

Action research as an investigative approach within a computer based community of learners

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The purpose of this paper is to outline the method of research used in a PhD project where the aim was to determine the extent to which computers enhanced learning when implemented within a distributed learning environment (DLE). When learning is distributed, cognition is not solely an individual pursuit but is shared with mediating resources found within the learning environment. A type of communal environment is developed within which students, together with other students and resources, construct new knowledge and understandings. In this instance, analysis was based on the nature of discourse to emerge from student interactions around the computer. It was essential, therefore, to adopt a research methodology that would carefully detect the discrete levels of understandings evident within these collaborations. Given the capricious nature of social interactions however, the methodology also needed to be flexible and accommodating. As such, a *tentative action research plan* was devised to manage these issues.

Keywords: action research, distributed learning environment, community of learners, social constructivism

The study

The ultimate aim of the study was to determine the extent to which computers, when accessed as cognitive tools promoted effective learning. Cognitive tools are computerised applications that afford the potential to mediate meaningful knowledge construction (Jonassen, 2000). Their interactive qualities, and their ability to visually represent students' knowledge construction processes, promote cognitive and metacognitive thinking and fosters learning for understanding. Some theorists even claim that cognitive tools afford the potential to amplify and re-organise mental functioning (Pea, 1985, Perkins, 1993).

However, based on claims that cognitive tools have largely failed to transform learning in any notable way (Hunter, 1998; Jonassen & Reeves, 1996; Rogers, 2001), it was contended that due consideration be given to the ways in which these tools are implemented within classrooms. Therefore, as part of the first phase of the study, a DLE was designed and used as an implementation framework for Inspiration (an electronic concept mapping cognitive tool) into a fourth year Bachelor of Education unit.

Social constructivism

The theoretical framework underpinning the DLE was based on social constructivism. Social constructivists contend that learning is the process of becoming socialised into a particular way of thinking. This occurs through participation within 'communities of practice' (Crook, 1994, p. 38), where cognition is supported by discourse, resources and the cultural rituals associated with the learning environment at hand. Viewed in this way, the classroom is a complex 'cognitive system' (Moore & Rocklin, 1998) where individuals interact with one another and a variety of resources in the pursuit of cognitive activity.

This conception of the classroom as a 'cognitive system' has direct implications for the type of research methodology chosen to explore it. Certainly, the study of isolated elements of cognitive phenomena within a classroom will be quite different to the study of the classroom as a cognitive whole. In support of this contention Salomon (1991) writes, "classrooms ... are complex, often nested conglomerates of interdependent variables, events, perceptions, attitudes, expectations and behaviours, and thus their study cannot be approached in the same way that the study of single events and single variables can" (p. 11).

These assumptions influenced the methodological direction of this study where the objective was to determine the effectiveness of cognitive tools when implemented within a DLE. Given that the environment was based on the belief that classrooms are 'knowledge building communities' (Hewitt & Scardamalia, 1998), where resources collectively contribute to cognitive activity, the methodology was required to acknowledge the indivisible nature of the classroom in this instance. While the cognitive tool was a focal point of this study, it was acknowledged that its success depended on many other interdependent variables within the learning environment. In relation to this, Salomon et al. (1991) write, "No computer technology in and of itself can be made to affect thinking. One needs to consider both theoretically and practically, the whole social & cultural milieu in which instruction takes place" (p. 3). Consequently, qualitative methodology was used given that its principles are in tune with a DLE, and capable of capturing and expressing the cognitive activity that emerges. It was also thought that qualitative approaches would be more sensitive to the nuances characteristic of social situations and more likely to provide results that were rich, descriptive and a genuine reflection of the participants' perspectives.

More specifically, the procedures associated with action research were followed given that the problem being investigated was within the social setting of the researcher's own class. As such, the researcher for this study was also the teacher, as well as a mediating resource who facilitated the shared construction of knowledge.

Action research

Action research is the study of a social situation with a view to changing or improving the quality of action within it (Elliot, 1982 cited in Winter, 1989). This process can be likened to a type of professional development where the practitioner attempts to learn about aspects of his or her practice. However, according to McTaggart (1994), the findings to emerge from this professional development are not only of value to the practitioner, but may be deemed valuable by other audiences with similar needs and concerns. He writes, "...action research is not merely about learning, [but] ... is about knowledge production and about the improvement of practice [amongst similarly] committed groups" (p. 317).

Numerous action research models have been developed during the last 50 years, all of which describe this methodology as a series of repetitive steps involving the implementation of a plan which seeks to improve a particular situation. While some of these models are more elaborate than others, each one describes the research process as a systematic, self reflective spiral of planning, acting, observing and reflecting. These four stages constitute one step in a study's cycle and are repeated until the situation being monitored has improved, or the desired goals have been achieved. In this way, "theories' are not validated independently and then applied to practice. They are validated through practice" (Elliott, 1982 cited in Winter, 1989, p. 13).

Due to the development and implementation of these models, much has been learned about the action research process. In particular, the literature describing and supporting their specific features has contributed to the acceptance of this inquiry as a valuable approach to educational research. And while some of these education specific models have been criticised in the literature, these criticisms have been typically used as the basis for refining and improving action research methodology as a whole.

For example, early action research models proposed by Lewin, Kemmis, Elliott and Ebbutt have been defined in the literature as being too controlling (Hopkins, 1985). Furthermore, Lewin's model has been rebuked by educational researchers for its lack of educational focus (Hopkins, 1985). While Kemmis, Elliott and Ebbutt have addressed this issue by developing models that are specific to educational contexts, they have also been described as prescriptive, one dimensional and inattentive to the multifaceted nature of classroom problems (McNiff, 1994). In relation to the unpredictable albeit related issues that arise out of primary investigations, researchers have identified the need for more flexible and dynamic action research models.

McNiff's (1994) multi-spiral model has attempted to address this need in that it not only acknowledges that side issues occur but that they also need disciplined consideration. Consequently, she has proposed that Chomsky's (cited in McNiff, 1994) three levels of observe, describe and explain be applied to all phases of inquiry into the main problem, as well as related sub-problems.

However, Atkinson (1994) argues that the spiral spin offs might cause the researcher to lose sight of the main issue and that having multiple investigations on the go at one time could result in the loss of rigour and discipline in the entire research process. Ritchie's (1995) multi-layered approach overcomes this problem in that related issues are not treated separately but are subsumed into the main investigation. Analysis of one phase (layer) forms the basis for subsequent layers. However, this model does not recognise possible inexplicable occurrences that may not be able to be subsumed into the initial inquiry.

Therefore, in designing this study, the strengths and shortcomings of each of these action research models were considered and it became evident that a tentative plan of action was required, rather than a rigid model. This tentative plan needed to be robust enough to guide the research process, yet flexible enough to embrace the complex, non-linear 'messiness' characteristic of most classroom contexts. As such, the concept map presented in Figure 1 was devised.

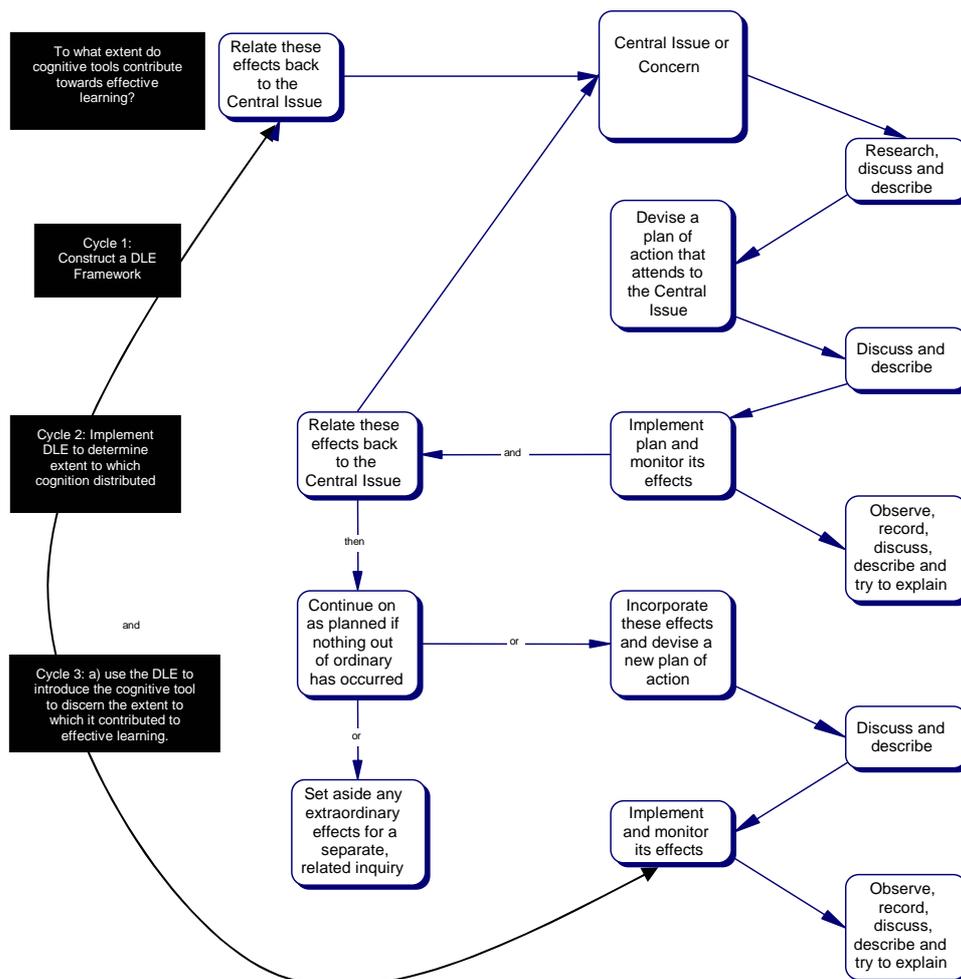


Figure 1: Tentative plan of action for the study

This map reflects the integrated relationship between the planning, acting, observing and reflecting phases of the inquiry, as proposed by Lewin (1946), Kemmis (Kemmis & Taggart, 1982), and Elliott (McNiff, 1994). It reflects the need for logic and order, as proposed by Ebbutt (1983) as well as the need to continuously revisit the central issue. It reflects the 'multi-layered' approach proposed by Ritchie (1995) in the sense that with every new cycle, the outcomes of previous ones are used to inform new insights, claims and plans. And above all, it reflects Chomsky's three levels of adequacy (observation, description and explanation) which, according to McNiff (1994), moves the inquiry towards an authentic resolution of the problem. The study constituted three cycles of action, throughout which this plan acted as a flexible road map.

Procedure

In the first and second cycle, the DLE was designed and tested. In the third cycle it was used as the catalyst to introduce an electronic concept mapping tool (Inspiration) into a fourth year Bachelor of Education unit to discern the extent to which it contributed to effective learning when accessed as a cognitive tool.

Concept mapping software was chosen due to the interrelated nature of the concepts within the unit. Each class was based on collaborative group work and whole class discussions, the understandings from which were then built into a series of concept maps which each group devised. The collaborative groups were made up of three students and one computer. Analysis was aimed at determining the socio-cognitive processes that were evident within the group collaborations, so on three separate occasions, these groups were audio-taped as they constructed their concept maps and completed class activities. Although not the sole source of data, the transcripts from these class activities were the main focus of analysis.

The analysis tool was derived from models within the literature that describe varying forms and levels of conceptual growth. Biggs & Collis' (1984) SOLO Taxonomy, Marton, Dall'Alba & Beaty's (1993) conceptions of learning, and Jonassen and Tessmer's (1996) learning taxonomy were chosen for their rich descriptions of learning outcomes which can be applied to both solo and socio-cognitive processes. In attempting to decide which of these three models would be the most suitable for this study, all three were combined to develop a thorough set of learning characteristics.

Because group discussion was the primary source of data, these combined learning characteristics were then translated into five types of corresponding discourse - *prestructural discourse*, *foundational discourse*, *relational discourse*, *extended abstract discourse* and *metacognitive discourse* – which are elaborated upon in Table 1.

Table 1: Analysis tool: Types of discourse

Types of discourse
<p>Prestructural discourse Statements that are illogical, irrelevant, incorrect or incoherent. Statements about related declarative knowledge that are isolated from any other information. Statements that are indicative of memory recall or recognition of isolated declarative knowledge.</p>
<p>Foundational discourse Statements that are indicative of a developing understanding – groups can identify more than one relevant concept and will endeavour to (either successfully or unsuccessfully) relate these concepts together. Statements show consistency and congruence with expert perspectives.</p>
<p>Relational discourse Statements are indicative of the formation of a diverse, complex semantic network of interrelated concepts. Knowledge of these relationships is articulated freely and effectively to others. A range of strategies are employed to facilitate deep level understandings of material and explanations are logical, coherent and speedy.</p>
<p>Extended abstract discourse Statements indicate the group's ability to apply concepts to a range of situations using learned operations. There is a sense of originality emerging and confidence to experiment with concepts in diverse contexts. Analogies are being drawn, abstract inferences made, as well as personal theories, all of which are highly plausible and sophisticated. As a result of these newly formed appreciations, changes are apparent in the way the group perceives concepts about certain phenomenon.</p>
<p>Metacognitive discourse Statements reflect knowledge about the group's ability as learning entity - its strengths and shortcomings. There is an awareness of the learning context - what the task requirements are, what resources are available, how these resources can be used effectively, and what skills and processes will facilitate successful completion of the task. This incorporates knowledge and application of appropriate learning strategies (cognitive, metacognitive and resource management). Groups are able to articulate, monitor and regulate their effort, persistence, willingness to learn.</p>

Findings

Prestructural discourse was mostly apparent at the introduction of modules where groups pooled their existing ideas on the topic. At times, these comments would be based on misconceptions or they would lack meaningful integration with other similar concepts.

Foundational discourse was the most common type of talk throughout the semester for all groups. In these instances, groups pooled their prior knowledge about concepts which was then evaluated, questioned or challenged. There appeared to be a genuine commitment towards understanding the material which was evident in their attempts to explain concepts, relate them to personal experiences and fit them into their concept maps in logical and meaningful ways. Also, foundational discourse mostly occurred in conjunction with the concept map, where its image was used as a visual prompt to activate conversations.

Relational discourse was also evident in all groups' discussions yet some groups were more consistent than others. In these instances, conversations were fluid and based on sound understandings of concepts. The groups were able to make logical inferences about concepts based on their relationships to other concepts. Relational discourse often emerged in conjunction with a group's decision to reorganise the layout of their concept map. It seemed that as their understandings developed so too did their confidence to experiment with a range of spatial possibilities.

Extended abstract discourse was less evident - only occurring once during the recorded sessions. In light of Biggs and Moore's (1993) contention that this sophisticated level of thought is a rarity in classrooms, this finding is not surprising.

Metacognitive discourse was evident throughout all transcripts. In most cases, the students used the computer to help them visualise their growing understanding of the concepts and as a metacognitive prompt that enabled them to identify gaps in their understandings.

While all types of discourse were present throughout the groups' discussions, foundational, relational and metacognitive discourse had a strong presence in each recording session. When presented with a task or concept, there was consistent evidence in the data that groups reflected on their combined prior knowledge, made inferences about it, challenged each other, determined the implications of interrelationships and made attempts to fit ideas into coherent explanations. This process typically occurred in the presence of the concept mapping tool, which clearly provided the group with visual representations of their developing understandings.

Conclusions

It can be concluded from these findings that the characteristics that support the development of foundational knowledge, relational knowledge, metacognitive knowledge and (possibly) extended abstract knowledge are present due to a form of socially organised intervention with the computer. Collaborative group work with and around the computer fostered the conditions that lead to quality learning outcomes in a distributed learning environment. Interaction with the computer appeared to have mediated the groups' attempts to place structure and coherency in their dialogue, identify gaps in their understandings and take the appropriate steps towards integrating knowledge.

Furthermore, the tentative plan of action research that was used to scaffold this investigation proved to be a highly successful methodological approach. Not only was it sensitive to the nuances evident within the social milieu being investigated, its fluidity also ensured that each cycle of research worked in partnership to address the main investigation in a rigorous yet compliant fashion. As was argued in this paper, formal action research models are not always constructive and perhaps even limiting to researchers who adopt them as their ultimate frame of reference. This study demonstrates that a 'tentative plan', which is firmly grounded in action research principles, can be a more valuable approach.

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