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Developing Conversations: Supporting Learning with a Group Support System

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ABSTRACT

This paper explores the process of supporting learning through the use of a 'low impact' Group Support System (GSS) based on handset technology. The protocol used is described and a conceptual framework is proposed with which to explain practice. The framework centres on the encouragement of conversation which is focused on the reasons for differences, coupled with a reduction of personal anxiety, achieved with the flexibility offered through the GSS meeting environment. A field-based case study in post graduate education is reported in detail, and a number of other field-based case studies are reported in summary. These serve to demonstrate the potential for suitably designed Group Support Systems to aid groups to overcome certain fundamental difficulties with which they have to contend.

Keywords: Conversation, Group Support System (GSS), Handset Technology, Low Impact, Supporting Learning

INTRODUCTION

A broad spectrum of group decision (or process) support technologies (or systems) has been developed since the early 1980's, which is referred to using the generic term Group Support System (GSS). These are information systems used to support the process by which a group of people meet and interact for learning and/or deciding type tasks. They are sometimes also known as Group Process Support Systems, Group Decision Support Systems, Electronic Meeting Systems, and Electronic Meeting

Aids. They have been developed to alleviate the well-documented problems of groups such as conformity of group members, domination of the group by certain individuals, and the effects of miscommunication within the group.

There are a number of different types of GSS, including networked computer based GSS (e.g. Nunamaker et al., 1997; DeSanctis et al., 2008) and handset based GSS (e.g. Jones et al., 2006, Read et al., 2007). The objective of these systems are to improve the effectiveness of the group process and reduce negative effects of groups, including the pressure to conform,

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free riding of members, and domination of the group by one or more members (Nunamaker et al., 1991). Many GSS will share common characteristics (Finlay & Marples, 1992), including enhanced communication facilities between group participants, enhanced modelling and interface facilities to permit voting and ranking, and the availability of both qualitative and quantitative decision support tools, with which members are comfortable, which are transparent in operation, and which are flexible. Such systems may be designed to embrace features of group-based processes, including processes of information sharing, storage and retrieval, and also of learning (Wilson et al., 2007).

The majority of research into GSS has been based on computer networked systems and there has been limited research into GSS based on handset systems, known as keypad-GSS or k-GSS by Watson et al. (1994), when compared to GSS based on computer networks. Finlay and Marples (1991) identified handset based systems as being ideal for average size meetings and which can be easily carried from room to room. Watson and Bostrom (1991) identify two strengths of handset based GSS: their portability which enables them to be used in a wide number of settings, and the display of voting which is flexible and easy to use. Because of the less intrusive nature of handset based GSS on the group when compared to networked GSS, these systems are also known as ‘low impact’ GSS (see e.g. Read et al., 2012).

A number of trials of this type of low impact GSS have been carried out in classroom contexts (e.g. Gear and Read, 1993; Irving and Hunt, 1994; Jones et al., 2001, Banks, 2001, Groves et al., 2006). When used in a classroom, these systems can also sometimes be known as Audience Response Systems. Kay and LeSage (2009) have given a comprehensive review of teaching strategies in higher education that have been developed using Audience Response Systems, including general teaching strategies, motivational strategies, assessment strategies and learning based strategies.

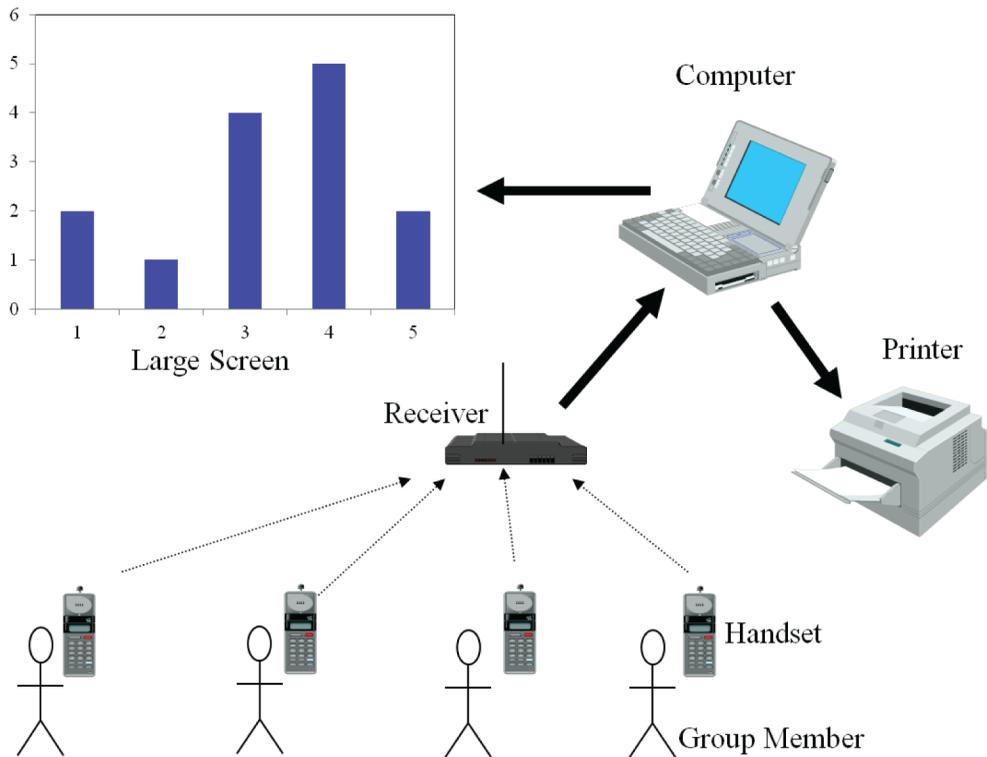
THE TEAMWORKER GSS

We have developed a handset based ‘low impact’ GSS that makes use of a wireless handset approach in order to maintain face-to-face interactions, augmented by the additional channel of communication provided by the technology, known as *Teamworker* (Gear & Read, 1993). Each member of a group is provided with a wireless handset. This comprises a 0-9 numeric keypad, styled to mimic a telephone layout. We term this type of system as a ‘low impact’ GSS because the technology has a lower profile within the group when compared to networked systems, and focus is maintained on a single group screen. The difference in technology between networked systems and ‘low impact’ type systems, and the resulting differences in the group process, means that results of studies with the former cannot necessarily be transferred to the latter.

At appropriate points of a meeting, a group member can enter their judgement, vote, or opinion on an issue by pressing a key on their handset. The messages are all received at a single personal computer running selected software for the meeting type. The computer is linked to a large screen in order to display the set of judgements that have been entered back to the group in various graphical formats (see Figure 1). Typically, this feedback might be a histogram showing the range and distribution of inputs, while maintaining personal anonymity. The handsets can be used to enter a range of judgement types, including scoring, voting or comparing options, assessing parameters such as risk, and assessing feelings or emotions.

This ‘low impact’ GSS is designed to overcome emotional barriers to the use of technology, whilst maintaining face-to-face communication, aided by a single group screen. This paper is aimed at extending existing theory, stemming from observations of a series of field applications using this GSS design. One educational application, the use of business cases with postgraduate business students, is

Figure 1. The teamworker group support system



developed briefly We introduce a conceptual framework that builds on ideas which seek to explain how a ‘low-impact’ GSS environment can enhance individual and group learning in face-to-face group sessions.

The perspective adopted proposes that a group of individuals working on a task can learn (develop or change their beliefs, ideas, etc.) by exploring the reasons for differences of opinion in conversation, provided each member is able to express their feelings without inhibition from the social pressures that such a process may produce. In other words, the anonymity provided by the GSS environment enables participants to express their view without the risk of being publicly undermined. When making personal judgements in a less ‘risky’ environment, learning, or taking on new ideas and changing opinions, may be more likely to occur without jeopardising one’s standing within the group.

GSS GROUP PROCESSES

Research into the effectiveness of GSS in experimental settings (e.g. Barkhi and Kao, 2011) and field settings (e.g. Luo et al, 2011) has provided variable results. In a thorough search of the literature, Fjermasted and Hiltz (1999) reviewed over 200 different controlled experiments that had been published in the academic literature (both journals and conferences). They found that there was no significant difference between supported and unsupported face to face decision making groups. However, research using field experiments and real-life applications appear to be much more positive. For example, Chun and Park (1998) compared experimental and field studies. Eighteen field studies were identified from the literature, each of which measured different variables. Analysing the results of each of these field studies,

Chun and Park (1998) found that, when using a GSS, the time to decision and decision quality were improved, and that participants reported satisfaction with the process using a GSS, had high confidence in the decision outcomes and reported improved participation. The reasons for the inconsistent results between experimental and field settings may be due to the use of contrived tasks with small and adhoc groups of often four members or less in experimental settings (Stevans, 1995).

In an influential review of GSS group processes by Nunamaker (1997), it was noted that the GSS research had established the improved productivity of GSS groups compared to those without technological support. In a comparison of a number of field studies from around the world, it was found that a significant saving could be made in both labour costs and time spent through the use of this intervention. The reasons for this saving were explained through the effect that GSS had on both reducing 'process losses' and augmenting 'process gains' (Nunamaker, et al., 1991). *Process losses* describe the problems experienced by groups that produce a negative effect on the interaction and, consequently, the group outcome (e.g. free-riding, production blocking, evaluation apprehension, domination, etc.). *Process gains* refer to the qualities of group interaction that can enhance the process and contribute positively to the group outcome (e.g. synergy, stimulation, learning, democratic involvement etc.).

These issues have been addressed through the introduction of managed process techniques, such as Delphi Technique (Dalkey, 1967, MacCarthy & Atthirawong, 2003); and Nominal Group Technique (NGT) (Van de Ven & Delbecq, 1971). Nunamaker et al. (1991) and others since have also found that a GSS process employing forms of NGT effectively enhances the group process beyond manual process techniques, by reducing some process losses and improving the potential for process gains, e.g. Reagan-Cirincione (1994). The group meeting scenario is often fundamentally described as comprising main *input* (resource) categories, including: the participants; the place; the time;

the task; and any technological process aids used by the group. These components operate together toward the group *outcome*, by means of a central *process*. As previous research advises, it is within the process that we can find a description of the relationship between these inputs and outcomes (See Figure 2- Gear, Read & Minkes, 1996).

However, Weingart (1997) commented that related management research rarely focuses on the intricacies of participant communication processes, but tends to reduce the procedure to input-output relationships or more static measures of validity. Rohrbaugh (1989) agrees, stating that "*Any assessment of the effectiveness of a group decision process ... requires directing primary attention to the process itself, not to subsequent outcomes*". Finlay (1998) makes the point that validation of a GSS has to involve the development and testing of a theory of process.

We contend that validation of GSS involves the development of explanatory theory, emerging from research of three aspects: the details of process, the perceptions of participants, and the value of outputs in a given context (Read, 2003).

THE 'TEAMWORKER' GSS PROCESS

The 'Teamworker' GSS is employed to facilitate a given group, providing a semi-structured environment, allowing both focussed discussion and structured, individual responses to issues, in a face-to-face setting. The low impact technology guides participants through sessions where a series of questions are presented, to which they respond (individually and anonymously) via the GSS. The process mimics the Nominal Group Technique, in that participants are able to discuss differences of opinions based on anonymous inputs. Figure 3 illustrates the stages of the GSS group process.

A question is presented to the group via the GSS, providing several options for participants to choose from. Each member is required to select the option that reflects their judgement via their individual handsets. The GSS displays the

Figure 2. GSS group meeting components (Gear, Read & Minkes, 1996)

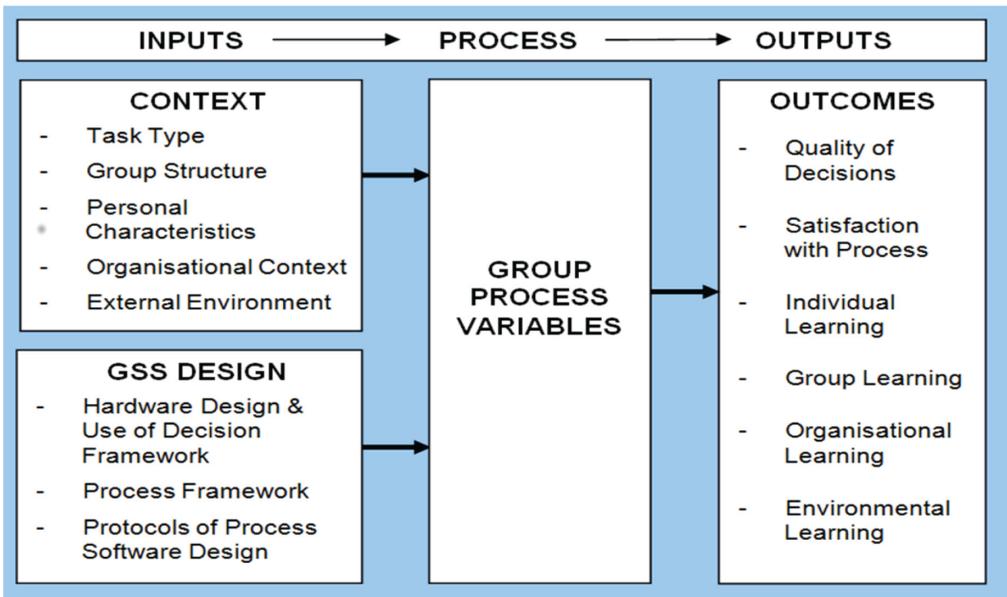
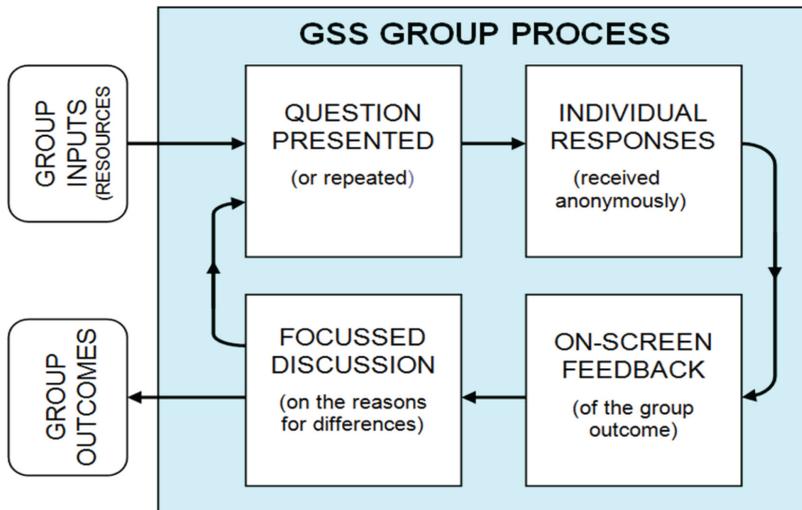


Figure 3. Protocol of a typical, 'low impact' GSS group process



range and distribution of responses in histogram form (barchart) via a large group screen. This stimulates a discussion that is focussed on the reasons for differences of opinion. During this group discussion, the participants are able to explore the various points of view, and assess

their decision in light of this interactive session. The question may be repeated via the GSS screen and participants are shown the new histogram.

In the consensus-based decision environment, a face-to-face group discussion enables the exchange of important information, such

as a review of relevant literature, presentations from experts, and the sharing of personal concerns. The use of this kind of ‘low impact’ GSS enables individual judgements to be made anonymously, in order to reduce personal anxieties that may affect a participant’s ability to express their opinion in a group setting. It is proposed here that, by providing anonymous judgement conditions within a face-to-face group environment, participants can absorb and reflect on the information available, whilst feeling less anxious, and therefore, more able, to develop and express their personal judgements.

SOCIAL INFLUENCE

‘Social Influence’ focuses on the idea that interpersonal processes can lead to changes in the beliefs, feelings, or behaviours of another person (Forsyth, 1995). However, these social influences can sometimes cause changes that may be detrimental to an individual’s judgements. Whilst the main aims of forming workgroups may be to increase the number of ideas and perspectives that are brought to bear on the task, and to improve on the pool of knowledge used to provide background and weight to the judgements made, the group situation itself, and the idea of expressing oneself in public, may cause obstacles or distortions in the overall outcomes they produce.

The main aims of the GSS process, however, are to facilitate constructive, focussed discussion (the communication of expert knowledge, ideas, opinions, etc.), provide time for individual reflection, and reduce the biasing or destructive anxieties of working with others. Participating in a group can be a daunting experience, as various perspectives and levels of expertise, status and power are present, which may provoke a kind of ‘performance’ or ‘judgement’ anxiety in other members. When a person is required to communicate and express him/herself in a group situation, they may feel that their knowledge, opinions, ideas, and even their personal characteristics, are at risk of being brought into question or possibly undermined.

During a GSS process, there are periods of group discussion, interspersed with anonymous voting rounds, where individuals can express their view privately. Once a round of voting has taken place, and the range of opinions has been displayed, a discussion on the reasons for differences of opinion may bring some clarity to any conflict that may arise. However, if the discussion fails to reconcile these differences of opinion, each individual must make their decision based on their assessment of the information exchanged, and the rationalisation of their own views, during personal reflection.

In any face-to-face group situation where new or different ideas are presented that are contrary to the view held by a participant, the group outcome requires that each individual resolves this conflict, whilst in the confines of the group environment when forming their final judgement. The apprehension of actively participating in this kind of environment may cause a distortion or biasing effect on the process of individual reflection.

Adverse social influences that can sway a person’s judgement *toward change* may include: being inhibited by an opposing expert or dominant opinion; or the persuasive power of a large opposing majority. Majority influence could be ‘adversely’ influential to an anxious individual in a minority position. Moscovici (1980) argued that, whilst minority influence leads to true opinion change (‘conversion’), majority influence produces agreement in public, but possible disagreement in private (‘compliance’). Conversely, adverse influences *not to change* one’s judgement may include: a reluctance to change from a majority (popular) to a minority (unpopular) position; or a reluctance to express a change in one’s opinion as it could be seen as a sign of weakness, no matter how well-founded the opposition’s case may be. These outcomes are undesirable and will *not* help to improve the quality of consensus decisions.

The danger is that a participant’s decision could be influenced more by the fear of having their status/knowledge/personal characteristics undermined (e.g. self preservation), and less on

what is best for the task at hand. The perception of risk to a person's standing in the group may lead to a voting position that is based on more subjective, less objective or altruistic, reasons. This could result in a reluctance to give up one's own opinion (leading to *no change* in judgement), or a reluctance to express a minority view (leading to either *staying with* or *moving to the majority*).

The framework developed below aims to explain how the GSS environment can assist in overcoming the anxieties of expressing individual opinions in a group situation.

A CONCEPTUAL FRAMEWORK FOR INDIVIDUAL AND COLLECTIVE LEARNING IN A GSS ENVIRONMENT

The conceptual framework in this paper is based on the inter-relationships between anonymity, participation, anxiety and learning in groups, focussing on the role of conversation, and surfacing differences of opinion as an aid to learning. This framework is developed in order to gain insights into the role and value of 'low profile' group support technology of the form described in this paper. It may be useful to potential users of this type of technological intervention to share our experience of linking practice to a theoretical framework. This framework is based on three assumptions:

1. **Social Learning:** Individual learning can occur as an outcome of a social rather than solely personal process;
2. **Learning and Anxiety in Groups:** Individual learning processes are mediated at critical moments by the level of unease or perhaps anxiety that is experienced by an individual in a group setting;
3. **Exploring Differences in Conversation:** Opportunities for individual learning can emerge naturally when groups of individuals are able to explore their reasons for differences of view related to an issue or task.

The overall statement that emerges from the above is that a group of individuals working on a task can learn with each other by exploring their reasons for differences of judgement in conversation, provided that the process is designed to limit the level of anxiety which such a process may invoke in each participant. This has been put most eloquently by Jensen and Kolb (2002): "*If truth is to 'do its work' we need to create space that is hospitable and not filled with fear*".

Social Learning

Our thinking is based on the proposition, put forward by Vygotsky (1978), that psychological processes (eg of thinking and learning) have to be explained as part of active collaboration and participation with the social environment. Vygotsky argued that states of consciousness cannot be explained by consciousness itself, but in the interaction between thinking people. That is, consciousness "*arises, functions, and develops in the process of peoples' interaction with reality, on the basis of their sensuously objective activity, their socio-historical practice*" (Spirkin, 1983). The interaction is with physical objects and tools, as well as with what has been termed "psychological tools" (Vygotsky, 1978; Wertsch, 1985). These include a wide variety of metaphors and models, but most importantly, language, which serves to stimulate and mediate mental activity. Individual learning, from this perspective, concerns a personal process of working with, and internalising, the interactions of a public process, during which there has been an exchange of thoughts, ideas and beliefs. Turner et al. (2009) used Vygotsky's framework to explain how student-student conversations can be a positive support to the learning process and contrasted this approach with alternative frameworks which place greater emphasis upon the role of the tutor who knows the 'right' answer and corrects the learners.

A detailed presentation of this theoretical perspective in relation to second language learning, has been provided by Lantalf and Appel

(1998). These ideas closely parallel that of the social psychologist George Herbert Mead, who stated from a pragmatic viewpoint *“that mind can never find expression, and could never have come in to existence at all, except in terms of a social environment”* (1972).

‘Learning and Anxiety’ in Groups

Inevitably, individual learning implies a degree of unease, if not anxiety, with one’s current condition. Learning involves the acquisition of knowledge, revised ways of thinking and of learning how to learn. It may also involve relaxing, or rejecting, attachments to prior beliefs, knowledge and ideas that have served well enough before.

The approach to learning proposed in this paper is based on anonymised feedback of opinions and judgements, and reflection on them, which goes beyond a personalised process to a social perspective. This philosophy has been presented for example by Reynolds (1998), who has used the term ‘critical reflection’ with key characteristics concerned with a questioning of existing assumptions, a focus on the group rather than on the individual, and a view that learning is facilitated by a democratically organised forum.

Each person in a learning group is likely to experience some degree of unease, if not anxiety, at key stages of the process. The material may be new, or it may be difficult to make a personal contribution to the conversation. In this situation, there are two basic courses of action open to each participant: towards learning or towards an avoidance of learning. Vince and Martin (1993) develop this proposal in relation to organisational learning, and Read et al. (2012) have developed a practical method for surfacing and exploring ‘situated knowledge’ in an organisation using a low impact GSS which encouraged organisational members to give voice to the emotions and politics of leadership and learning in organisations, and which helped to articulate how situated knowledge was ignored as well as utilised. The GSS was particularly useful because the anonymity of

responses minimised individual defensive reactions to the difficult issues discussed. Individual behaviours will be conditioned by personality traits, but the design of the learning opportunity has the potential to stimulate or stifle learning.

Exploring Differences in Conversation

In the last two sections we presented a viewpoint that communication is material and is central to our being and knowing. We assume that we are a species motivated towards learning, which is enacted through conversation. Our third assumption is that the emergence of ‘difference’ is essential to learning (Wyss-Flamm, 2002). Exposure to difference(s) can stimulate the need to try to enter each other’s minds, something for which conversation is crucial (Argyris & Schon, 1978). An awareness of difference exposes to ourselves what we know, what we do not know, and what we want to know. This awareness can lead to intra-personal as well as inter-personal processes, interacting with each other as the conversation progresses. However, returning to our earlier proposition concerned with ‘learning and anxiety’, the quality of the conversational flow, in terms of its potential for learning, is likely to be strongly affected by feelings of anxiety. As Wyss-Flamm has put it *“we would expect the level of psychological safety in the conversational space to set strong tone for conversational learning in a team”*.

The level of ‘personal safety’ is likely to affect whether ‘the difference’ is treated as an opportunity for learning or a flight from it. The design and process for the use of technology in support of learning, which we describe in this paper, is aimed at the creation of a conversational space that is safe enough for risk taking behaviours to emerge so that differences can be worked with. An aim of our approach is to encourage the emergence of ‘dialogue’ (Isaacs, 1993, p.25). This form of conversation differs from ‘debate’ (with perhaps an adversarial tendency), but instead encourages a collective and collaborative communication process during which people can identify and explore their

individual and collective assumptions, views and beliefs, and probe into the reasons for them, as part of a mutual ‘learning & deciding’ activity. Groves et al. (2002) have reported an analysis of the quality of conversation in groups of health professionals.

The GSS technology, in design as well as in mode of operation, has the potential to provide a “safe container” in which differences can be exposed and worked with in an environment of reduced threat to each person (see also Rogers, 1970; Schein, 1993). The GSS which we describe in this paper is designed to reduce the dialectical tensions which will be present.

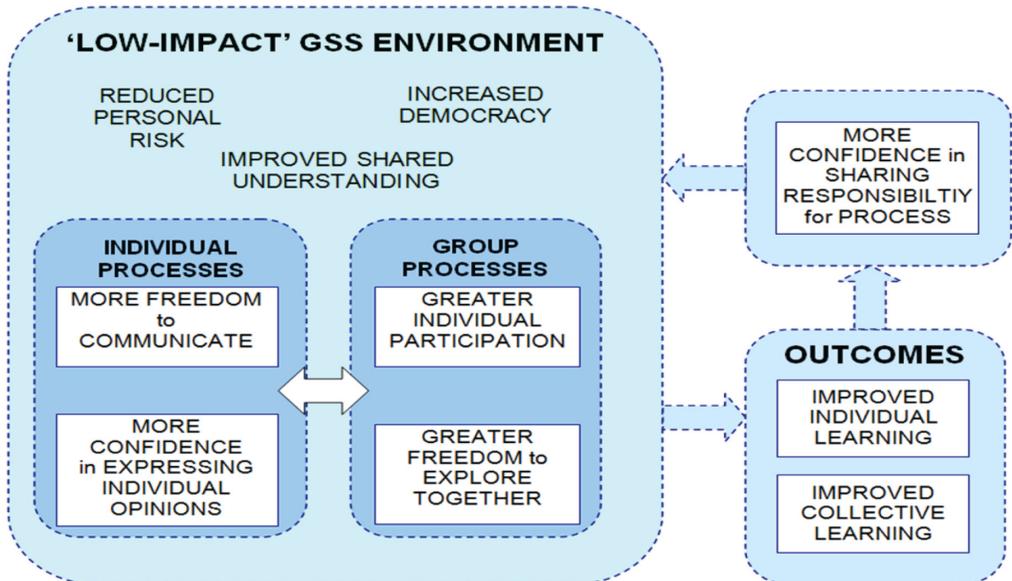
The model shown in Figure 3 is an attempt to represent visually the complex relationships between anonymity, participation, and learning in groups supported by a ‘low-impact’ GSS. Whilst the nature of GSS inputs provide a democratic platform (i.e. one person/or one sub-group – one vote) it is important that individuals can share information effectively, so that each member can understand the issues, and the group can be more confident in the equal sharing of responsibility for the quality of process and, hence, the final outcome. The

figure implies an environment provided by the GSS which is not static, but changing as a group session develops, and as the participants come to understand the nature of the process and how to make effective use of it.

By providing judgemental phases in the group process that are anonymous, it is argued here that the personal risk of having one’s judgement undermined, (ie. open to some degree of ridicule or ‘loss of face’, is reduced. Figure 4 outlines the expected changes to the group process, as compared with more ‘normal’ group processes, under these conditions.

As each member moves through the group process, the anonymity provided by the design can facilitate a less stressful environment for individuals to communicate within. When the results of an initial round of inputs has been displayed, discussion can focus on the reasons for differences of opinion. Without having to reveal individual judgements, a participant can experience *more freedom to communicate* with others, without jeopardising their personal standing in the group. This enables *greater participation* from individuals in the group discussions, encouraging greater *confidence*

Figure 4. Anonymity, participation & learning in GSS process



in expressing individual opinions, and aiding the group as a whole to *explore* the reasons for differences of opinion together.

The perceived improvements in the communication between participants during the anonymous GSS process should enhance the opportunities for *individual and group learning* and, ultimately, should improve the quality of the judgements made.

As the GSS process employs a democratic system of gathering judgements, the responsibility for the effectiveness of the process and its outcomes is divided equally between individual members at each stage of a group session. Advancements in individual and collective learning should improve the group's *confidence in sharing this responsibility* and, hence, for producing the most beneficial or appropriate group judgement. These help to improve the perceptions of democracy (or social equality), and the perceptions of a 'safe' (less risky) environment for individual expression and communication as they move through subsequent issues.

The following section presents briefly an application of this approach with a group of post-graduate students as they explore and debate business cases. A detailed description and analysis of this case study can be found in Jones et al. (2006).

CASE STUDY: AN APPLICATION IN POSTGRADUATE EDUCATION

Background

A number of trials have been undertaken of ways in which a low impact GSS, used in conjunction with business cases, has the potential to improve the learning experience within a tutorial setting with postgraduate management students. The trials consisted of several classroom tutorial sessions, each of about two hours. The students were given the case material to study and analyse individually, and were asked to identify the strengths and weaknesses

in the case. The trial sessions formed a part of the 'normal' teaching programme. The aim was to produce a practical assessment of the use of the GSS in the classroom.

The '*Teamworker*' handsets were allocated either to individual students, or to small groups of about 4 students sitting around tables (one group, one handset). A set of questions was prepared for each session and exported into the software of the GSS. These were 'Likert' type statements, multiple choice options, and open ended questions. 'Ad hoc' questions were sometimes generated during the sessions. Sometimes, questions were repeated following discussion of differences. A set of ten to twenty questions was found suitable for a one to two hour period. A screen showing a question to which students respond with their individual handsets in Figure 5. To confirm that a response from a handset has been received the number cell corresponding to the handset number changes colour. Figure 5 shows that handsets 4 and 5 have responded at that moment in time (out of 19 students in the group, each with an individual handset). All students would typically respond within one or two minutes, although for complex questions requiring more thought the response time could be longer.

Once all students have responded with their individual handsets, the feedback screen is displayed. Figure 6 shows a typical feedback screen to this question, which is a barchart of the individual responses.

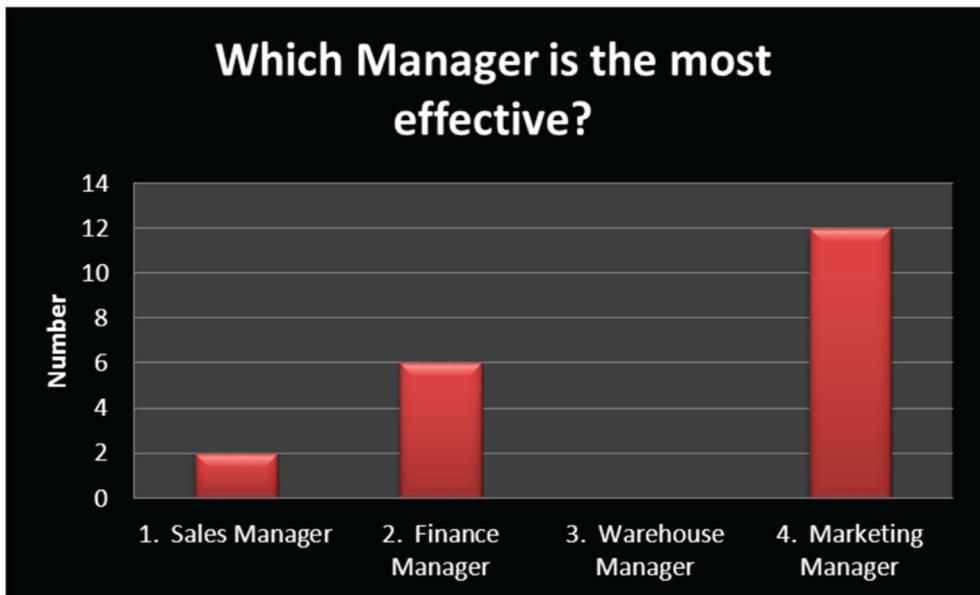
The teacher then uses this anonymous feedback to guide the analysis and discussion of the case, by asking students to provide the reasoning for their responses to the rest of the class. This would often generate a conversation between the students in the group, as differences of opinion were openly explored.

The teacher, and the students themselves, were part of an 'action research' activity, in which the introduction of the technology represents an intervention into "normal" practice, (McNiff, 1988). The sessions were evaluated in a number of ways in order to assess the process and its benefits/problems. These ways included

Figure 5. Input question screen



Figure 6. Typical feedback screen



non-participant observation; lecturer field notes; informal discussions with students; and a set of evaluation questions presented to the students at the end of each session.

Student Perceptions

The students were asked to answer some reflective questions on their experience of the tutorial and of the use of the new technology. The handsets were used for this purpose, to encourage honesty of response, due to the anonymity. The questions covered a range of issues from general reactions to the tutorial to future use of the technology. All the students were positive about the sessions. They all found the technology easy to use, and most students reported that they found it easier than usual to contribute to the conversations. All students agreed that the influence of dominant personalities was reduced, and felt that it would be useful to use the technology for other sessions involving the analysis of business cases.

Teacher Perceptions

From the teacher's point of view, the sessions were more positive and beneficial than sessions run in a more 'conventional' way. The students were able to participate and focused discussion was generated easily in every trial. The feedback screen display of differences of opinion provided a focus for stimulating discussion. The 'individual' and the 'sub-group use' handset sessions produced high levels of conversation and involvement and were far more dynamic than normal non-GSS supported tutorials. The allocation of handsets to sub-groups was especially encouraging as there was a high level of 'within sub-group' as well as 'plenary' level discussions of the reasons for differences of opinion, as well as discussion within sub-groups regarding their choice of response to a question. A feature of the sessions was the extent to which the students 'took over' and controlled the sessions for themselves. At times, the teacher needed to move things on in order to cover the material.

Discussion of Case

This case description has presented the key themes that have emerged from using a GSS with postgraduate student groups. There was wider and more even student involvement, and a more focused conversation than experienced at more traditionally run sessions. The anonymity provided by the technology appeared to lower the risk of exposure and encourage conversation.

The trials show that interactive sessions of this type can be useful as a means of analysing business cases. Some students even suggested how the GSS could be used in their own work organisations. These included: feedback to management (e.g. suggestions for improvement to organisation); staff appraisal; analysing decisions; role play for training; skills development; attitude surveys and market research. The following section summarises some other areas where we have trialled applications of this type of GSS.

OTHER FIELD APPLICATIONS

A number of other field-based applications and trials of a low-impact GSS are summarised here in order to give some indication of the wide range of situations where a 'low impact' GSS may be able to augment the normal meeting process (See Gear, 1993; Read, 2003, Read et al 2012). All of these applications involve processes of 'learning & deciding' in groups:

1. **Development of Organisational Learning:** This concerned the articulation of situated knowledge within an organisation by groups of employees in a multi-site SME organisation. The need was to develop a method to support SMEs in creating organisational designs and activities that can encourage collective learning and sustainable development. The method was successful in surfacing and exploring situated knowledge within the organisation, and where this was utilised and where this was ignored;

2. **University-Based Education and Training:** This concerned undergraduate teaching in a university-based Department of Pharmacy. The need was to ensure the development of professional skills when dealing with patients, and in accurate prescribing of appropriate drugs or medication for a given condition. This involved the relationship with the patient in order to make a proper diagnosis and prescription decision;
3. **Values and Priorities in Health Care:** The organisation is a Primary Care group (PCG) in the London area. The PCG held a stakeholder's conference involving about 80 people, selected in order to represent a cross-section of the local community. The conference was designed to achieve two objectives. Firstly, to establish a number of high priority areas concerned with health-care. Secondly, to agree on preferred approaches to how the local community could work with the PCG in order to implement solutions;
4. **Group Interactive Learning:** The application has taken place in the Business School at the University of Glamorgan. The on-line support has been trialled as an aid to the tutorial sessions where undergraduates and graduate students are analysing and discussing business case studies. The aim has been to produce a practical assessment of the use of "Teamworking" in classroom sessions. In particular, the trials were aimed at assessing the degree to which the technology can assist teachers to overcome some of the problems that are commonly experienced in this situation. Typically, these are ensuring that all students become involved in the debate of issues surrounding a case, surfacing opinions, and facilitating debate that focuses on key aspects;
5. **Development of Consistency of Professional Judgement:** The application is concerned with the use of 'Teamworker' for group interactive learning for public sector professionals in order to develop greater consistency of application of a client assessment model. The organisations involved over 100 municipalities in Norway and Denmark. The assessment model judges each of 17 criteria of assessment, on a 4-point scale, where '1' represents complete independence of needing help, and '4' corresponds to complete dependence on help from others. A crucial aim of the approach is to develop consistency of use of the model in order to provide appropriate care on an equitable basis in all regions;
6. **Portfolio Selection in Commercial R&D:** The organisation is a multinational pharmaceutical group, with R&D laboratories collaborating with each other across sites in Europe and North America. The decision area is concerned with the selection of a preferred portfolio of projects to which to allocate scarce resources, especially manpower. A number of factors are taken into account in this process, including market potential, competition, stage in development, chances of technical success, therapeutic area balance, long and short term returns, resource constraints and key resource availabilities. A series of meetings is held each year to decide the portfolio, and other review meetings are called at other times to decide changes;
7. **Research Proposal Selection in a Public Body:** The organisation is a British Research Council. Committee-based decisions concerning the selection for funding of research proposals submitted by researchers in Universities and Polytechnics are considered by peer review. Committees of 15-25 members consider long lists of proposals in each of a number of scientific areas. The overall budget is predefined, but the precise apportionment of this figure between the scientific areas is deliberately left open when the committees meet;
8. **Future funding Decisions of Strategic Options in a Public Body:** The organisation is a research funding organisation

- which was required to determine whether future funding of a number of strategic technology areas should be held at present levels, increased above current funding or reduced below current funding, given the overall funding and budget limits. A committee comprising 12 experts was asked to meet to prepare advise to the organisation on 14 different technology areas;
9. **Perceptions in Retail Marketing:** The organisation is a medium sized retail chain selling a wide range of audio, video and TV equipment with a significant regional presence and image. In particular, it had achieved a pre-eminent position in terms of certain up-market brands. It was thought by some store managers that prospective customers viewed the company as expensive and up-market because the expensive brands were stocked and associated strongly with the chain. The management group were in disagreement as to how their other lower priced, mainly Japanese, brands were perceived by their customers, and how closely the chain's image related to these other brands;
 10. **Option Selection in Defence:** The organisation is a research establishment within the UK Ministry of Defence. A set of seven options had been identified for a military system to meet a well-defined threat. A considerable amount of experimental and simulation based data was available. The criteria by which to judge the options were pre-defined;
 11. **Analysis of Key Competencies and Performance:** This application is located in the brewing industry. The Chief Executive had formulated a clear vision statement for the business, and also established a set of thirteen associated key task performance factors. These were the set of task abilities he expected in his key team of operational managers in order to achieve the vision. It was considered essential to assess the strengths and weaknesses of the key team of managers both individually and as a whole;
 12. **Long Range Planning:** The organisation is a large multi-national manufacturing company in a high technology business. Concern was expressed to ensure that the company was making wise strategic decisions regarding technologies intended for commercial introduction and exploitation on 10-30 year future time frames;
 13. **General Practitioner Workshops:** A series of studies are currently underway involving groups of GPs and other health professionals, in workshops that explore the diagnosis and treatment of a number of medical conditions. Topic areas include: hypertension, depression, teenage pregnancy, and childhood asthma, with forthcoming sessions on the diagnosis and treatment of cancer. Comparisons are noted between established and *ad hoc* groups of varying sizes;
 14. **Panel Testing & Tasting:** The organisation is a major brewer with a large range of beers and lagers at a number of dispersed sites. Production is tasted and tested by panels of experts on a daily basis. The objective is to identify, for each branded product, deviations in either direction from a defined product profile. The profile is based on 35 dimensions related to identifiable aspects of taste, appearance and smell;
 15. **Child Protection Conferences:** These child protection conferences bring together family members, the child where appropriate, a chairperson, and those professionals most closely involved with the child and family, which can include a social worker, youth worker, police representative, school or play-group representative, school nurse, etc. Two principal questions are considered: Is the child at continuing risk of significant harm? If so, does safeguarding the child require the intervention delivered through a formal child protection plan? If the conference decides that both of these criteria are satisfied, the child's name is placed on the register, and a child protection plan is agreed.

CONCLUSION

The low impact, handset-based type of support is designed to provide an additional channel of communication for a group. Validation of this type of GSS has to be concerned with developing an understanding of the social processes that are taking place. The mode of operation of the technology, and the design of the group process used in conjunction with the technology, has been designed to minimise defensive reactions among individuals and within a group. In support of this statement, it is important to note that the individual always maintains control over what he or she communicates, whether verbally or through input from a handset.

The response to each question screen is input as an anonymous (non-attributed) judgement, appearing as a contribution to an aggregated display. The ensuing conversation is then focussed on the reasons, and reasoning, which may underlie the range of opinion that is fed back to the group. The reasons behind displayed differences of opinion can be explored and discussed in a personalised or non-personalised way. Any declaration of a personally held view is entirely a matter for the individual participant to decide, and is not a process requirement. Each student always remains in control of their own behaviour.

A feature of the listed applications was the ease with which discussions, aided by the technology, included the expression of reasons underlying displayed differences. It appears that the process design can provide a level of safety that enables each participant to make and receive contributions more easily.

The technology and accompanying protocol addresses two aspects of communication that are often in conflict. On the one hand, the technology is helping to reduce the risks associated with personal communication, while on the other hand it is seeking to increase the outputs of collective communication, all taking place in a learning environment. This suggestion has

been made by Gear et al. (2003) in the context of using the technology as an aid to organisational learning in employee groups. Indeed, in a sense, the classroom may be regarded as a micro-organisation, and the ensuing process—a form of organisational learning.

The trials with postgraduates described in this paper have presented an example of one approach to social learning by creating a temporary and relatively safe classroom environment. The students are encouraged to learn by exploring their opinions in relation to others in a relatively safe situation, with reduced barriers. This form of temporary ‘suspension’ has been proposed as key to a process of ‘dialogue’ (Isaacs, 1993).

We remain cautious about what can be claimed, although our conclusions are encouraging. Group processes are not only extensions of processes appropriated to individuals when engaged with a task. A new entity is created with its own dynamics, with complex social processes involving position modification and learning between participants. It does appear that ‘low impact’ group support systems can aid social processes by means of appropriately designed software. This can incorporate selected features from, for example, multiple criteria decision-making, Nominal Group Technique, Delphi and other managerial models and methods developed to aid ‘learning and deciding’ type activities. There are various ways in which this can be done, depending on the particular context, as demonstrated in the wide-ranging nature of the applications listed in this paper. We hope that the results of field trials presented in this paper will stimulate further developments of practice and theory for this type of group support in a variety of contexts.

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