Imprinting and its impact on online learning environments

Ruth Geer
School of Education
University of South Australia

Abstract

Research into the interactive behaviour and cognitive development of students in asynchronous online discussion forums has led to the development of a number of notions. Students in their interactions displayed similar cognitive indicators across various assigned topics for discussion. The impact of these initial communications led to the notion of "imprinting" as a means of characterising the consistent cognitive behaviour of the students in subsequent interactions. The record of cognitive indicators across the topics could be considered as cognitive tracks that demonstrate a particular learning approach described in terms of narrow or broad static cognitive tracks. Alternatively based on the instructional design students may exhibit narrow or broad dynamic cognitive tracks. This paper develops the relevance and impact of such concepts emerging from an analysis of the digital discourse. Their importance is reflected upon in the development of a new first year teacher education course. Educators should understand such concepts and take these into account when designing effective online learning communities.

Online learning communities

Various theoretical perspectives influence the design of courses and an understanding of how students learn in online environments. Their theoretical underpinnings are in social and cognitive constructivism. A number of researchers (Garrison, Anderson, & Archer, 2000; McLoughlin, 2002; Oliver & Herrington, 2003) have developed models that identify critical elements of online learning communities. Key elements associated with online instructional design, include interactivity, collaboration, social, teaching and cognitive presence.

The development of higher order cognition requires strategies involving sustained interaction that can occur in both traditional and online learning settings. Learning occurs as knowledge is built from understanding and experience that usually takes time to assimilate. Individuals also learn at different rates and through differing experiences (Meyer, 2003). The online environment provides learners with the added opportunity to manage their own time to a large extent and in particular, if using asynchronous tools, to reflect upon what they are learning (Garrison & Anderson, 2003). They can share their reflections and increase their understanding through discussion and negotiation. Sustained interaction not only enhances the internal thinking processes but allows for open debate of issues. This supports the development of the cognitive and metacognitive capacity of the individual.

Although learning may be a natural occurrence, higher order cognition is attained from learning experiences that are appropriately structured and facilitated by educators (Pitt, 1997). In addition, interaction and collaboration have been identified as key ingredients in online learning environments (King & Doerfert, 1996). However it cannot be assumed that learners automatically know how to interact and collaborate to achieve the desired learning outcomes. Educators must carefully build these experiences into the design. Later researchers (Agostinho, Oliver, Harper, Hedberg, & Wills, 2002; Garrison et al., 2000; McLoughlin, 2002; Stacey & Rice, 2002) have added to these critical elements with a body of knowledge emerging that identifies additional elements and addresses how individuals learn with the technologies.

With constantly emerging technologies educators face the issues of which technologies are best suited to support the required learning outcomes and how to utilize these technologies that are evolving more rapidly than the pedagogies. Due to a lack of pedagogical guidance about integrating technologies for collaboration and communication, educators are left with mounting dilemmas and confusion (Bonk & Cunningham, 1998). Currently, the corporate world drives much of the information economy and influences the development of information technologies. Educators require a greater say in the evolution of technologies that will equip students with the cognitive skills that make them successful lifelong learners. Technologies that support greater collaborative activities are emerging slowly, as educators push for more collaborative interactivity.

The most common and widespread communication technologies use text-based interactions. In the online environment, exchanges primarily take place through written language without the benefits of paralanguage (nonverbal cues). Written communication, therefore, could be considered a rather lean medium for communication with the absence of indicators that help to sustain the dynamics of the group. Such deficiencies may be seen as detracting from the learning. However, written communication does also have the benefit of allowing time for reflection which is important for higher order cognitive thinking (Garrison et al., 2000). Feenberg (1999, cited in Anderson, Rourke, Garrison, & Archer, 2001) suggests that writing should not be considered a poor substitute for the spoken language as it has its own properties and powers.

Interaction has been a major theme in education for some time, but it has gained increased attention with the popularity of online learning and the reliance on technology to support the required interactions. The definition of interaction has been defined from many perspectives, influenced by numerous factors such as type of technology used, anticipated learning outcomes, instructor involvement and task design. Different types of interactions lead to different learning outcomes. This has particular implications in designing a pedagogical framework that must accommodate various types of interaction and perceived learning outcomes influenced by the activity and the chosen interactive technology. Technology also brings with it particular challenges, such as, familiarity and skills to operate the technology, and choosing the right type of technology, synchronous or asynchronous to accommodate the learning outcomes required from the task.

Collaboration is identified as a desirable type of interaction in online learning communities. Collaboration encourages learners to move to the higher levels of cognition made possible by the intensity of the exchanges in arriving at a consensus. 'Collaboration is an approach to teaching and learning that goes beyond simple interaction and declarative instructions' (Garrison et al., 2000, p. 6). It is an ingredient that helps to form a community. Collaboration shifts the learning from being situated in an environment to a community, where the learner is enveloped in the learning process. Collaborative efforts result in the acquisition of knowledge, skills or attitudes (Graham & Scarborough, 1999). Students can benefit from collaborative learning whether low, average or high achievers (Susman, 1998), where student support and interdependence help to shift students in their understanding. Collaboration attempts to draw learners who may be at different stages in their understanding up to the same level for the particular task. In collaborative situations, higher achievers benefit through having to articulate and rationalise their own arguments. Information from the individuals is shared with the group while supporting the development of higher order thinking skills resulting in consensus through negotiation.

Higher order cognition is the ability to think critically, creatively, and to be able to investigate, problem solve and synthesise the information. Where the interaction is dynamic, learners are able to contemplate the differing perspectives and reflect on their own views, thus building new meanings. Learning collaboratively provides a suitable educational context for critical thinking processes and deep learning styles (Newman, Johnson, Webb, & Cochrane, 1997). McLoughlin and Luca (2000) propose that according to sociocultural theory, dialogue is instrumental in helping learners to internalise their ideas and knowledge. Learning is then advanced 'as tasks are pitched just beyond the learners' zone of proximal development' (McLoughlin & Luca, 2000), while interactions with other learners provide the scaffolding that supports their cognitive development.

An analysis of cognitive development provides insight into the quality of the learning experiences. In online learning communities active interaction is an essential component in the development of critical thinking, as interaction encourages thinking that leads to reasoning and the revision of ideas (McLoughlin, 1997). Cognitive presence is the participants' ability to construct meaning through sustained communication. It is a vital element of critical thinking (Garrison et al., 2000), and therefore becomes an essential element of any learning community.

The overall evaluation of the effectiveness of online learning communities is difficult. Numerous models have been used to evaluate the learning that is occurring in discussion forums. Initially the focus of evaluation was on results evident from a quantitative analysis of the data which provide insight into work habits and students' associated messaging behaviour as expressed through time/date references, email addresses and other available data. It was then realised that the digitising of the information opened up new possibilities for evaluation and greater insight could be gained from a qualitative analysis of the discourse. There is now a substantial body of literature that focuses on such discourse analysis. Early models (Garrison, 1992; Henri, 1992; Mason, 1992) are providing the foundations for the development of other evaluative models (Gunawardena, 1997; Newman, 1997; McLoughlin, 2000; Geer, 2001). These models have been used in varying ways to analyse the discourse for evidence of higher order thinking.

An adaptation of Gunawardena, Lowe and Anderson's (1997) Interaction Analysis Model for examining social construction of knowledge in computer conferencing, provided a basis for developing an effective evaluative model for analysing archived discourse. By using the indicators under the various phases of the model, assessing the development of cognition became possible. Some changes were needed to explicitly address the interactive behaviours that might be occurring in the construction of knowledge. Adaptations to this model drew on Garrisons et al's *Community of Inquiry* model (2000) and Henri's five dimensions of learning (1992). This evaluative tool (Table 1) became known as a model for social behaviour, cognitive development and interactive analysis (SCIA) (Geer & Barnes, 2001). The model allowed for an investigation of the discourse at three levels. The three types of learner orientations (social, individual and group) identified the interactive behaviour of the participants. The phases within each orientation characterised the cognitive activity, while the indicators within the phases showed the approaches to learning that were being adopted.

Table 1: A model for social behaviour, cognitive development and interactive analysis (SCIA)

S. Participation and social behaviour

S1 Individual disclosure
- S1-a Basic introduction.
- S1-b Extended revelation
- S1-c Self evaluation

S2 Social behaviour
- S2-a Courtesy
- S2-b Level of dominance/authority
- S2-c Seeking help
- S2-d Willingness to initiate

S3 Mutual Consideration
- S3-a Identifying mutual interest
- S3-b Willingness to exchange
- S3-c Valuing others' views

I. Cognitive behaviour analysis at individual level

I1 Elementary clarification
- I1-a Observing/studying a problem
- I1-b Identifying its elements
- I1-c Observing/studying their linkages

I2 In-depth clarification
- I2-a Analysing a problem
- I2-b Identifying assumptions
- I2-c Establishing referential criteria
- I2-d Seeking out specialized information

I3 Synthesis and application
- I3-a Drawing primary conclusions
- I3-b Proposing an idea based on links and relevant information
- I3-c Value judgment on relevant solutions
- I3-d Making final decisions and deciding on the action(s) to be taken

G. Interactive behaviour analysis at group level

G1 Planning
- G1-a Organizing work/planning group work/setting shared tasks
- G1-b Initiating activities/setting up activities for group work

G2 Sharing/comparing/contributing of information
- G2-a Defining and identifying a problem
- G2-b Stating opinions regarding the problem
- G2-c Asking and answering questions to clarify details of statements
- G2-d Sharing and exchanging knowledge, resources and information
- G2-e Corroborating examples provided by one or more participants
- G2-f Challenging others to engage in group discussion
- G2-g Help and feedback giving

Table 1 cont.

G3 Inconsistency of ideas, concepts or statements
- G3-a Identifying and stating areas of disagreement
- G3-b Asking and answering questions to clarify the source and extent of disagreement
- G3-c Restating the participants' position and advancing arguments or considerations supported by references

G4 Negotiation of meaning/co-construction of knowledge
- G4-a Negotiating or clarifying the meaning of terms, areas of agreement and disagreement
- G4-b Proposing new statements embodying compromise and co-construction
- G4-c Integrating or accommodating metaphors or analogies

G5 Testing and modification of proposed synthesis or co-construction of knowledge
- G5-a Testing against existing knowledge and information
- G5-b Testing against personal experience
- G5-c Testing against formal data collected

G6 Agreement statement(s) and application of newly constructed knowledge
- G6-a Summarization of agreement(s)
- G6-b Application of new knowledge

The study

Email contributions of 275 students belonging to 15 discussion forums and amounting to over 1500 messages over four years of a core first year, semester long, teacher education course were analysed using an evaluative tool (SCIA). The course structure comprised workshops, lectures and an online discussion forum. Each workshop group had its own discussion forum comprising approximately 20 students who were further divided into small groups of about 5 students. Online discussion forums, which were the focus of this study, provided students with the opportunity for a richer and more active engagement with the course content beyond the normal workshop times. Over the semester four different topics were discussed with the exchanges on each topic occurring over a seven-day period every three weeks. A different small group was responsible for each of the online discussion topics culminating in a face-to-face presentation of the key issues raised in the forums. There was a collaborative assessment for each small group (20% of the total assessment) based on their online participation and face-to-face presentation.

The mandatory topic contributions were coded against the three orientations (social, individual and group) and indicators relevant to that orientation were applied to the discourse. The different approaches used by the small groups became evident in the orientation adopted by the forum. The cognitive indicators within the various orientations and phases offered insight into the differing approaches that students used to respond to the various topics. Indicators were aggregated at both the student and forum level resulting in individuals being associated with a particular orientation; i.e. some individuals were more social or group oriented than others. At the forum level groups tended to exhibit an individual, group or a mixed orientation consistently across all topics. This suggested that the particular behaviour that was exhibited for the first topic tended to be replicated across the other topics as illustrated in Figure 1.

The cognitive indicators were recorded for each topic as well as their aggregates against each student. Using Pearson's product moment the social, individual and group orientations were explored for relationships across the four topics. The data showed a strong level of continuity across topics 1 to 4 in the case of individual and group aggregates and a weaker but still positive level of continuity in the case of the social aggregates across topics.

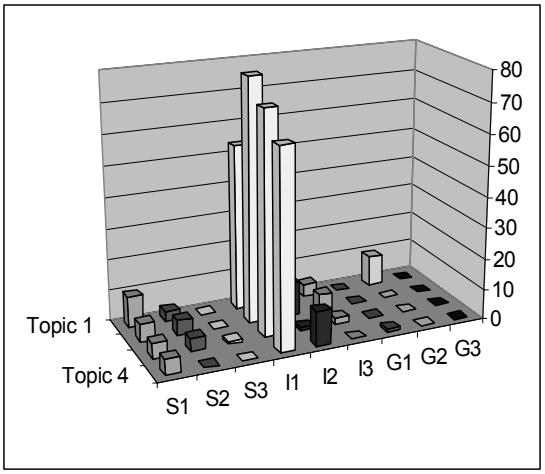

Figure 1: Individually oriented forum

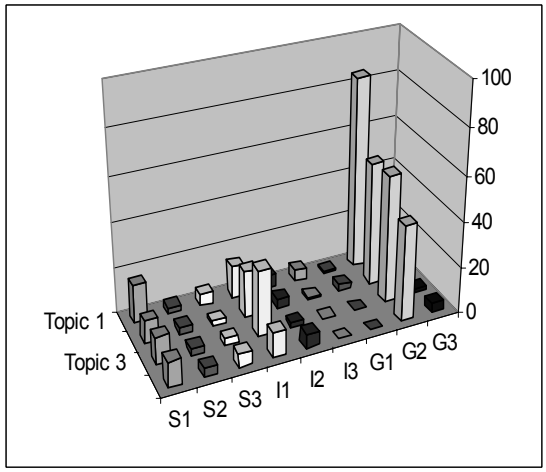

Figure 2: Group oriented forum

The powerful influence of Topic 1 on subsequent topics was confirmed through a canonical correlation analysis that examined the relationship between cognitive indicator aggregates. For individually oriented cognitive aggregates, the canonical variance was 0.52, accounting for 26%, while for group oriented cognitive aggregates, the canonical coefficient was 0.34, accounting for 11.4%. Therefore the cognitive behaviour exhibited for Topic 1 could be said to be predicting between 11 and 26% of cognitive behaviour for subsequent topics. Further examination of the cognitive indicators from the discourse analysis showed that students appeared to exhibit particular interactive and cognitive behaviours over time. The cognitive levels achieved in the first response were predictors of cognitive levels achieved in later responses. Thus the first response becomes critical in determining communicative patterns in subsequent exchanges and the learning outcomes likely to be achieved.

Initial communication patterns are shown to be powerful in determining subsequent interactive behaviours in the forums. The impact of these initial communications led to the notion of "imprinting" as a means of characterising the serially consistent cognitive behaviour of the students within the forums. The effects of imprinting then become a consideration in the formation of discussion forums or online learning communities. There was sufficient evidence across the orientations to suggest that imprinting may be a valid predictor of students' future interactions. From a teaching and learning perspective this implies that the cognitive behaviours that occur in the first topic therefore need to reflect the desired learning outcomes, if the discussion forums are to meet course objectives.

Accepting that repetition and reinforcement of cognitive development may be important to sustain, imprinting becomes a positive outcome of discussion forums. This may be an important learning strategy in certain disciplines such as science and mathematics where understanding and application of concepts requires repetition and practice.

The treatment and learning strategies employed for the first topic by the students become critical in achieving desired learning outcomes. Educators need to be clear about the purpose of the discussion forum, the desired outcomes (including cognitive development), and the type of interactions they wish to encourage. They must build into the design; strategies that will ensure desired outcomes are evident. Thus the notion of 'imprinting' assumes the need to 'get it right' from the start to ensure cognitive development is supported and sustained.

If cognitive indicators suggestive of the desired learning outcomes for the course are present in the first topic, then imprinting becomes an important consideration in the instructional design of courses and in ensuring student success. Students have an opportunity to build on the strengths on this type of learning. The diagram below (Figure 3) suggests two types of imprinting that can occur over time using topic-focused discussion as the interactive pedagogy. Although the findings can only be confirmed for this type of activity, it is possible that its relevance may also extend to other interactive activities.

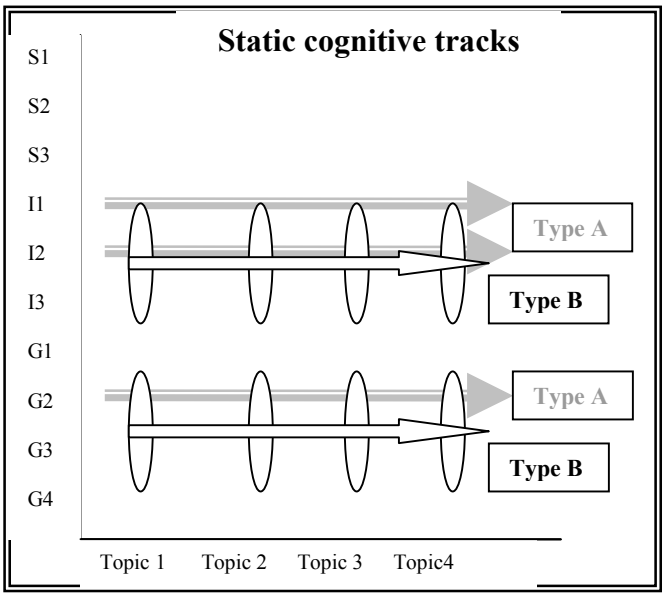

Figure 3: Imprinting designs across time

In some instances one particular indicator may dominate the discussion (such as elementary clarification, I1 or sharing/comparing information, G2), which prevails across the discussion topics (Type A). In these cases the cognitive development remains static across the topics. 'Static' describes the process where there is little or no change in indicators over a period of time. Furthermore, students may demonstrate a set of cognitive indicators for each topic that are repeated for subsequent topics (Type B). Here students show an appreciation of differing cognitive strategies and knowledge acquisition for each topic. Their responses for each topic may demonstrate a cognitive movement through the indicators; such as starting with problem identification which progresses to analysis and the drawing of some conclusions. However, rather than furthering the development of learning approaches, students use the same set of indicators for each topic indicating a broader but static track.

It is helpful to consider the record of cognitive indicators in the course as a cognitive track which may be relatively straight and narrow as students focus on a particular learning approach, such as I1a, I2a or G2a (Figure 3), wavering very little in their approach to each topic. Alternatively it may be a broader track as students explore, investigate and interpret different approaches to knowledge acquisition. These two types of imprinting will be referred to as 'static cognitive tracks' where the cognitive engagement is consistent across the topics. Hence, if the aim of the discussion forum is to have students analyse a topic showing cognition phases of say, I2 or G2, then imprinting will ensure that narrow track, Type A, occurs across the topics. However if the intention of the forums is to develop students' higher order thinking then an example of a broad track, Type B, should be evident. If the topics or tasks require similar treatment by the students, imprinting may guarantee valid learning outcomes, while also providing early predictions of their learning achievements and success.

In most contexts where imprinting is desirable, Type B would be the optimum static cognitive track along which students should travel. Imprinting supports learning and teaching, where consolidation in cognitive development is needed over time. This particular course design required consistency with similar learning outcomes required for each small group. This study showed strong evidence that imprinting in discussion forums is a likely effect across time where task expectations and learning outcomes are consistent.

On the other hand, if educators wish to avoid imprinting because they desire students to move progressively rather than statically along various cognitive tracks, then factors that lead to imprinting must be counterbalanced with changes to the instructional design and teaching presence. There will be situations when imprinting is inappropriate because educators want to see a shift in students' thinking. The term 'dynamic cognitive track' suggests a change in learning focus where students move through various cognitive indicators that indicate students are utilising differing strategies and developing further cognitive skills over time. Dynamic, characterised by constant change, is contrasted with static.

Type C in Figure 4 represents narrow cognitive tracks along which educators may wish students to travel through a course. Initially the first topic may require identification and observation of the problem, but with each topic or changed activity, students are required to move cognitively along the tracks, which move them through differing learning outcomes. Type D suggests a more scaffolded approach on a broader track where students ideally build on their understanding and knowledge from the previous topic as they move towards the construction of new knowledge. There is an overlap of indicators, consolidating the various strategies which students use as the basis for further cognitive investigation.

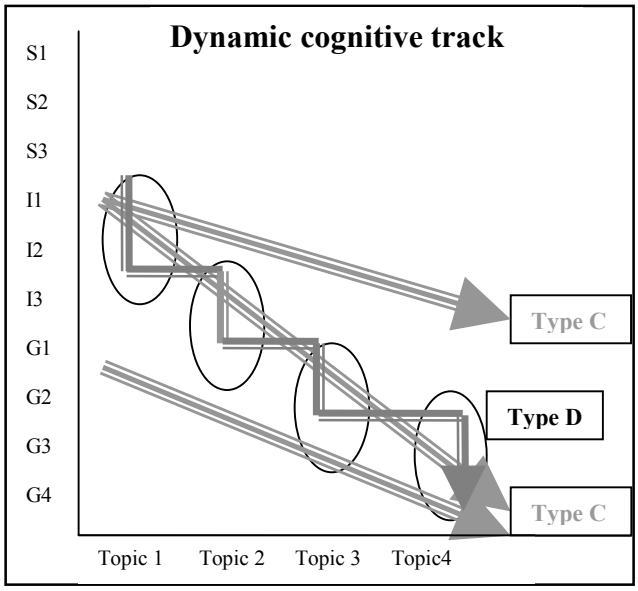

Figure 4: Progressive cognitive movement across time

The impact of imprinting for teaching and learning

The influences leading to imprinting must be understood in order to impact on the cognitive dynamics of the online learning community. Educators should identify appropriate cognitive tracks along which they want their students to journey. Instructional design is shown to be integral to the interactive behaviour of students within discussion forums. Educators must consider the technologies that are able to support the type of track desired by the educator. Figures 3 and 4 suggest narrow and broad cognitive tracks along which students may journey using asynchronous communication tools. However, further research is needed to understand whether cognitive tracks would be similar if using synchronous tools.

One of the most obvious reasons for imprinting is that it is a desired outcome for the course. On the other hand it may be that interactivity is not sufficiently varied in the instructional design. Students may see no need to change their learning approach for subsequent responses, particularly if the first response is considered as adequate or acceptable. Students could assume that requirements have been met if lecturers or peers do not give feedback that suggests inadequacies. Particular student characteristics that impact on the style of the response are also likely to impact on subsequent responses. For example, if students are self-directed and portray an individual focus, that approach is likely to be evident in all their responses.

From an organisational perspective, if the small group responsible for the discussion is successful, it would be counter productive for the other small groups addressing later topics to make changes that may not work. If the goals of the discussion forum are clear, the first topic becomes the model for subsequent topic discussions. If responses are required but not assessed, there is less likelihood of changes in the type of behaviour and in the cognition of the students. Thus, lack of intervention is likely to lead to imprinting.

The technologies that are utilised may also affect the potential for imprinting. This ‘notion’ of imprinting is more general than just cognitive and interactive behaviours; it implies forming habits around the technologies being used. Indeed in a study offering a range of contemporary technologies, Huysman et al. (2003) found that the type of technology used for initial collaborative tasks continued to be used throughout the interactions. This style of media use, which was strengthened and became entrenched in the group interactions, was referred to as ‘media stickiness’. Not only is there the potential for imprinting of cognitive and interactive behaviours, but there is also the media-stickiness of the technology. Instructional design therefore is paramount in determining the interactive behaviour of discussion forums and the likely occurrence of imprinting.

In summary, the effects of imprinting provide lecturers with a strong predictor of student performance dependent on the first response. Based on the notion of imprinting, poor performance in the first topic may be an indicator of a poor final mark for the assessment. Intervention strategies need to be implemented for those students who are not exhibiting the desired outcomes in the first topic. In the context of this study the first topic response was a useful predictor that provided early signs of required educator intervention where responses did not meet expectations. This may mean additional guidance, support and modelling by the educator to ensure that the expectations of the discussion forum are evident. Students can then consolidate these expectations over the remaining topics.

To ensure learning advantages from the results of imprinting, educators must allow time for students to familiarise themselves with the environment and with their peers through social interaction. Learning goals must be explicit with clear guidelines on the required interactivity and outcomes. Educators should focus their energies and effort in supporting students with the first topic. If imprinting is a desired effect educators must ensure the presence of cognitive indicators relevant to desired learning outcomes in their initial communications.

When considering the effects of imprinting, educators should determine whether imprinting is appropriate for the particular context, and if not, make the necessary adjustments to the instructional design. Where imprinting may be an inappropriate strategy, educators must focus on the types of activities and technologies that will support their students in adopting a variety of learning approaches that ultimately lead along the broad dynamic cognitive tracks.

This research has initiated the concept of cognitive tracks to guide the educator in determining what the particular cognitive track should be in their course. This then has implications for the instructional design where scaffolding and modelling are critical to ensure adoption of a suitable cognitive track by the student. It has exposed the importance of instructional design for quality interaction using technology-mediated tools. In essence the teaching and learning design determines the type of cognitive tracks students follow, and which become discernible through an analysis of the digital archives.

Reflections for instructional design of a new course

The findings of this research have impacted on the design of a new teacher education first year course. Although the basic structure of the new course with lectures, workshops and online discussion forums was similar to the course discussed in the research much more attention was given to designing effective online learning experiences. Student involvement, but mainly through collaborative small groups again comprised 20% of the final grade. Assigning a higher proportion of grades was dismissed, as collaborative assessment often made it more difficult to distinguish the better from the poorer students in the final grade.

The findings of the discussed research influenced the organisation of discussion forums. Student-led discussion forums were again used to discuss topics related to the integration of technologies into the classroom. The importance of the type of topics and subsequent desired interactions were recognised. Topics chosen were more open-ended and controversial to encourage increased and more intense interaction. Examples of such topics were: “A well developed web-based learning system will replace the teacher” or “Technology stifles creativity”. Although at this stage no detailed analysis has been undertaken it became obvious from reading the responses that students were engaging differently and more intensely with the topics. The topics frequently resulted in the group being divided over their beliefs leading to more rigorous discussion. Students also tended to be far more creative in their answers, frequently resorting to examples or relating a story to make their point and further their convictions. In the face-to-face presentations it became obvious that many students were quite passionate about their beliefs and further argued their stance in the classroom situation. A mixed approach where students had opportunity to engage with the topic online and further continue their arguments in a classroom situation led to increased understanding. The current experiences, although at this stage only based on observation and reflection with this new course has highlighted the importance of the type of questions or activities being set and the blended learning approach to further and deepen the interactions.

Another issue that educators in the course tried to address was shifting the students from individual responses to posting responses that acknowledged they were members of a learning forum. Instead of necessitating a minimum of one response of approximately 400 words, the requirement changed to a minimum of two responses, although still requiring an aggregated response of 400 words. Students’ second responses generally made reference to the responses of others in their group reflecting a greater sense of cooperation and “groupness”.

Another strategy that contributed to more group oriented discussion was the preparation that went into understanding the role of the small group in directing the student-led discussions. As the course consisted of a face-to-face component the first workshop was devoted to understanding the dynamics within a small group. Students were required to participate in group role playing. From this students learned that there are many roles in a small group and that dissension within the group is important in encouraging critical thinking and negotiating possible solutions. Where there is no face to face component additional time must be spent in social interaction to help students get to know each other so that they become comfortable adopting various roles within the group to foster heightened interaction with the intention of leading to higher cognitive development.

Hence, when moderating the discussion topics the various small group members assigned themselves different roles. There was the initiator who challenged the forum to discuss the topic. There were the moderators who drew on the comments of others to encourage further discussion through questioning and critiquing of responses. At the conclusion of the week of discussion there was the person who summarised the discussion that occurred. Everyone therefore was conscious of the fact that their responses were being read by the majority of members of their forum, thus ensuring a quality in the responses. Students were encouraged to make reference to various articles that they had read on the topic.

Imprinting would be evident over time as outcomes were the same for each group. Educators overseeing the various forums put a lot of effort into the first small group to ensure that the desired learning outcomes were met. Besides gaining a greater understanding of the topic, one of the aims was to encourage higher order thinking. The increased interaction led to greater sharing, comparing and questioning of ideas. There was also evidence of identifying and stating areas of disagreement that had not been evident in the forums discussed in the research. Student were restating their position and advancing their arguments to further their convictions. New ideas were being put forward in an endeavour to come to some agreement. Some of the topics resulted in no consensus of agreement. They agreed to disagree. In other topics the small group helped the participants to modify their views in order to come to some agreement. From the perspective of cognitive tracks, students were generally adopting a more dynamic static track. This is an optimum track for which educators should aim where imprinting is evident and a designed outcome.

In summary, educators need to understand the concept of student cognitive tracks and plan to help students travel the more dynamic track. Considerations must be given to the type of tasks that will encourage interaction as well as disagreement among the participants to encourage the development of higher order cognition. Time must be spent in supporting and guiding the first small group leading the forum where imprinting is desirable. The earlier research also highlighted the importance of the technology as 'media stickiness' is also evident among groups. Hence it is critical that appropriate technologies are used that will support a deeper more reflective interaction while at the same time meeting the needs of the students who require flexibility in time and place for their interactions. Asynchronous email discussion lists, which use a "push" technology and are readily available, has proven to be an appropriate technology for the current needs of the course. Students are learning to cooperate, although not as yet in a truly collaborative sense, to arrive at an increased understanding of issues related to integrating technology into the primary classroom. Students are experiencing in some sense what it means to be participants in an online learning community.

References

Agostinho, S., Oliver, R., Harper, B., Hedberg, J., & Wills, S. (2002). *A tool to evaluate the potential for an ICT-based learning design to foster high quality learning.* Paper presented at the 19th annual ascilite conference, Auckland, NZ.

Anderson, T., Rourke, L., Garrison, D. R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks, 5*(2), 1–17.

Bonk, C. J., & Cunningham, D. J. (1998). Searching for learner-centered, constructivist and sociocultural components of collaborative educational learning tools. In C. J. Bonk & K. S. King (Eds.), *Electronic collaborators: Learner-centred technologies for literacy, apprenticeship and discourse* (pp. 25–50). Mahwah, NJ: Lawrence Erlbaum.

Garrison, D. R. (1992). Critical thinking and self directed learning in adult education: An analysis of responsibility and control issues. *Adult Education Quarterly, 42*(3), 136–148.

Garrison, D. R., & Anderson, T. (2003). *E-learning in the 21st century: A framework for research and practice.* London: RoutledgeFalmer.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet & Higher Education, 2*(2–3), 1–19.

Geer, R., & Barnes, A. (2001, 2002). *Teaching and learning through technology-mediated interaction*. Paper presented at the World conference on computers in education, Copenhagen, Denmark.

Graham, M., & Scarborough, H. (1999). Computer mediated communication and collaborative learning in an undrgraduate distance education environment. *Australian Journal of Educational Technology, 15*(1), 20–46.

Gunawardena, C. N., Lowe, C., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*(4), 397–431.

Henri, F. (1992). Computer conferencing and content analysis. In A. Kaye (Ed.), *Collaborative learning through computer conferencing: The Najaden papers* (pp. 117–136). Berlin: Springer-Verlag.

Huysman, M., Steinfield, C., Jang, C-Y., David, K. (2003). Virtual teams and the appropriation of communication technology: Exploring the concept of media stickiness. *Computer Supported Cooperative Work, 12,* 411–436.

King, J. L., & Doerfert, D. L. (1996). *Interaction in the distance education setting*. Retrieved September 7, 1999, from http://www.ssu.missouri.edu/ssu/Aged/NAERM/s-e-4.htm

Mason, R. (1992). Evaluation methodologies for computer conferencing applications. In A. R. Kaye (Ed.), *Collaborative learning through computer conferencing: The Najaden papers* (pp. 105–116). Berlin: Springer-Verlag.

McLoughlin, C. (2002). Computer supported teamwork: An integrative approach to evaluating cooperative learning in an online environment. *Australian Journal of Educational Technology, 18*(2), 227–254.

McLoughlin, C., & Luca, J. (2000). *Cognitive engagement and higher order thinking through computer conferencing: We know why but do we know how?* Paper presented at the 9th annual teaching learning forum, Perth.

McLoughlin, C. E. (1997). *Investigating conditions for higher order thinking in telematics environments.* Doctor of Philosophy, Edith Cowan University, Perth, Australia.

Meyer, K. A. (2003). Face-to-face versus threaded discussions: The role of time and higher order thinking. *Journal of Asynchronous Learning Networks (JALN), 7*(3), 55–65.

Newman, D. R., Johnson, C., Webb, B., & Cochrane, C. (1997). Evaluating the quality of learning in computer supported co-operative learning. *Journal of the American Society for Information Science, 48*(6), 484–495.

Oliver, R., & Herrington, J. (2003). Exploring technology-mediated learning from a pedagogical perspective. *Journal of Interactive Learning Environments, 11*(2), 111–126.

Pitt, T. J. C. A. (1997). *Creating powerful online courses using multiple instructional strategies.* Retrieved October 26, 1998, from http://leahi.kcc.hawaii.edu/org/tcc_conf97/pres/pitt.html

Stacey, E., & Rice, M. (2002). Evaluating an online learning environment. *Australian Journal of Educational Technology, 18*(3), 323–340.

Susman, E. B. (1998). Cooperative learning: A review of factors that increase the effectiveness of cooperative computer-based instruction. *Journal of Educational Computing Research, 18*(4), 303–322.