The Use of Interactive Visual Metaphors to Enhance Group Discussions Using Mobile Devices

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Abstract. In this paper, we consider the problems of group discussions and collaborative decision-making, where one or more of the participants are using restrictive interfaces such as mobile phones or PDAs. We suggest possible solutions to some of these problems and present MAVis (Mobile Argumentation Visualizer), a web-based interface built upon upon a balance-beam visual metaphor. We report on user experiences of interacting with the visual metaphor, and on the challenges of transferring this to a multi-user environment supporting mobile devices.

Keywords: m-learning, collaborative working, decision-making, wicked problems, visual metaphors.

1 Introduction

In collaborative decision-making scenarios, where decisions are based on shared understanding through discussion, most, if not all problems encountered can be defined as *wicked problems* [1].

According to Conklin [2], wicked problems are intrinsically situated in socially complex settings. He summarizes their characteristics as follows:

- You don't understand the problem until you have developed a solution;
- Wicked problems have no stopping rule;
- Solutions to wicked problems are not right or wrong;
- Every wicked problem is essentially unique and novel;
- Every solution to a wicked problem is a "one-shot operation";
- Wicked problems have no given alternative solutions.

In this paper, we present an approach to the consideration of wicked problems in specific scenarios with m-learning characteristics. Example application areas in these scenarios include:

- Students on e-learning courses who need to communicate with fellow course members in remote or field locations;
- Students on traditional courses engaged in group activities;

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- Students in work placements (e.g. medical, nursing and social work) who will be required to engage in multidisciplinary groups but may not be co-located;
- Collaboration between students in different countries and from different cultures.

It is self-evident that effective group and team working are essential transferable skills for students to acquire to enhance their employability and prepare them for post-University life. Current trends in the increasing internationalization and demographic diversity of Higher Education students however, present challenges for educators to preserve high-level critical thinking and reflective practice skills – both of which are enhanced by discussion, consultation and expert advice.

We have developed a suite of collaborative discussion tools, which use a simple visual metaphor to enhance group discussions [3, 4]. In this paper, we present the mobile version of this suite of tools, which we have called MAVis (Mobile Argumentation Visualizer).

We describe the background and history of MAVis, and the rationale for the visual metaphor we use. We then report our experiences of MAVis in an m-learning setting, and conclude with a reflection on this experience and a proposal for further work.

2 Background

By far the most common of all mobile devices is the telephone. The two most common communication channels utilized by mobile phone users are voice and SMS text messaging. In m-learning scenarios, we argue that there are inherent problems with relying on these channels alone, namely:

Voice –

- Requires temporal concurrency;
- Only one participant can contribute at a time;
- Remembering accurately what is said and by whom;
- Difficulty with accents;
- There is usually no auditable record;
- Problems for the hard of hearing.

Text -

- Requires manual dexterity;
- Multiple threads are difficult to track;
- Restricted real estate limits the text that can be viewed without scrolling;
- It is difficult to group related concepts;
- Like voice, it relies upon a common understanding of what language actually means.

We argue that in addition to these issues, neither channel lends itself very well to remote collaboration, because there is usually a lack of structure to the discussion without the physical presence of a chairperson to maintain order and to remind everyone of the objectives.

The increasing use of sophisticated mobile telephones and PDAs (Personal Digital Assistants) and the advance of the network infrastructure that supports them, present developers with opportunities to use more sophisticated visual channels in m-learning

[5, 6]. However, with these opportunities come the challenge of providing users with a valuable experience, given the constraints of mobile device size [7].

Our solution is to use a simple visual metaphor, known linguistically as the *argument-as-balance* metaphor [8], which we argue is easy to use, intuitive and efficient on screen real-estate. We now describe the rationale and history of our experience with this metaphorical approach in the context of collaborative discussion.

2.1 Rationale

The concept of linguistic metaphor is well-known in the fields of prose and poetry. For example, Lakoff and Johnson [8] describe the conceptual metaphor of *argument-as-war* with the following expressions:

Your claims are *indefensible*.
He *attacked every weak point* in my argument.
His criticisms were *right on target*.
I *demolished* his argument.
I never *won* an argument with him.
You disagree? Okay, *shoot*!
If you use that *strategy*, he'll *wipe you out*.
He *shot down* all of my arguments.

Lakoff and Johnson also describe the *argument-as-building* metaphor (if you don't *support* your argument with *solid* facts, the whole thing will *collapse*), the *argument-as-container* metaphor (that argument *has holes in it*), and the *argument-as-journey* metaphor (you're *going around in circles).*

Another common *argument-as* linguistic metaphor is the *argument-as-balance* metaphor, where rational argument is understood as a twin-pan balance of weights, the weight on each side representing the strength of counter arguments, for example: the debater *built up a weighty* argument; the jury *weighed* the merits of both sides; more facts might *tip the scale* [9].

In CSCW (computer-supported collaborative work), the visual metaphor has been identified by Eppler [10] as useful to organize content meaningfully and to present an overall message. Eppler also identifies visual metaphors in this context as being easy to use, easy to remember, and easy to understand. Eppler compares visual metaphors with concept maps, mind maps and conceptual diagrams. He concludes that for collaborative working, a combination of these techniques can be used for the greatest effect. However, for mobile devices, we argue that the physical limitations of the hardware do not support this approach. Certainly, the other techniques use much more screen space, and there are dangers of users being confused if they cannot easily view potentially complex diagrams and maps. The visual metaphor provides a better overview, as Eppler states (p.207):

"In order to summarize the discussion on a topic in a memorable and insightful way, a rich visual metaphor is used that positions all discussed items within an appealing and self-explanatory metaphoric structure."

Consequently, for collaborative m-learning applications, we have progressed with the visual metaphor, which we originally proposed for more generalized environments [3, 4].

2.2 History

On analysis of the alternative metaphorical interpretations of argumentation, we developed a tool which uses the argument-as-balance metaphor [3]. The tool is called DAVE (Decision and Argumentation Visualization Explorer). Developed in Macromedia Flash, it runs in a web browser or as a standalone application. It was originally developed to provide visual and intuitive support for presenting an argument, for communicating advice, and for assessing risk. Figure 1 shows an illustration of a patient's risk of contracting coronary heart disease, based on a number of medical factors.

Fig. 1. DAVE A decision-support tool [3]. The contribution of *n* factors *(cf)* is the product of its magnitude and its importance *(I)* and *m* ameliorating factors *(af)* produce a contraindication in the same way. Thus: total indication = $\sum_{i=1}^{n} cf_i I_i - \sum_{i=1}^{m} af_i I_i$.

DAVIE (Decision and Argumentation Visualization International Explorer) was developed as an extension to DAVE [4]. It uses multiple instantiations of the central balance component of DAVE, which can be manipulated independently by participants. Our aim was to discover if it was possible to help a group develop a composite mental model of a problem area by using interactive graphical representations that show how each member of the group arrived at their stated opinions.

Conceived as a tool to support decision-making in multi-disciplinary teams across international and cultural boundaries, it has been useful as an analytical tool in conflict resolution situations and in training exercises where groups need to develop common conceptual maps. Each user selects and manipulates the factors in a given decision-making or problem scenario. The balance components are then collated in a stack formation into a single view which can be shared over the Internet. Correlation between factors on each balance is represented by connections from each balance component (Figure 2). DAVIE shows, for each member of a team, the relative importance that they attach to the various factors involved in reaching their own considered positions. Group members can then compare their own positions with

those of other individual members or an average of the entire group. The intention is that team members can easily see how other people reach the opinions that they hold (or more precisely, how they justify them) in order that discussion can be focused towards resolving areas of fundamental difference.

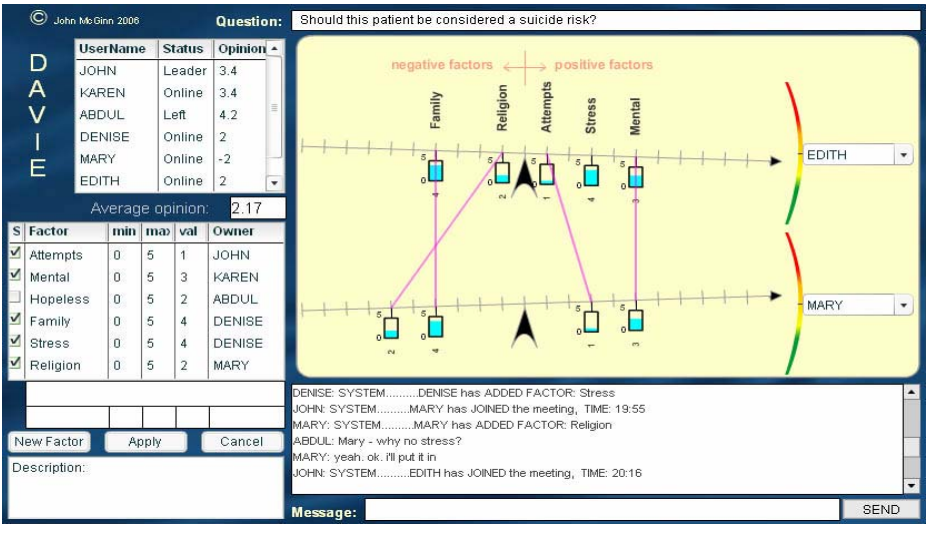

Fig. 2. DAVIE. A multi-user decision-support tool [4]. The connections provide an immediate visualization of the level of agreement between partners. The number of inclined connections indicates the level of disagreement between partners. It is also possible to identify partners who agree on the overall decision but for completely different reasons.

DAVIE can be used in a collaborative situation, where partners are given the opportunity to moderate and mediate the decision-making factors. Once a collective view has been reached, which may or may not result in total agreement, DAVIE can be used to complement discussion and act as an aide-memoire in conflict-resolution scenarios.

In the example in figure 2, students take on the roles of a multidisciplinary team assessing the suicide risk of a client. Students suggest factors for or against the proposition and these factors are then "owned" by appropriate members of the team. For example, Denise is playing the role of a social worker, so she is responsible for using her professional judgement to attach a value to the factors of *Family Support* and *Stress*. Once all of the factors are set out, each team member chooses which factors they consider to be significant and places them on the beam in positions that correspond to their perceived importance. Students are thus able to explore and determine areas of commonality and difference in order that they can better understand their own opinions and the cognitive models of the other participants.

There are two versions of DAVIE. The first version, DAVIEw, is used in a group or classroom situation. The application is presented with a data projector or an interactive whiteboard. It has been tested with groups of pre-registered Nursing students considering questions of medical intervention. Feedback from the students indicated that most of them found the visualization to be helpful or very helpful, although a minority commented that reducing life or death decisions to numbers or

graphics was an inappropriate trivialization. This was not a view shared by professional practitioners to whom the application has since been presented.

We have also developed a remote version of the software, DAVIEr, which has been used by Computer Science students in the study of computer ethics. In this scenario, the students worked independently at their own machines but collaborated through a chat server. Again feedback was positive and students found the software useful after they were trained to use it. As in most exercises involving unstructured communication, the chat element of the application resulted in a large amount of trivial and irrelevant posting. However, the existence of a graphic that represents previously considered views allows a moderator to quickly refocus the discussion in a way that is difficult with a text-only interface.

3 MAVis

To support m-learning, we have developed a version of DAVIEr called MAVis (Mobile Argumentation Visualizer). It is web-based, written in Macromedia Flash and

Fig. 3a. left) the main MAVis screen shows the interactive visual representations of the users' opinions and compares them to any other user. This screen also has a reduced text output panel so that the user can track incoming messages from other participants. **right)** the CHAT screen is a basic messaging client. This has an enlarged text output panel and a text input field.

operates through an XML socket server. MAVis and DAVIEr share the same messaging system and are therefore completely compatible. Almost all of the code is common. Messaging was facilitated in the development of the application through the XML socket server. MAVis incorporates the balance-beam visual metaphor, a chat client, a user status list, and a factors editor. Each feature is accessed via a series of tabs at the top of the user screen (figures 3a and 3b).

Fig. 3b. left) the USERS screen lists all of the participants, notes their status and displays a numerical representation of their opinions. **right)** the FACTORS screen lists all the factors that are being considered by everyone, together with their range and values. The screen also permits a user to add a new factor or edit one that they own. They can see descriptions of factors owned by other users but not edit them.

4 Discussion

We have used the MAVis interface as a client in Internet Explorer using the Macromedia FlashPlayer 7 plug-in in devices running Microsoft Pocket PC operating system. It is not yet possible for the MAVis device to be used by the moderator of a

session because it lacks some of the necessary functionality, particularly the ability to save and restore sessions. However, users of MAVis have been able to engage fully with discussions being carried out between workstation devices. The main problem is one of speed. The application runs very slowly on a mobile device. It is slow to load over a wireless connection (around 120kB) and slow to operate because of the limited processing power and memory of the mobile device. The interface itself, however, works well.

Flash has proved to be very capable for the rapid development of MAVis and we believe that the use of visual metaphors to enhance text-based discussions has been sufficiently demonstrated to warrant further development of the application. The use of tabbed screens to switch between functional areas is simple and effective. The application needs to work much faster though to match the ease of use observed on the workstation client. We need to determine whether an alternative presentation such as popups for supplementary information would generate a better user experience.

5 Conclusion and Further Work

We have shown that visual metaphors can enhance discussions of wicked problems between remote parties. We have also demonstrated that this is possible on the restricted interfaces of current mobile devices.

More work needs to be done to determine whether response rates can be improved using Flash, or whether the application needs to be rewritten in a different language. We also need to test the application with other platforms and consider security issues.

Another avenue is to use the visual metaphors to enhance voice communication. This would certainly make the interface simpler but would severely limit the number of concurrent users.

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