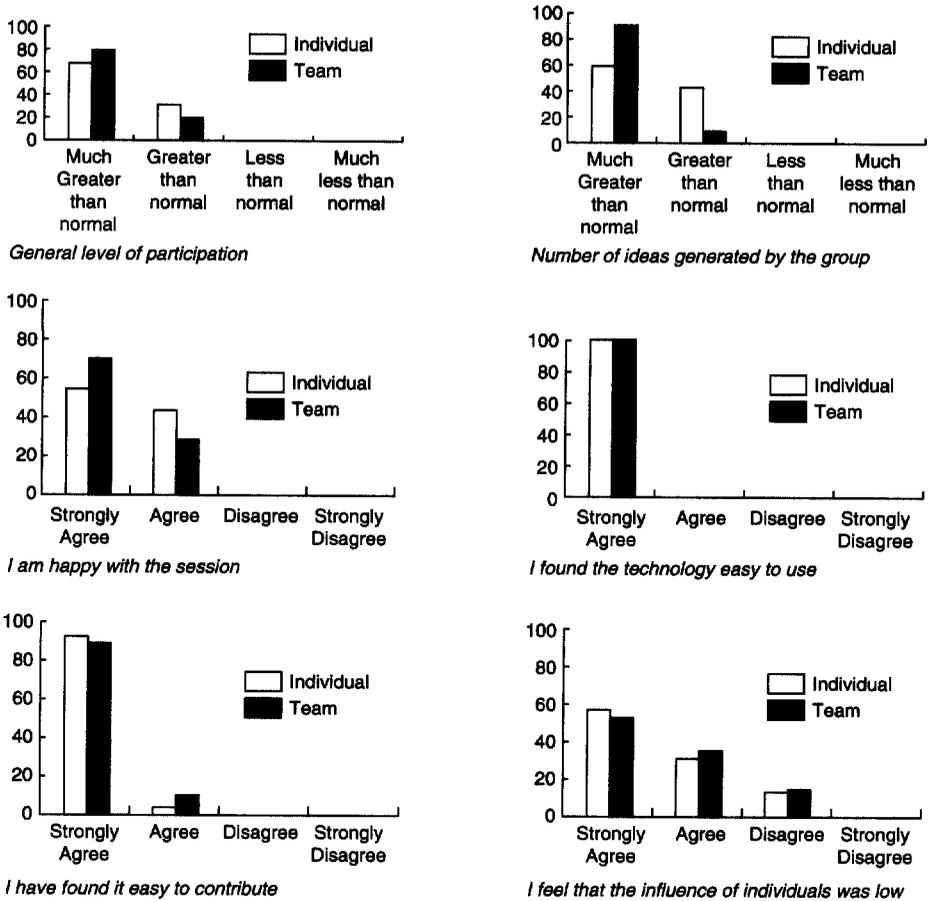
A common issue in seminars is that certain students can dominate sessions and this was one of the issues we were keen to address. The technology seemed to have a democratising effect and only 10% of the sample felt that some students had dominated the seminar.

Idea generation and discussion of issues

Another important issue was how easily could students contribute to the discussion once issues had been raised. Encouragingly over 90% found it easy to contribute and the seminars certainly were focused and discussions were comprehensive. A seminar ideally should be a session that generates ideas and allows the tutor to judge student's level of understanding. The students certainly agreed that the technology increased the number of ideas generated by the group. Although all responses were positive, there was a better reaction from the team sessions than the individual.

Technology

We did not want technology to dominate but to support the discussion, encourage debate and stimulate focused analysis of the case. All the students strongly agreed that the technology was easy to use and they needed very little instruction. There is a danger



Numbers of students: Individual = 36, Group = 50

Figure 5: Student perceptions

that a “novelty factor” is attached to new approaches particularly where technology is involved. All the students felt that it would be useful to use the technology to analyse other cases. Since the pilot study, we have used the technology with many of the same students and broadened the involvement to postgraduate courses. The reactions are still positive and we intend to monitor this over a period of time.

“Individual Use” vs “Team Use” of handsets

The feedback screen always stimulated debate. Guidance and encouragement was needed from the tutor for all the trials, but in different ways. The “Individual Use” handset sessions were not as dynamic. There was less independent group debate, but the reactions of the students were interesting. In Trial 3, one student who normally

participates was uneasy, not about the use of technology, but the change to session routine. Indeed, his body language suggested a negative effect on his confidence. Most discussion points in the "Individual Use" handset session were directed at the tutor.

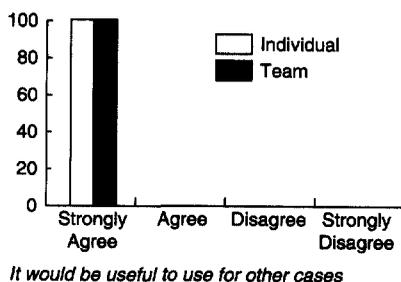
In the "Team Use" sessions, there was considerable discussion within the teams. Students took a more active role, and the technology helped to draw together points, and develop debate between groups. When a consensus could not be reached, their problem-solving skills were exercised. These sessions were far more dynamic and the students appeared to be in more control of their own learning. Groups worked well together and it was noticeable that the overseas students played a more active role. The students seemed motivated and actively participated. The tutor did not need to encourage debate - the students were quite able to do that themselves. The role of the tutor was to control discussion and move the debate on when necessary. This was essential in trying to ensure that the learning objectives set at the start of the seminar were achieved. Informal meetings with students were invaluable. Their reactions were very clear—this was an effective way to work with case studies.

Discussion and conclusions

The tutor involved in the project identified four major benefits of using the technology based on wireless handsets:

- Firstly, it provided an easy means of focusing attention and subsequent discussion. In a 1-hour seminar session, rapid feedback is extremely useful. The feedback display showing the extent of agreement and disagreement made it straightforward to manage a classroom debate around the differences of opinion. The tutor was operating more as a classroom manager, timing, for example, when to reveal further information, make comments, or supply correct answers as appropriate. Student responses to issues and problems were displayed instantly and appreciated, they liked the immediate feedback. The on-line technique allowed the seminars to move at a rapid pace and to focus on areas needing attention.
- Secondly, the tutor perceived a significantly higher level of involvement and participation than usual. This was particularly true when the students operated in small teams rather than individually. The system had a democratising effect and encouraged a diverse group of students to all contribute in different ways to the debate. The level of discussion was of a high standard. Students remained focused and attentive throughout the session. In "normal" sessions, debate tended to be dominated by a minority and could become unfocused. The technology offered a flexible framework for discussion. Bannon (1996) comments on the importance of "talk". The "Team Use" handset sessions worked particularly well and students were able to resolve a range of complex issues effectively, and confirmed the findings of Forman and Cazden (1996). Most importantly, the on-line feedback meant that the tutor was aware of issues of misunderstanding, or learning difficulties, at the time, and was able to address them during the session rather than later. Students were more motivated than in traditional case study seminars.

- Thirdly, the issue of establishing equality in a diverse group was addressed. According to Walsh *et al.* (1996) equality of participation leads to more collaborative learning. Using the GPSS, allowed all students to contribute in some way. There was a particularly positive reaction from overseas students who felt that they could contribute on more equal terms in the seminars.
- Fourthly, it seems premature at this stage of the research to comment in depth about how the success of this approach can be linked to learning outcomes. However we had some positive indicators. The case study used in two of the trials was linked to an assignment and students certainly seemed to benefit from the work done in the seminar. Also they were able to analyse the results in a spreadsheet. Student have asked to use the technology with business cases (Figure 6) claiming that it helped their understanding of the issues. If learning outcomes are about developing knowledge and key skills, then the approach has potential.



Numbers of students: Individual = 36, Group = 50

Figure 6: Student perceptions

The technology offered a number of advantages. The layout of the feedback screen was clear, and contained enough information to stimulate discussion. The software allowed responses to be displayed quickly and to be anonymous or attributed (depending on what the tutor wished to achieve in the session). Anonymity lowered the risk of being exposed by a wrong answer. Our experience supports the importance of anonymity to a more open debate (Aiken, 1992). Further analysis of the responses in a spreadsheet after the session was valuable for the tutor and/or students. It was unanimously agreed that the technology was simple to use and to an extent became "invisible." The handsets were simple to use and the software presented the results of the questions instantaneously. From a student point of view, the evaluation questions were answered positively—student perceptions of the value of the technology were very encouraging. Comments on understanding and interaction were obviously vital for the future use of the GPSS in a classroom setting. Students felt they would like the opportunity to work through case studies in this way again. In this connection it may be noted that Anderson (1997) has claimed that seminars provide an opportunity for active learning to take place, and for communication skills to be developed.

Recommendations

The pilot study indicates that it is feasible, and beneficial, to introduce interactive sessions of this type into modules containing business cases. The experience supports a collaborative model of learning (Race, 1998) which encourages the exchange of diverse ideas, as well as the feedback of those ideas, as crucial components in the effective processing of information and concepts. The paper has described one promising approach to realising this model, which should encourage further research aimed at addressing a number of issues, including the following:

- Are learning outcomes significantly enhanced?
- Is retention of learning enhanced?
- What are the effects over time as a group learns to use the system?
- How does the technology vary in effectiveness between small or large groups?
- For what types of session is the technology an advantage: cases, lectures, seminars, debates, etc?
- How does the technology help mixed groups?
- In what subject areas may there be benefits?
- Can the technology be used successfully by a range of tutors.

These questions are concerned with assessing the effectiveness of group process support for learning in a variety of contexts. So how do we move forward to explore these questions? Since the Pilot study, we have extended the use of the technology to post-graduate courses and we have also used the system repeatedly with some groups. If we wish to look at learning outcomes this can only be done effectively over a period of time.

We are convinced that technology is a valuable tool for supporting case study analysis and developing important skills in students but we wish to broaden the study. It is our intention to introduce this application of technology to a range of subject areas in the University of Glamorgan and also look at its applicability in other teaching situations. The team would welcome collaboration from interested colleagues in other educational institutions to explore the questions raised in the paper. It is appropriate that one of the students should have the last word:

“The seminar made me look at the case from different perspectives and discuss ideas. I like to be able to see what other people are thinking and know that I am on the right lines. This is a good way to learn and develop a bit of confidence.” *Final Year Student.*

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