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Technology for the Future: the Use of Online Discussion Forums to Support Learners' Cognitive Organisation

Abstract:
Learning is a complex process influenced by many factors. But what actually happens during the learning process? This paper explores the processes involved in learning and cognitive organisation. Cognitive organisation refers to the arrangement of knowledge within a learner's mind through systemic classification and reorganisation of conceptual schemata. Cognitive organisation is fundamental to learning and new advances in technology offer modern educators the ability to support this process outside of the traditional classroom environment. The invention of Computer Mediated Communication technologies, such as online discussion, can be used as pedagogical scaffolding tools to assist learners in the process of cognitive organisation. This paper examines the literature that underpins the theory of cognitive organisation and a pilot study that explores the use of online discussion forums to support learners' cognitive organisation.

Key words: Cognitive Organisation; Learning; Online Discussion Forum

Technology and its Current Application in Learning

The last two decades have seen considerable advances in Information Communications Technology (ICT). Technology now impinges on all aspects of modern-day lives and will continue to do so for many more decades to come. This assumption is significant when thinking about the role of technology in educational contexts. Education is central to the learning of the young members of our society, the future decision makers of our world. As such, educational institutions should be on the cutting edge of technological advancement.

Teaching and Technology

Teaching can be defined as a sociocultural activity which aims to impart information; transmit knowledge; facilitate understanding; change student's conceptions; and

support student learning (Watkins and Mortimore 1999). These aims are achieved through pedagogy which can be defined as “any conscious activity by one person designed to enhance learning in another” (Watkins and Mortimore 1999, 3). Modern-day teachers are trained to recognise the thinking potential of other learners and to construct models of the world for them to engage with to help them construe their own experience. This sustained process assists students in acquiring new forms of knowledge from their instructors who are deemed to be appropriate providers and evaluators of learning (Bernstein 1999). Pedagogy is achieved through instructional scaffolding, which involves the use of strategies to help the learner progress from their current abilities to the intended goal of the task (Good and Brophy 2003). Many technologies function as scaffolds and tools to help students solve problems (Bransford, Brown, and Cocking 2000):

> What has not yet been fully understood is that computer-based technologies can be powerful pedagogical tools – not just rich sources of information, but also extensions of human capabilities and contexts for social interactions supporting learning. (Bransford, Brown, and Cocking 2000, 230)

In today’s information-rich society, learners grow up in an “environment which is semiotically diverse and complex and which requires of them new skills and broader forms of literacy” (Noss and Pachler 1999, 201). ICT can help learners make the knowledge construction process transparent as well as provide classificatory systems which simplify knowledge processing (Noss and Pachler 1999).

Computer Mediated Communication and Online Discussion Forums

Computer Mediated Communication (CMC) requires users to adapt their social and linguistic behaviour to the medium in order to engage with other people. Establishing the use of CMC is a complex process involving changes to the personal and social context of daily life. This type of communication has already become embedded in daily life through the advent of email. However, other CMC technologies also offer considerable opportunities to enhance learning (Somekh 2007). One such CMC technology is the online discussion forum. Online discussion forums are asynchronous learning environments that allow users to collaborate without the need for face-to-face interaction. These virtual communities of inquiry allow learners to

construct experiences and knowledge through questioning, analysing the subject matter, and challenging assumptions. Interactivity is one of the most striking characteristics of online discussion forums and a factor with the greatest potential to impact learning (Marra, Moore, and Klimczak 2004). This interactivity has been shown to facilitate metacognitive reasoning (Marra 2006) and advancement of dialogical skills (Knowlton 2005) which are seen as essential elements in facilitating cognitive organisation within an individual. The development of these key areas means learners can achieve more advanced ways of representing meaning and organising knowledge into their cognitive-conceptual structure. The use of online discussion forums by adolescent learners offers something traditional classroom teaching does not. It is a pedagogical tool that should be explored in depth in order to assist adolescent learners in achieving more advanced states of cognitive organisation. In order to understand how new technologies, such as the online discussion forum, can be used in education an examination of the literature underpinning the theory of cognitive organisation is needed.

Cognitive Organisation and Constructivist Learning

The structuring of meaning into organised knowledge through language and learning is central to the development of an individual's cognitive structure. (Bransford, Brown, and Cocking 2000; Hall 2003) The mind creates meaning; and, in turn, concatenates this meaning into patterns of organised knowledge. The principles of constructivism delineate this process by providing a framework for the explication of internal cognitive processes, including the elements and procedures that coordinate the organisation of cognitive structures. Constructivism centralises the role of the individual in the processes of thinking, learning and 'coming to know'. It privileges the participation of the individual in generating meaning and understanding by connecting new experiences with already existing knowledge (Ornstein and Hunkins 2004). Good and Brophy (2003) outline four basic principles of constructivism: (1) unique representations of knowledge are constructed by the learner; (2) these representations of knowledge are structured as networks around controlling ideas; (3) prior knowledge influences the interpretation of new information; and (4) sometimes new learning results in a change in the learner's understanding of a key idea and the restructuring of existing knowledge (Good and Brophy 2003). This means that individuals construct reality by building accurate mental representations such as

propositional networks, concepts, cause and effect patterns, and condition-action production rules that reflect 'the way things really are' (Woolfolk 2001). Packer and Goicoechea (2000) suggest that the process of learning is linked to the qualitative reorganisation of these mental representations and knowledge structures. The constructivist view of learning depicts knowledge structures as actively constructed by learners in their attempts to make sense of the world. The learner operates within the realm of experience which is segmented and ordered as a result of existing concepts, relations, theories and models, which have been constructed in the attempt to create a more or less regular, predictable world (Glaserfeld 1998). This predictable world is the result of a syncretism of internal cognitive processes and external social interactions.

Internal Cognitive Processes and Philosophy of Mind

The processes involved in cognition are not neat, linear, efficient or mechanistic (Henderson and Kesson 2004). Some educationalists suggest, however, that individuals progress through three major internal cognitive stages: accumulation, the gathering and retrieving of information; formation, the construction of ideas; and checking, making sure the ideas are correct (Hammer and Elby 2002). These processes provide a platform that can aid in understanding how the mind operates. At the centre of any philosophy of mind there are epistemological and ontological concerns, which can be clarified by the underpinning theories of Personal Epistemology and Dialectics. Personal Epistemology is concerned with the cognitive processes that underpin the way an individual views the nature of knowledge and the nature of knowing (Pintrich 2002). It is the core system of beliefs that underpins the formation of knowing for each individual. These epistemic beliefs are considered to be an individual's beliefs about the nature of truth and knowledge. They can be independent of each other and mature at different rates. The effects of epistemic beliefs are that they directly or indirectly filter knowledge and mediate learning (Schommer-Aikins 2002). The four principles of Dialectics proposed by Gadotti (1996) provide a useful approach to framing an ontological conception of mind. The first principle is *totality*, in which everything is related. The mind is presented as a coherent whole in which objects and phenomena are related to each other, reciprocally conditioning each other. The second principle is *movement* whereby everything has the potential to be transformed. Movement is a quality inherent to the

mind which is in continuous transformation; it is never definitively established and always remains unfinished. The third principle is *qualitative change*. The transformation of mind is not regulated by a systematic quantitative algorithm; rather, changes occur through the transfiguration of qualitative elements. The fourth principle is *contradiction and the unity and struggle of opposites*. Transformation is possible only because opposing forces coexist in their own interior and simultaneously move toward unity and opposition (Gadotti 1996). The mind undergoes dialectical transformation, mediated and filtered by epistemic beliefs, through the use of representational systems of meaning.

Systems of Representation, Coding, Classification, Prototypes and Exemplars

Representation means depiction or symbolising in the mind through description or portrayal or imagination. It is the production and formation of the meaning attributed to specific concepts within our minds through language (Hall 2003). The system of representation in the mind does not consist of individual concepts; rather, it consists of different procedures that arrange, organise, cluster, configure and classify concepts by establishing complex relationships between them. The meaning created is dependent on the relationship between things in the world, such as people, objects and events (real or fictional), and the mind's representational system. Things do not contain meaning themselves; instead, the individual constructs meaning using representational systems of concepts and signs. Moreover, it is not the material world that conveys meaning: it is the language system or whatever system the individual is using to represent concepts. Individuals use the conceptual systems of their culture and the linguistic and other representational systems to construct meaning, to make the world meaningful and to communicate about the world meaningfully to others (Hall 2003). Representational systems are organised using coding and classification. Bernstein (1999) describes code as a tacitly acquired regulative principle that integrates and selects relevant meanings, controls forms of representations, and manages the contextual parameters which configure an individual's knowledge (Cloran 1999). Code is the operating semiotic that organises knowledge classification. Classification refers not to what is classified but to the relationships between contents. It is the nature of the differentiation between contents. Where classification is strong, contents are well insulated from each other. When classification is weak, there is reduced insulation because the boundaries become weak or blurred. Classification

thus refers to the degree of boundary maintenance between content (Martin 1999). Boundaries may be endotropic or exotropic. Endotropic boundaries have isolated content that is self generating – autogamous and autogenetic. This creates a sharply defined, impermeable boundary. Exotropic boundaries do not confine the content; they are cosmoramic, dynamic open systems. Change and maintenance arise from interaction between classificatory elements in reciprocal engagement. They create interstices, locations, and openings for code to create new classifications (Hasan 1999). Coding first creates classifications known as prototypes. A prototype is the typical, normal, commonly experienced archetypal features of something. Early conceptual development is often based on establishing prototypes, largely from initial experiences of particular instances known as exemplars. These instances provide contextual examples in which distinctions and similarities between the core attributes of something can be generated. Exemplars become refined over time to 'average out' and represent the typical or key features of a concept (Long 2000). Concepts are the elemental components of the cognitive system.

Concepts, Schemata, Cognitive Structures and Memory

A concept is an elemental unit of the conceptual system which is the very essence of logic and rationality (Taylor 1989). Studies show that concepts do not remain as isolated items but become components of larger, related classes called schemata. Conceptual schemata are built up by the individual through observing similarities and differences across a range of experiences (Bransford, Brown, and Cocking 2000). Schemas are webs of concepts linked by shared characteristics, relations or essential attributes (Alexander 2006). They are cognitively structured clusters of information that are used to represent events, concepts, actions or processes. These cognitive structures use sets of assumptions to make meaning of our experience. These meaning-making structures need to be coherent and in equilibrium in order to organise the continual interaction between us and our world (Magolda 2002). Cognitive structures are arranged in organisational networks that consist of theories, models, taxonomies and paradigms. These networks function to (1) make sophisticated interpretations of sensory input; (2) create complex connections; and (3) organise concepts together in order to maintain coherence of our experiences (Nickerson 1990). These networks include facts, concepts, and generalisations, along with related values, dispositions, procedural knowledge (implementation skills), and

conditional knowledge (of when and why to apply parts of the network) (Good and Brophy 2003). These cognitive structures develop through the use of memory. Long-term memory offers humans the capacity to store information that they derive from their experiences and interactions with reality. In fact, the more information learners already have there, the more easily they can store new material. Effective storage typically involves meaningful learning – that is, connecting new information with existing knowledge and beliefs. By making such connections, learners make better sense of their experience, retrieve what they have learned more easily, and create an increasingly organised and integrated body of knowledge that helps them interpret new experiences (Ormrod 2006b). This need to organise information to help interpret experiences is an inherent quality in human cognition. Research indicates that the mind is an active processor. When a series of events are presented in a random sequence, the mind reorders and organises them into a sequence that makes sense (Bransford, Brown, and Cocking 2000). In addition, the recall of information is significantly aided when a person's idea network is '"planfully" organised (Derry 1990). A person's memory creates the organisational networks needed for storage of information. Ormrod (2006a) divides memory into three systems: (1) declarative, which stores how things are; (2) procedural, which stores how to do things; and (3) conditional, which stores how to respond under different circumstances (Ormrod 2006a). Declarative (explicit) memory can be subdivided into the main body of semantic memory (knowledge of meaning), which covers meaningful information such as concepts and propositions, and episodic memory. This involves information about an experienced event or situation (recall of events). Procedural (implicit) memory involves skills (represented by the procedures needed to perform an activity). Habituation, conditioning and priming (previous exposure affects recall ability) form the basis of conditional (contextual) memory (Long 2000). The integration of these systems of memory aids in the development of a more organised cognitive network. A more organised cognitive network is more adaptable and becomes more receptive to cognitive-conceptual change.

Cognitive-Conceptual Change and Metacognition

The revision of one's understanding of a topic in response to new information is called cognitive-conceptual change (Ormrod 2006b). The three phases of cognitive-conceptual change are accretion; tuning; and restructuring. Accretion is the simplest

phase and involves any elaboration or enrichment of already existing knowledge structures. Tuning is the adjusting of conceptual structures which cannot accept information that is contradictory or anomalous (Alexander 2006). Restructuring occurs when cognitive dissonance motivates people to resolve conflicting ideas within their system of representation, often restructuring their ideas or beliefs (Long 2000). Learners may undergo more radical restructuring that can involve simultaneous changes in large networks of connected knowledge (Good and Brophy 2003). This sometimes causes a transformation in the learner's perception of reality through an ontological shift or decentring of core epistemic beliefs (Alexander 2006; Popkewitz, Pereyra, and Franklin 2001). The process of cognitive-conceptual is supported through the development of metacognition. Metacognition is the awareness and management of one's own thought, or 'thinking about thinking' (Kuhn and Dean 2004). Metacognition is developed through reflection and evaluation of one's experience. Experience alone does not lead to knowledge: learners must integrate theoretical studies, self-knowledge and practical experience; come to terms with their own biases, attitudes and values; articulate their own stances on issues; and become self-appraising leading to personal growth (Whitton et al. 2004). Engaging in metacognitive thought is a key element in facilitating cognitive organisation within an individual. The attainment of higher levels of cognitive organisation can lead to individual expertise.

Experts

People who have developed expertise in a particular area of knowledge are able to think more effectively about problems and issues in those areas. Understanding expertise is important because it provides insight into the nature of thinking and cognitive organisation. It is not simply general abilities, such as memory and intelligence, nor the use of general strategies that differentiate experts from novices. Instead, experts have acquired extensive knowledge that affects what they notice and how they organise, represent, and interpret information in their environment. This in turn affects their abilities to remember, reason, and solve problems. There are four key principles that indicate expertise: (1) experts observe meaningful patterns and features of information that are not observed by novices; (2) the content knowledge acquired by experts is organised in ways that reflect a deep understanding of their subject matter; (3) experts' knowledge cannot be reduced to sets of isolated facts or

axioms; instead, it is contextually organised and conditioned on sets of circumstances; and, (4) experts require little attentional effort to flexibly retrieve important aspects of their knowledge (Bransford, Brown, and Cocking 2000). Experts have higher levels of cognitive organisation than novices. The role of external social interactions is also important in the organisational development of internal cognitive structures.

External Social Interactions, Culture, Collaboration and Dialogical Communication

Social opportunities have the ability to influence an individual's motivation. The feeling a person gets when contributing something to others can be especially motivating (Bransford, Brown, and Cocking 2000). Interactions among peers can serve as catalysts to change ways of thinking. Through social discourse learners may gather pertinent data and be exposed to alternative perspectives on issues. They may also recognise that ideas deserve to be reflected upon and analysed rather than simply memorised (Alexander 2006). Social processes are shaped through cultural experience which can be defined as the ongoing process of interpreting and valuing the world (Wadham, Pudsey, and Ross 2007). This process creates a construction of reality, made up of representations and generalisations which are shared and transmitted by members of the cultural group. This process happens through the interaction of members in a variety of social and cultural contexts (Bonvillain 1997). These contexts allow for social collaboration in groups. A group is a social structure in which a collection of individuals' patterns of interaction are repetitive, expected, and can be predicted by the participants (Schmuck and Schmuck 2001). Groups form the basis for collaborative learning. The main function of groups is to facilitate communication which is the basis for social constructivist learning. A key communicative strategy in social collaboration is dialogue. Students remember new ideas and experiences more effectively and accurately when they talk about these things with others (Ormrod 2006b). Dialogical communication helps learners to reflect on the processes, referents, and scope of their knowledge constructions (Larochelle and Bednarz 1998). Engaging in dialogue is a key element in facilitating cognitive organisation within an individual. This engagement can be facilitated through teaching and pedagogy. In particular, online discussion forums offer teachers a scaffolding tool to help support learning. Modern students who engage in discussion in these interactive asynchronous environments can develop more advanced and organised cognitive edifices.

Creating a Framework for Thinking about Cognitive Organisation

The literature detailing the processes involved in the theory of cognitive organisation is very complex. The formulation of an operational definition and a framework outlining the processes involved assists in situating the theory of cognitive organisation more clearly. Based on a synthesis of the literature the following operational definition has been postulated:

Cognitive organisation is the dynamic process whereby knowledge is arranged within an individual's mind. It involves the systematic classification of concepts and the reorganisation of conceptual schemata in order to achieve cognitive consonancy.

Further to this definition, a framework outlining the processes involved in cognitive organisation has been developed. A stage-by-stage approach has been used to structure this framework. Each stage is designed to be more cognitively complex than the previous stage. The terminology suggested may be revised after further research into the literature on each term in order to establish a clear developmental sequence. These are the initial seven stages of cognitive organisational advancement which have been postulated:

1. Staticity: The learner's existing cognitive-conceptual framework is unchanging.
2. Concrete Accretion: The learner's existing cognitive-conceptual framework engages with new knowledge.
3. Developmental Attunement: The learner's existing conceptual framework attempts to accommodate new knowledge.
4. Active Reshapement: The learner's existing cognitive-conceptual framework adapts to include the new knowledge.
5. Practical Reflectivity: The learner's adapted conceptual framework uses the new knowledge in practical situations to recognise and interpret new patterns that assist in understanding the world.
6. Metacognitive Reflexivity: The learner's adapted cognitive-conceptual framework is further strengthened as the new patterns of understanding are fed back to the cognitive conceptual-framework in order to increase the complexity of the learner's understanding.

7. Epistemological Recursivity: The learner's cognitive-conceptual framework consistently engages in praxis and abstract higher-order cognition in order to refine the learner's understanding of the world.

These stages are specific to a particular subject domain and aim to map the journey of a novice through to expert. It is noted that this framework is preliminary and that the terminology postulated needs to be further supported by rigorous investigation into current literature. Further investigation into each individual stage will be conducted once enough construct-related evidence has been collected to infer the validity of the framework. The Diagnostic Framework used for the pilot study is outlined in Table 1.1.

Table 1.1 Diagnostic Framework

Stage of Organisational Advancement (Within a specific subject domain)	*Level of understanding*	*Description*	*Internal Cognitive Processes*	*External Social Interactions*
1. Staticity	Disengaged	▪ existing knowledge is unchanging; ▪ new knowledge is not received.	▪ no engagement with new knowledge	▪ does not engage with or attempt to use the new knowledge.
2. Concrete Accretion	Novice	▪ new knowledge is received and processed through rote accretion; ▪ an endotropic closed system is in operation.	▪ habitual and mechanical augmentation of information	▪ makes general comments and questions using the new knowledge; ▪ attempts to convey the new knowledge.
3. Developmental Attunement	Beginner	▪ new knowledge is being linked to prior knowledge, classified and attuned to existing cognitive structures; ▪ assimilation is taking place; ▪ an endotropic closed system is in operation.	▪ active linking, tuning, assimilation and classification of information.	▪ makes general and specific comments and questions using the new knowledge; ▪ engages in intermittent dialogue using the new knowledge; ▪ attempts paraphrasing of the new knowledge.
4. Active Reshapement	Pre-Intermediate	▪ new knowledge is contradictory to existing cognitive structures; ▪ dissonance of concepts causes accommodation and restructuring to take place; ▪ system of operation moves from endotropic to exotropic.	▪ restructuring of categories and frameworks in order for accommodation of new concepts to occur; ▪ creation of new schemas	▪ engages in dialogue relating to the new knowledge in order to actively clarify and assist with understanding; ▪ paraphrases the new knowledge; ▪ attempts to make assertions based on the new knowledge.

Table 1.1 continued

Stage of Organisational Advancement (Within a specific subject domain)	*Level of understanding*	*Description*	*Internal Cognitive Processes*	*External Social Interactions*
5. Practical Reflectivity	Intermediate	▪ new knowledge is consciously reflected upon; ▪ knowledge is accreted, attuned and reshaped through praxis; ▪ an exotropic open system is in operation.	▪ strengthening of links between declarative and conditional memory structures; ▪ development of new schemas to represent and actively retrieve information.	▪ engages in sustained dialogue utilising the new knowledge; ▪ draws from conditional memory to ask key questions and make key comments using the new knowledge; ▪ relates the new knowledge to a wider knowledge base; ▪ makes assertions based on the new knowledge.
6. Metacognitive Reflexivity	Advanced	▪ new knowledge is reflexively internalised; ▪ knowledge is accreted, attuned and reshaped consistently through praxis; ▪ ideas/concepts are concatenated into a complex edifice; ▪ there is a high level of synchronicity; ▪ an exotropic dynamic open system is in operation.	▪ reification of links between procedural, declarative and conditional memory structures; ▪ development of complex schemas to represent and actively retrieve information.	▪ engages in sustained dialogue utilising the new knowledge; ▪ draws from conditional, procedural and declarative memory to ask critical questions and make critical comments when using the new knowledge; ▪ relates the new knowledge to a wider knowledge base attempting to transfer the new knowledge into different contexts; ▪ postulates ideas/concepts using the new knowledge; ▪ clearly makes assertions based on the new knowledge.

Table 1.1 continued

Stage of Organisational Advancement (Within a specific subject domain)	*Level of understanding*	*Description*	*Internal Cognitive Processes*	*External Social Interactions*
7. Epistemological Recursivity	Expert	▪ the epistemological principles of the new knowledge are recursively internalised; ▪ the principles are accreted, attuned and reshaped consistently through praxis; ▪ new theories/paradigms are propagated and concatenated into a complex edifice; ▪ knowledge access processes become meta-synchronous; ▪ the ontological assumptions of the knowledge are exposed and considered; ▪ an exotropic dynamic open system is in operation.	▪ meta-synchronism of declarative, procedural and conditional structures; ▪ development of meta-schemas to represent and actively retrieve information; ▪ high level of epistemic processes.	▪ engages in sustained dialogue using the new knowledge; ▪ draws from conditional, procedural and declarative memory to ask critical questions and make critical comments when using the new knowledge; ▪ relates the new knowledge to wider knowledge base by transferring the new knowledge into a wide variety of contexts; ▪ proposes new ways of conceiving the knowledge by using the core principles of the knowledge; ▪ postulates theoretical/paradigmatic overviews using the new knowledge; ▪ clearly and concisely makes assertions based on the new knowledge; ▪ challenges epistemological and ontological assumptions using the new knowledge.

Pilot Study

A pilot study was conducted in order to ascertain whether the Diagnostic Framework could be used as an instrument to map cognitive organisation; and also, to obtain some preliminary results on whether online discussion forums assisted learners' cognitive organisation. The participants involved in the pilot study were fifteen male Year 12 WACE English students who attended a private Catholic College in the Perth Metropolitan area.

Data Collection

There were two phases of data collection undertaken in this Project. Phase 1 was designed to collect evidence in order to validate the Diagnostic Framework (see Table 1.1). The online discussion forums' comments were collected and analysed in order to subject the Diagnostic Framework to construct-related evidence testing. Phase 2 was conducted by separating the students into small groups consisting of four or five students. The small group environment was designed to encourage multiple discussion entries and operated for two weeks. The data were collected at the completion of Phase 2 and catalogued for analysis against the Diagnostic Framework.

Data Analysis

The type of data analysis that was conducted in this study was an interpretive content analysis. The analysis involved the mapping of data, viewed as a tacit account of learner cognitive organisation, against the Diagnostic Framework (see Table 1.1). Content analysis "is a technique that allows researchers to study human behaviour in an indirect way, through an analysis of their communications" (Fraenkel and Wallen 2006). The essential focus of content analysis is the categorisation of the communication being analysed. In this case, the communication being analysed was printed transcripts of student dialogue taken from the online discussion forums. These data were analysed and mapped against the Diagnostic Framework (see Table 1.1).

Pilot Study Results

In Phase 1 of the research the online discussion comments were mapped against the Diagnostic Framework. All comments were mapped successfully against the Instrument and Phase 2 commenced. In Phase 2 of the research, the participants' online discussion comments were plotted to the Diagnostic Framework (Table 1.1). Graphs 5.1, 5.2, 5.3, 5.4 and 5.5 show the distribution of the data by including the stage of organisational advancement on the y-axis and the chronological sequence of the online discussion comments on the x-axis.

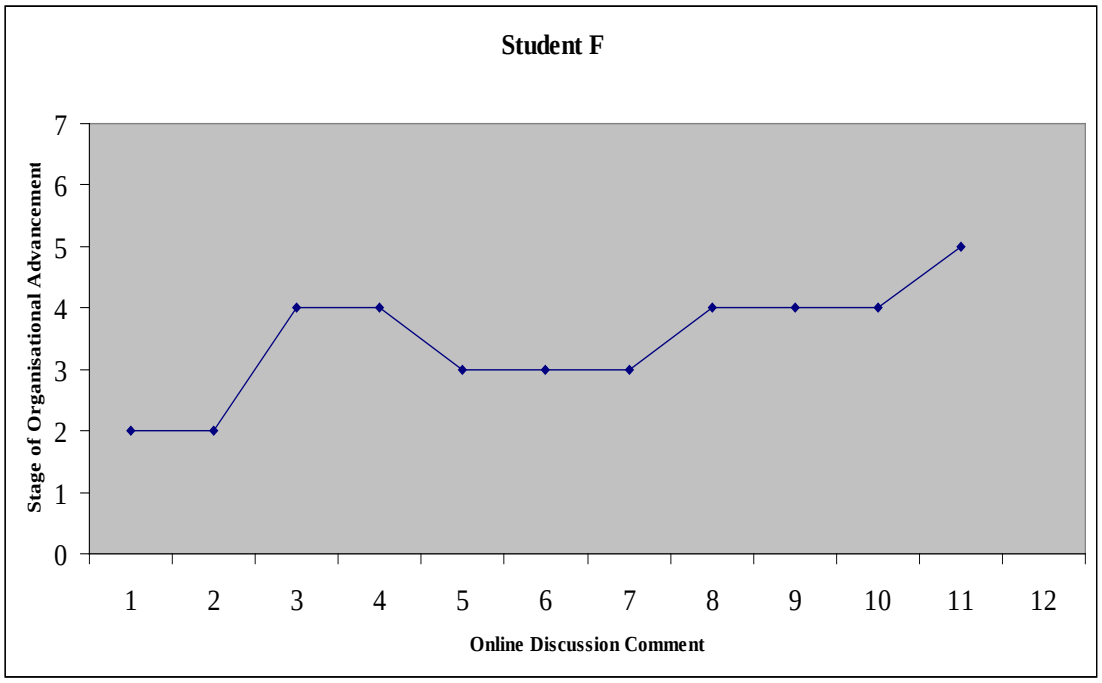

Figure 1 Graph for Student F

Student F's initial comments demonstrate a Concrete Accretion stage of cognitive organisation. His comments progress in organisational advancement through the Developmental Attunement and Active Reshapement stages. Although online discussion comments 3 and 4 are of a higher advancement level than the online discussion comments 5, 6 and 7 this is indicative of the temporary regression that can occur during the cognitive reorganisation process. Student F's final comment demonstrates a Practically Reflective stage of advancement; however, to maintain this level of advancement the student will need to engage with the knowledge on a regular

basis and continue to reorganise the knowledge in more sophisticated systems of conceptual representation.

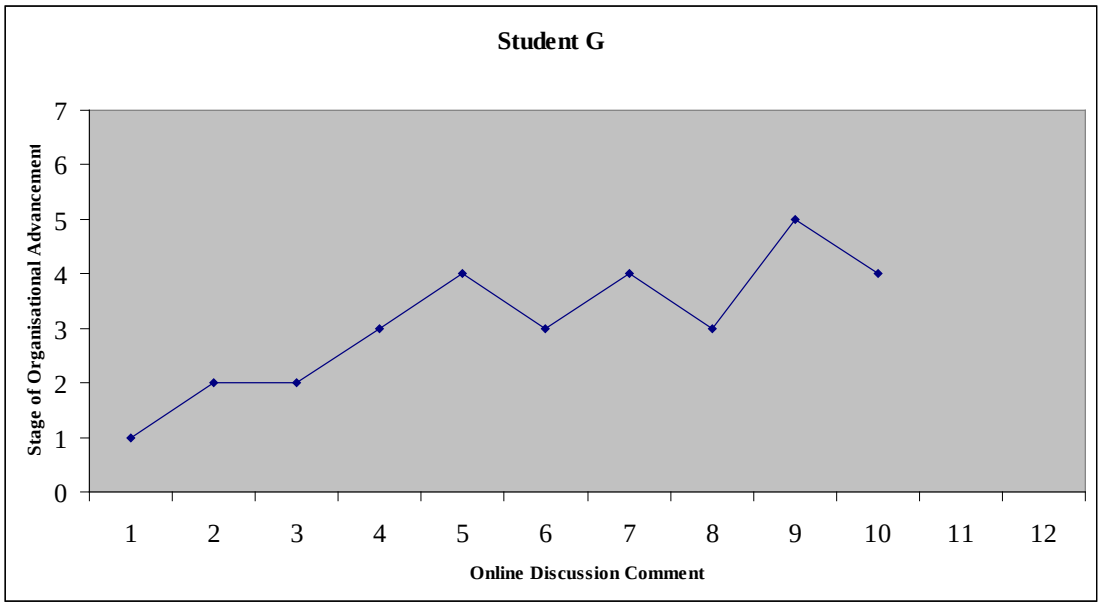

Figure 2 Graph for Student G

Student G's first comment does not attempt to use the new knowledge; however, online discussion comments 2 and 3 show some attempt at conveying the new knowledge. Student G's later comments demonstrate a higher level of organisational advancement and the participant progressively becomes more confident in utilising the new knowledge in the course, demonstrating a level of Practical Reflectivity in online discussion comment 9.

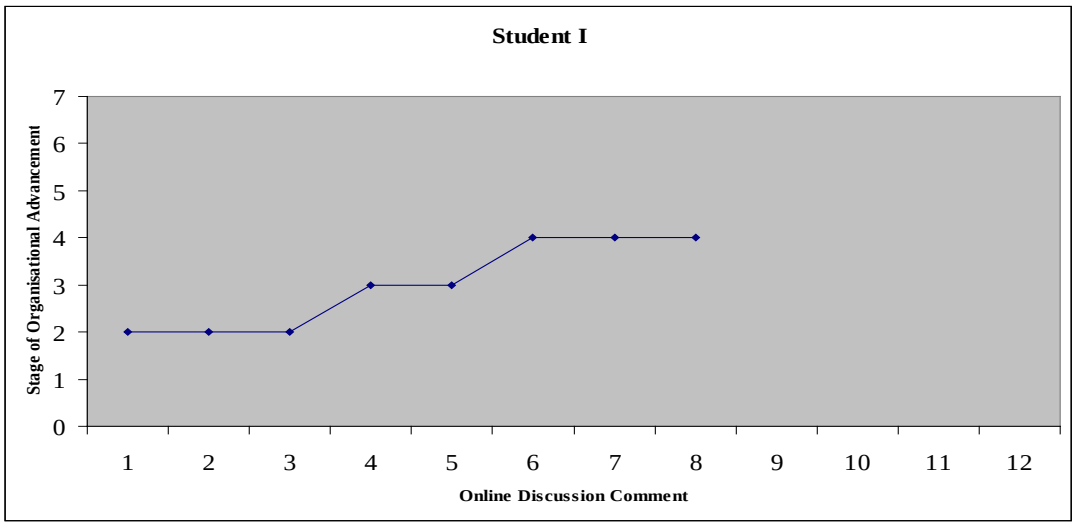

Figure 3 Graph for Student I

Student I's progression through the Stages of Organisational Advancement can be seen as more systematic and linear than some of the other participants. His final comments demonstrate his attempts at reshaping and reorganising his understanding of identity which is not evident in his earlier comments.

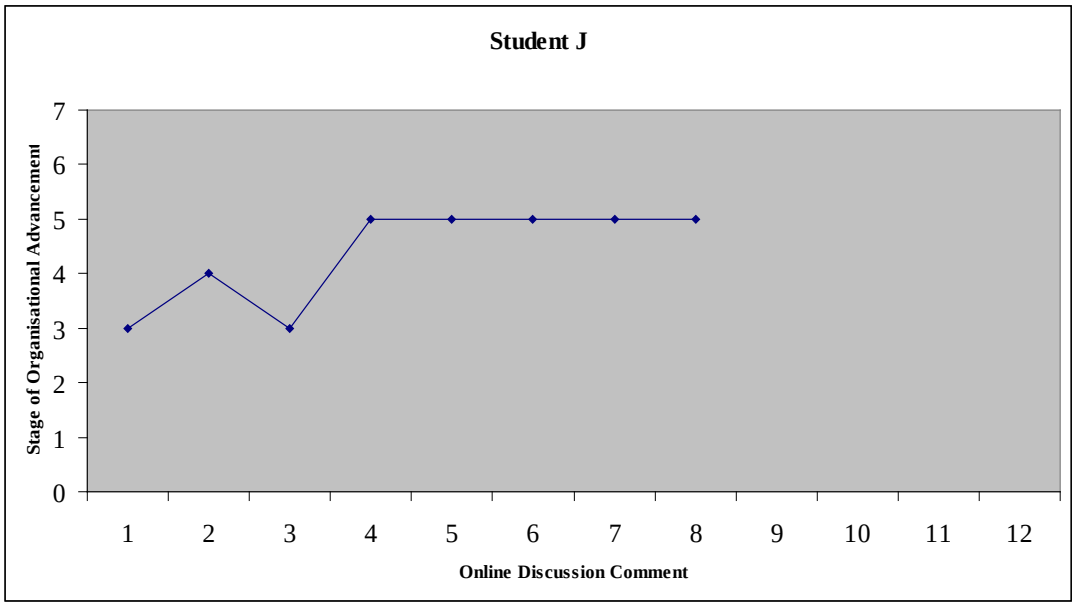

Figure 4 Graph for Student J

Student J reorganises and restructures his conceptual framework more quickly than some of the other participants. He advances to a level of Practical Reflectivity of Organisational Advancement and maintains it for the entirety of the small group discussion. This is a high level of achievement and indicates that the online discussion forums are assisting Student J's cognitive organisation.

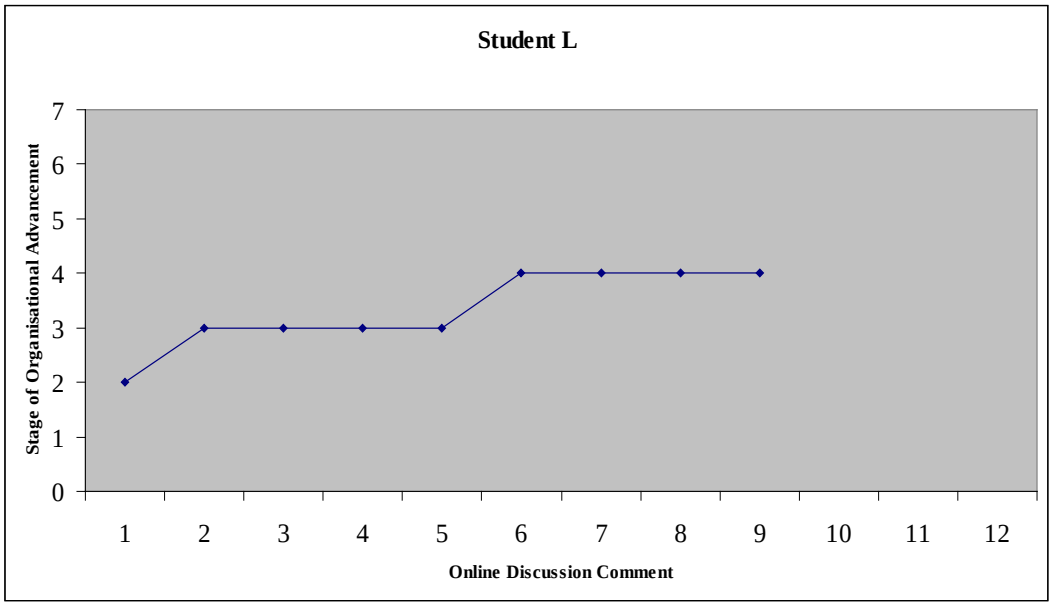

Figure 5 Graph for Student L

Student L moves slowly through the levels of Organisational Advancement and is still in the stage of Active Reshapement at the end of the discussion group forums. He posits some interesting questions but needs to work further to reorganise his understanding of the course concepts in order to attain a more sophisticated understanding within the subject domain. The online discussion forums have assisted Student L in making progress towards higher levels of cognitive organisation.

All of the students who participated in the online discussion forums demonstrated an increased level of cognitive organisation. The points plotted on each of the graphs represent patterns of knowledge reorganisation unique to each student. These patterns all demonstrate that the students have advanced in their level of knowledge organisation. This is a positive result; however, the levels of advancement that students achieved ranged only from Stage 1: *Staticity* to Stage 5: *Practical Reflectivity*. This range of results reflects the influence of the following factors:

1. *Limited time period:* The students involved in the study engaged with the new knowledge over a time period of eight weeks.
2. *Biological maturity:* Many students in Year 12 are still developing essential brain structures which are needed for cognitive organisation.

3. *Cognitive ability:* The students involved in this study were enrolled in an English Course of Study as a requirement of WACE graduation and not necessarily because they had a high aptitude for the subject.
4. *Expertise:* The higher stages of Organisational Advancement require a journey from novice to expert over a number of years and require much experiential knowledge in order to be attained. (Bransford, Brown, and Cocking 2000)
5. *Metacognition:* This is an essential element in the process of cognitive organisation and some students need to develop this area before being able to demonstrate higher levels of organisational advancement. (Whitton et al. 2004)
6. *Dialogical Communication:* Constructive dialogue is an essential element in the process of cognitive organisation and some students need to develop this area before being able to demonstrate higher levels of organisational advancement.

It is probable that these factors may have influenced the students' ability to reach Stage 6: *Metacognitive Reflexivivity* and Stage 7: *Epistemological Recursivity* levels of Organisational Advancement. However, for students to reach Stage 5: *Practical Reflectivity*, even with these extenuating factors, demonstrates the unquestionable success of the online discussion forums. By using the online discussion forums as a supplementary tool to support classroom activities all of the students within this study reached higher levels of cognitive organisation.

Summary

The preliminary results suggested that there was sufficient construct-related evidence to infer that the Diagnostic Framework (Table 1.1) was a valid instrument to map cognitive organisation within this pilot study; also, that there was sufficient content analysis evidence to infer that online discussion forums assist students in the process of knowledge organisation.

The findings of the research from the pilot study have implications for the current understanding of how individuals cognitively organise and represent systems of knowledge. This knowledge is in need of a clearly defined taxonomy that synthesises

the key stages of cognitive-organisational advancement. The Diagnostic Framework (Table 1.1) is an instrument that clearly demarcates and defines levels of cognitive-organisational advancement. These stages of organisational advancement have been proven identifiable in learners through the research conducted in Phase 1 and Phase 2. It is imperative that the Diagnostic Framework be tested further as it is the only tool currently developed that clearly maps the cognitive organisation of individual learners within specific subject domains. The potential applications for the use of the current version of the Diagnostic Framework are many; however, the development of a more sophisticated model of cognitive organisation, using the Framework as a basis, would advance knowledge in this area and should be the basis of ongoing research in this field.

The development of new technologies such as online discussion forums offer educators innovative and unique ways to assist student learning. The findings of this research suggest there is pedagogical merit in the use of online discussion forums in the subject area of English in Australian secondary schools. The research obtained from the pilot study demonstrates that the forums can support students in the process of knowledge organisation. This process is supported through the use of metacognitive skills and dialogical communication. These processes are enhanced within the online discussion forums' learning environment. Phase 2 of the research, in particular Graphs 5.1 to 5.5, clearly shows the cognitive-organisational development of each student participating in the online discussion forums. Given the demands of day-to-day classroom life, this asynchronous environment offers a unique opportunity for teachers and educators to support student learning outside of the classroom.

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