Designing Technology for Reflection on Experience

Supporting Collaboration and Reflection with Digital Tabletops

Richard Morris, Open University, UK
richard.morris@open.ac.uk

Introduction

Dewey (1933) described reflective thought as "active … and careful consideration … of knowledge in the light of grounds that support it and the further conclusions to which it tends". This skill is purposeful and critical and does not come about without considerable effort. Brookfield (1988) points out how reflection centres around four main activities: analysing assumptions, contextual awareness, imaginative speculation and reflective scepticism. Analysing assumptions is crucial in reflection on experience as one of the goals here is to restructure knowledge and integrate new experience with old. Contextual awareness means considering the wider social and environmental issues at hand, to create an integrated understanding of how the phenomenon being reflected on fits in with greater schemes. Imaginative speculation is important to make inductive reasoning about the domain possible and to raise awareness of incomplete or inconsistent knowledge and to see multiple perspectives. Reflective scepticism is a continuous process of critical thought which is carried out throughout the other three processes, where the reflecter comes from a neutral or actively sceptical viewpoint. These processes lend themselves to being supported by interactive tabletop applications. This is partly due to the tabletop's lightweight interaction methods, such as gestures and direct manipulation of objects and the ability to simultaneously engage in high quality social interaction (Scott, Grant and Mandryk, 2003). By high quality interaction is meant that collaborative dialogue in not hindered by strict turn-taking rules, and can be enriched by hand gestures and eye contact. By virtue of allowing the users to perform effective collaboration, high quality social interaction and make and manipulate digital objects, tabletop interaction environments may be able to more naturally support reflection on experience.

Hatton and Smith (1995) found that engaging with another person in a way that encourages talking, questioning, or confronting, helped the reflective process by placing the learner in a safe environment in which self-revelation can take place. This revelation can come about from Brookfield's reflective activities such as analysing assumptions or imaginative speculation which can lead to the formation of theories with greater explanatory power or which reveal underlying truths about the experience being reflected on. Although a person may be able to – through their own imagination – come up with scenarios which they can virtually 'test out' the theories they make while reflecting on their experience, this can be greatly enhanced by the involvement of a collaborator who can challenge and confront their assumptions and knowledge. A shared tabletop surface can be used by different individuals to make a case to others, through several forms of evidence, such as text, photos or video. This may be particularly helpful if someone is resistant to change (Fleck, 2003).

Interactions with tabletop displays, such as Microsoft's Surface or MERL's DiamondTouch look promising as a way of supporting novel forms of reflection on

experience. In particular, the shareable technology offers several advantages over traditional single user PCs. Firstly, working around a tabletop is instantly familiar, as this is the most common way collaboration occurs in non-digital domains. Secondly, a tabletop is a place to share and use objects, such as drawings, to augment conversation. Thirdly, objects can represent complex ideas, and persist visually, to create a form of external cognition (Scaife and Rogers, 1996), which can be leveraged to make reflective breakthroughs.

Tabletops are also able to offer effective support for reflective tasks due to being reality-based interfaces (Jacobs *et al.*, 2008). Being able to create meaningful representations can increase understanding amongst the collaborators by the virtue of simple creating an explicit representation (Chi *et al.*, 1994; Chi, 1996). Modelling interaction based on physical behaviours from the real world and using direct input overlaid on the display space with gestures can make for an easily-learned and lightweight interaction. Given that reflection is a demanding task, we propose that the more natural and lightweight the interface the better it will support reflection.

Fluid Interaction and Reflection

The property of an interaction, whereby the user is able to remain in this high-level mode of thought and move in and out of interaction between the computer and the social environment, has been called fluidity. It describes the property of an interaction between a user and a technology such that it supports the user staying at an unbroken creative state of mind and being able to think about complex or abstract problems without having their train of thought interrupted by low-level requirements of the interface, such as dialog boxes, or visual clutter (Guimbretiere, 2001). It is assumed that highly fluid novel forms of interaction are possible with interactive tabletops (Jacob *et al.*, 2008). Properties of interactive tabletops such as the direct manipulation of objects, the intuitive style of interaction and the visual persistence afforded by the large display area, all contribute to a reduced cognitive and working memory load. This can enhance initial usability and learnability and also enable interaction with the digital environment to be more flexible, facilitating reflective collaboration and social interaction with group members in the non-digital environment.

Sometimes the term fluidity has been used to refer to 'flow' where a person can extend their thoughts to the higher-order goals of a task, and where a subjective experience of ease and pleasure ensues when using a given interface (Csikszentmihalyi, 1991). It has also been expressed in terms of higher- and lower-order levels of cognition: where intermittent attention is supported between interface and conversation whilst keeping the creative thoughts and expressions 'flowing' (Morris *et al.*, 2008).

Tasks and User Groups

The sort of high-level reflective activities I propose to support using tabletops are the types of discussion that can lead to synthesising and integrating new knowledge and deeper understanding in a given domain. In particular, the quality, or type of things discussed, such as whether the topic of discussed focuses on abstracting principles from data, critical statements, speculation and imagination and integrative statements. It has not been shown that existing task classification systems such as McGrath's circumplex (1984) can be applied to tabletop-supported tasks, however I have

considered many possible tasks and user groups which could lend themselves to a tabletop application. Two domains I am currently investigating are (individual) sports coaching and financial analysis. These tasks seem to lend themselves very well to tabletop applications but differ in several dimensions. Firstly, the sports coaching involves a different type of collaboration than used in financial planning. In sports coaching the tabletop is being used to review video to reflect on the player's performance and the coach is scaffolding the player's understanding of the sport and their own performance. This is then used to plan training, strategy and make general insights into the game. Financial planning consists of a more symmetrical type of collaboration whereby a small group of three or four people will use the tabletop to display and analyse information either individually or in groups.

Secondly, the two tasks differ in terms of where the reflection takes place in respect to the central activity. For example, the central activity in sports coaching is the player actually performing the sport or practicing. The reflection occurs in the periods between the performances. In the financial activity the reflection occurs at the same times as the work is being performed at the table (the work may be calculation or trying out different ways of categorising data). Collaborators may then step out of their interaction with the digital content at the tabletop and engage in other forms of group collaboration, such as discussing their findings or heuristics, but this happens away from the tabletop interaction.

Thirdly, the tasks differ in terms of the types of digital content which is being used at the tabletop. In the sports example it is typically videos of the players performing their sport. This is a concrete type of object, in the sense that it represents something which actually happened in physical space. In the financial example, the data is more abstract and requires a layer of visualisation to assist thought and discussion.

I am currently conducting observations of the two contrasting activities being carried out in their current situations. I am analysing what currently happens at different times in a coach-player relationship and to what extent existing technology does or doesn't support this. The focus is on the facility to play, store and annotate video clips of the player in action. It is hypothesised that this way of adding meaning to video-guided reflection will increase reflection outcomes for both coach and player. In contrast the focus of the financial data analysis task is on how individual experts look for patterns and anomalies for different kinds of visualisations. The wider goal is to see whether the kinds of reflection are diversified or transform when the abstract visualisations are re-represented as a shared tabletop display.

I will employ both ethnographic observations and aggregate performance measures in my analysis. Measures of expertise as proposed by Chi (2006) using recall, perception, categorization, and verbal reports will be used. I will carry out video analysis to look for social effects such as leadership and dominance, I will look for correlations between tool usage and dialogue, equity of participation and time spent on planning and execution. In addition, I will also attempt to measure the quality of the discussion throughout the activity using a coding scheme to determine whether 'reflective talk' occurs to a greater extent at the tabletop.

References

Brookfield, S. (1988) Developing Critically Reflective Practitioners: A Rationale for Training Educators of Adults. In *Training Educators of Adults: The Theory and Practice of Graduate Adult Education*, ed. S. Brookfield. New York: Routledge.

Chi, M.T.H., de Leeuw, N., Chiu, M.H., LaVancher, C. (1994) Eliciting self-explanations improves understanding. Cognitive Science, 18: 439-477.

Chi, M. T. H. (1996) Constructing Self-Explanations and Scaffolded Explanations in Tutoring. Applied Cognitive Psychology, 10: S33-S49.

Chi, M.T.H. (2006). Methods to assess the representations of experts' and novices' Knowledge . In K.A. Ericsson, N. Charness, P. Feltovich, & R. Hoffman (Eds.), Cambridge Handbook of Expertise and Expert Performance. 167-184, Cambridge University Press.

Csikszentmihalyi, M. (1991) *Flow: the Psychology of Optimal Experience*. HarperCollins.

Dewey, J. (1933) *How We Think. A Restatement of the Relation of Reflective Thinking to the Educative Process*. revised edn., Boston: D. C. Heath.

Fleck, R. M. M. (2003) Supporting Reflection and Learning with New Technology. OzChi Doctoral Colloquium, *In Proc.* OzChi '03, Brisbane, Australia.

Guimbretière, F. V. (2002) Fluid Interaction for High Resolution Wall-Size Displays. Doctoral Thesis. UMI Order Number: AAI3040022. Stanford University.

Hatton, N. and Smith, D. (1995) Reflection in Teacher Education: Towards Definition and Implementation. The University of Sydney: School of Teaching and Curriculum Studies. http://www2.edfac.usyd.edu.au/LocalResource/Study1/hattonart.html - retrieved 6th September 2008.

Jacob, R.J.K., Girouard, A., Hirshfield, L.M., Horn, M.S., Shaer, O., Solovey, E.T. and Zigelbaum, J. (2008) Reality-Based Interaction: A Framework for Post-WIMP Interfaces, *In Proc.* ACM CHI 2008 Human Factors in Computing Systems Conference, 201-210, ACM Press.

Marshall, P., Hornecker, E., Morris, R. and Rogers, Y. (2008) When the Fingers do the Talking. *In Proc.* Tabletop '08.

McGrath, J. E. (1984). *Groups: Interaction and Performance*. Englewood Cliffs, NJ: Prentice Hall.

Scaife, M. and Rogers, Y. (1996) External Cognition: How do Graphical Representations Work? International Journal of Human-Computer Studies, 45, 185-213.

Scott, S.D., Grant, K.D., and Mandryk, R.L. (2003) System Guidelines for Co-located, Collaborative Work on a Tabletop Display. *In Proc.* ECSCW '03, 159-178.