

A questioning environment for scaffolding learners' questioning engagement with academic text: a university case study

J Hardman* & D Ng'ambi

University of Cape Town

ABSTRACT

Access to the textual world of academia requires that learners are familiar with the critical open-ended questioning stance demanded by textuality. Anecdotal evidence suggests that learners registered for the Bachelor of Education Honours degree are unable to generate appropriate questions to interrogate academic text, impacting on their ability to engage effectively with academia. While ample research exists to suggest that face-to-face scaffolding can facilitate learners' access to academic text, this is often a time consuming, repetitive activity, which fails to track learners' questions over time. Given that questioning is one of the most important learning-teaching tools available to both learner and educator, we have created a computer-based scaffolding environment in which students are required to generate questions to interrogate academic texts. Learners have been using this new scaffolding tool this year, and we report on preliminary findings from the study.

questioning underlies engagement with textuality. The challenge currently facing educators on the BEd honours course, then, is how to facilitate learners' access to academic text in an efficient manner when limited human and financial resources mitigate against individualised reading/tutoring programmes. In order to meet the challenge of developing cost and time-effective scaffolding materials, a computer-based questioning environment capable of scaffolding learners' questioning engagement with academic text was developed and implemented in the first semester of 2002. In this article we describe the theoretical underpinning of the project and analyse participant's questioning engagement with textuality using Blooms Taxonomy of Educational Objectives (1956).

MODELS FOR MEDIATION

This research assumes that learners can and do change. In fact, the very concept of *learning* must imply change. The theoretical foundation informing this assumption is the notion that when two different systems of knowledge meet (learners' epistemology encountering a completely different university epistemology), the resultant conflict provides the basis for transformation, in which learners as well as the university change (Craig 1989, 1991). Further, this framework assumes that such transformation, where cognitive operations undergo change, cannot be taught without activity on the part of the learner. That is, 'action must precede understanding' (Miller 1984; Kozulin 1995; Wertsch 1991). The assumption that learners can change is largely predicated on the Vygotskian conceptualisation of development as being socio-historical. Vygotsky conceptualises the Zone of Proximal Development as 'The distance between the actual developmental level as determined by independent problem solving and the level

INTRODUCTION

This research arose as a response to academic under-achievement by students registered in 2002 with the Department of Education for the BEd honours degree at the University of Cape Town. Anecdotal evidence (assignments, face to face interaction) indicates that some of these learners are unable to read actively. In other words, these learners appear unable to appreciate their role as active cognising agents engaged in constructing meaning from text. The inability to interrogate text is particularly serious within a university context, where critical

*Contact Person:

J Hardman, University of Cape Town, Rondebosch, 7701

Tel: 021 650 91111

e-mail: jhardman@humanities.uct.ac.za

of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers' (Vygotsky 1978:90).

It is within the zone of proximal development that mediation effects change; it is here that teachers/tutors/more experienced peers can exert some influence on the learner's future. It is accepted therefore, that educational intervention provides opportunities for learning. The Vygotskian concept of *mediation* as opposed to conventional teaching methods premised on the assumption that knowledge can be directly transferred from teacher to learner is central in bridging the gap between different learning histories. This understanding of mediation informs the specific focus on questioning in this research. By highlighting the gap between what the learner knows and what the learner needs to know, questions provide unique access to the learner's Zone of Proximal Development (ZPD), directing the teacher towards specific interventions (Vygotsky 1978). Questioning, then, is a very useful indicator of what assistance the learner needs. As such, it is a useful learning-teaching tool for the teacher. The learner's question, then, is not only a useful pedagogical indicator of the learner's knowledge base; it is also a cognitive tool, capable of regulating mental actions. Self-regulation (metacognition) requires an ability to question one's own actions, in order to ascertain which are effective strategies for doing certain things and which are not. Problem solving, then, requires the ability to interrogate our own actions, to ask questions (Strohm-Kitchener 1983). A learner's question provides the perfect opportunity for teaching by setting the learner and teacher on the same path, towards learning (Piaget 1977). The concept of mediation informing learning-teaching strategies employed in this research can be briefly condensed into the following fundamental points (Bradbury & Griesel 1994):

1. This framework accepts that all people are capable of logico-mathematical thought from adolescence onwards. The focus here, then, is on universal competencies, as opposed to the testing paradigm's focus on differences. However, it is accepted that the development of such competencies is largely dependent on learning opportunities. Where learners have not had such learning opportunities, clearly they will not have had the opportunities to fully develop their abilities (Craig 1991; Miller 1984). The learning-teaching context must be able to guide these underprepared learners' engagement with the tasks. To this end, the computer based tutorials run by the lecturer serve as 'spaces' for mediated action.
2. This framework accepts that the very different learning histories of different learners will equip them with competencies suitable to a greater or lesser degree to the problem solving situations encountered at university.
3. All people have the ability to change; the degree to which they do so however, depends largely on the disequilibrium provoked between the person and the available resources for overcoming the conflict. What learners bring to the task and what the task demands may differ incredibly. It is at this moment, faced with an 'incomplete' base from which to generate active engagement with the task, that the student may feel confused, or in conflict (Piaget 1977). It is here that the space is created for asking questions, provoking learning (Dillon 1988).

The epistemology of text: University ways of knowing.

Learners embarking on their first year of university study are confronted with a world that is essentially textually based (Bradbury & Griesel 1994). Engaging in academic enquiry requires that one is familiar with the critical demands of textuality. Heterogeneous learning histories, however, result in learners with differing levels of familiarity (and consequently differing levels of preparedness) with textuality entering university. Particularly for under prepared students, whose prior schooling may not have effectively mediated their entry into textuality, engaging with university tasks presents challenges. These learners are inclined to view text as an authority; something fixed that closes, rather than opens enquiry. Consequently, these learners approach university ill-structured problems in the same way as they would approach puzzle-like problems, as problems that have a single, knowable answer, which, once found, can close further enquiry. In the Human Sciences, however, textuality demands a critical stance to the text, viewing it as an invitation to open enquiry, rather than close it. It is essential that the nature of textuality be 'opened up' for these learners, facilitating their engagement with university tasks. In other words, the implicit demands contained within text need to be explicitly exposed, illustrating for learners that text demands a different kind of action from them than speech does.

To this end, a consulting environment in which the "intelligent handler" gets questions, analyses and categorises questions, dynamically creates question views based on user profile, allows users to respond to questions in question-based chat rooms with specific foci on questioning abilities required to interrogate academic texts has been developed (Ng'ambi 2002). In this article we describe the textual interrogation process and question classification results based on Bloom's Taxonomy (1956).

COMPUTER-BASED TEXT INTERROGATION ENVIRONMENT

The development of the environment was influenced by a social constructivist understanding of knowledge (Bruner 1966; 1990). While constructivism is generally associated with low structure and permissiveness, we needed an environment that encouraged creativity with some form of discipline and structure. Given that this project was situated within a B.Ed honours course, rather than allowing individual learners to choose their own academic text to interrogate, we imposed structure by choosing two texts for the whole class to interrogate. Learners were instructed to generate as many questions as possible to interrogate the text and these questions were used as a form of knowledge representation resulting from interrogation. Wilson (1997) indicates that knowledge is rooted in experience and requires a form for its representation. According to Wilson, all forms of representation constrain what can be represented; they can only partially represent what we know. Thus the objective of the computer-based environment was to use the type of questions that learners asked for partial representation of what learners knew about the text. Bloom's Taxonomy was used to classify questions. We now explain how the learners engaged with the environment

Users were provided with a learning activity, which formed a domain in which questions are asked

(Ng'ambi 2002). Two short texts (Appendix A) extracted from course readings were presented to participants in Microsoft Word (figure1).

In addition to the text, three buttons were provided in the toolbar. These buttons were: *Ask Question*, *Modify Questions*, *Save Questions*. The process of asking a question involved two stages: 1. Highlighting the word or sentence the user wanted to ask about 2. Typing in the full question. These questions created a question pool. The question pool was then analysed using Bloom's taxonomy (table 1).

According to Bloom's scale (table 2), knowledge, comprehension and application level questions are of lower level while analysis; synthesis and evaluation are of higher order. The system automatically analysed questions and provided many different views of questions based on Bloom's classification. One of the advantages of a computer-based environment was the ability to automatically classify questions according to Blooms Taxonomy. Given this classification, it was possible to perform drill-down analysis on empirical data (figure 2).

Figure 2 illustrates how that a user, W001 asked analysis, application, comprehension, evaluation, knowledge and synthesis type of questions. The actual questions are also listed. Figure 3 shows that W001 was not the only user who asked comprehen-

Figure 1

Text 1 with interrogative toolbar

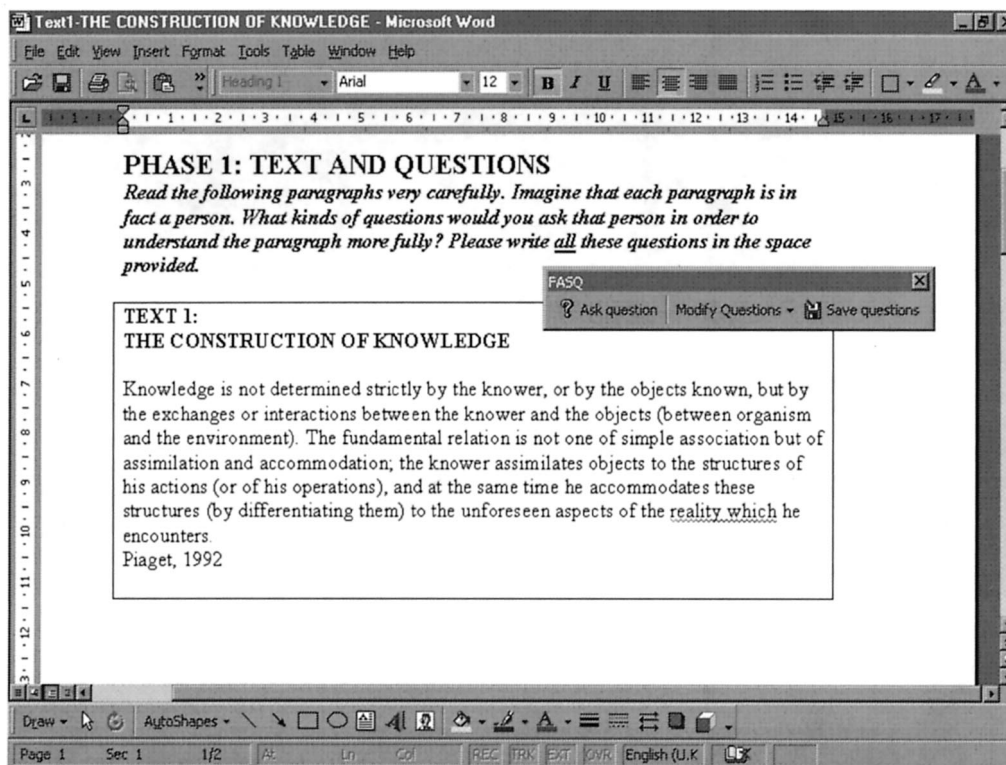


Table 1
Bloom's Taxonomy

	Category	Question style
1	Knowledge	Is it about remembering forgotten information?
2	Comprehension	Is it about grasping (understanding) meanings of the text?
3	Application	Is it seeking how to use known information in a new and concrete (ie single, best answers) situation?
4	Analysis	Is it about breaking down a text into component parts and examining them?
5	Synthesis	Is it about applying prior knowledge and skills to produce a new whole?
6	Evaluation	Is it judging the value of material based on personal values/ opinions without right or wrong?

(Adapted from: <http://faculty.washington.edu/krumme/guides/bloom.html>)

Table 2
Bloom's Questioning Styles

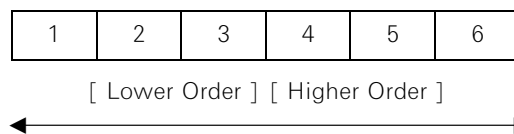


Figure 2
Drill-Down Analysis

An Interactive Critical Engagement

Users Category Meanings Topics Graphs Frequency Exit

drctre001
Intros005
smxtho001
wllsor001

Analysis
Application
Comprehension
Evaluation

- Briefly explain the three forms
- Can you explain what the experimental sciences are?
- Do you think equilibration is balance-related?
- Finished structure? where does this fit in ? please explain in simple language
- How is the knower and the object interrelated?
- How is the object related to the environment?
- Please explain the difference between exchanges or interactions?
- Schemes and sub schemes are psychology related ,but how and please simply it for me?

Comprehension

sion type of questions but these questions were also asked by d001, i005 and s001.

It is the ease with which this drill-down analysis is provided that provides a significant advantage over manual classification of questions. In view of this drill-down analysis, it was possible to monitor the frequency of user questions per Bloom's categories. It is this categorisation that provided insight as to the type of questions (lower or higher order) asked by learners. For example figure 4 shows that w001 asked 10 knowledge questions, 4 comprehension, 2 synthesis and only 1 analysis type of question.

All new questions posted into the environment were not only automatically classified but also appeared on top of each users list of questions. This allowed for "old" questions to drop down the list while remaining visible, providing other users with the chance to reference these questions if necessary.

METHOD

Subjects

In order to evaluate the impact of the computer-based environment on learners' engagement with academic text, the participants were randomly assigned to either an experimental group, which was exposed to the intervention, or a control group (Shoffner *et al* 2000). The 20 participants are all in-service teachers registered with the Department of Education at the University of Cape Town for a BEd honours module entitled "Cognitive Development and Learning". 17 of the participants could be described as coming from a previously disadvantaged background. In order to assess academic literacy levels in a pre and post test scenario, all participants wrote the Placement Test in English for Educational Purposes (PTEEP) diagnostic and attainment test, which has been shown to be a valid and reliable indicator of academic literacy levels (see for example, Yeld *et al* 1997).

Figure 3
Drilling-Down Comprehension

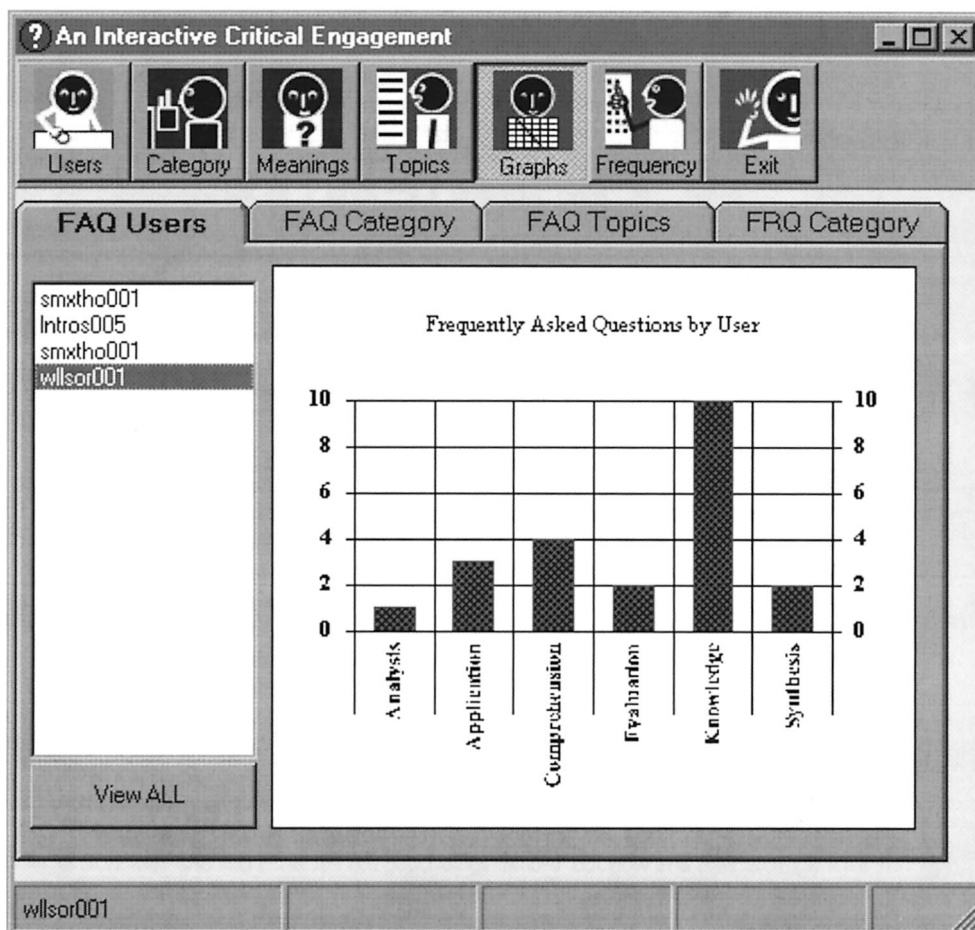
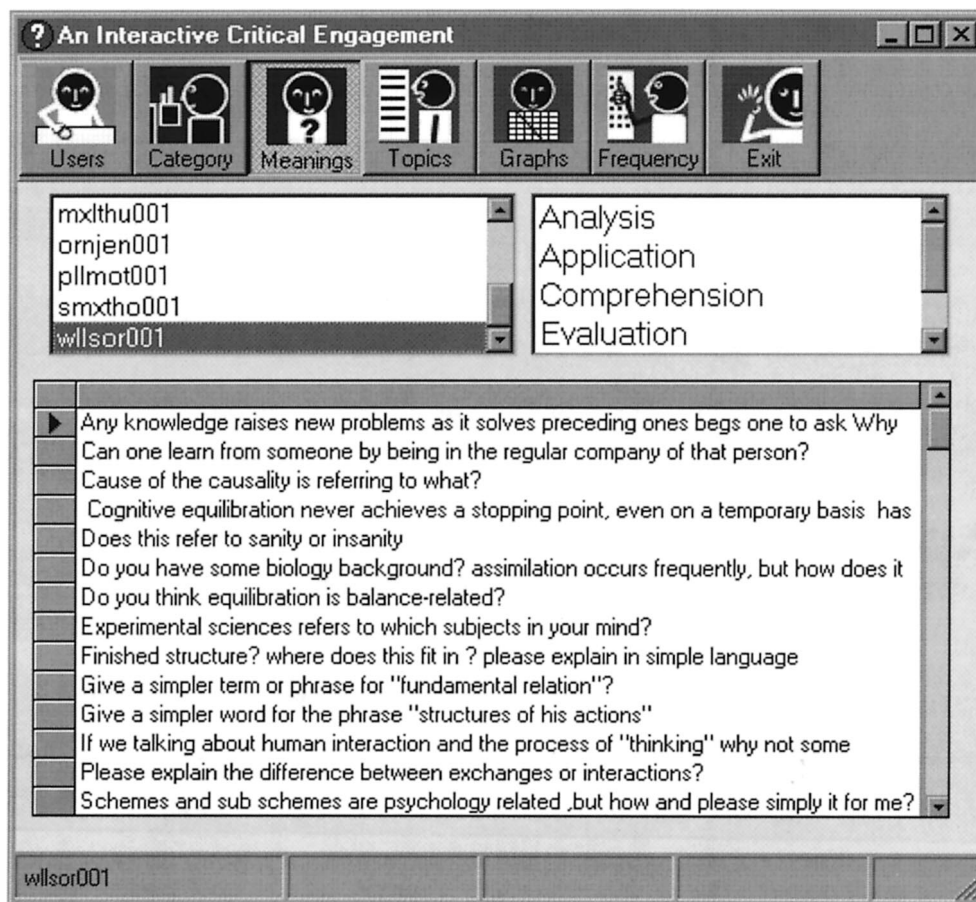


Figure 4
Question Frequency by User



Procedure

Participants from both the control and experimental group were presented with two academic texts drawn from their major assignment reading and were instructed to generate as many questions as possible in response to these texts. Participants were also instructed to identify the author's question to which the texts were an answer. That is, they were required to identify what Bradbury (1997) has called the 'essential' question responsible for generating the text. This kind of question requires that the reader distance himself/herself from the superfluous detail of the text and ask questions that probe the central issue of the text. Group 1 carried out this task in the computer-questioning environment, while group 2 carried out the same task manually on paper. Participants were given 1 hour and 30 minutes to complete the task. The lecturer/researcher also engaged in this task, generating questions within the computer environment that she felt were relevant to interrogating the two texts.

Data Analysis

Questions generated by group 1 and the lecturer were captured by the computer and automatically analysed in terms of Bloom's Taxonomy of Educational Objectives (1956). Questions generated by group 2 were captured manually by the researcher and independently categorised by the researcher and a postgraduate research student using Bloom's Taxonomy. Questions were analysed in terms of a) frequency of question b) type of question and c) learner's ability to generate essential questions. Questioning styles were compared with learners' PTEEP results in order to ascertain whether sophisticated questioners outperform less sophisticated questioners.

FINDINGS AND DISCUSSION

Findings indicate that learners from both group 1 and group 2 ask predominantly ($f=78\%$) lower order questions, which can best be categorised as "knowledge" type questions in terms of Bloom's Taxonomy.

For example, one of the most frequently asked knowledge questions was: "What is assimilation?" Conversely, the lecturer, who is familiar with the demands of textuality, asked predominantly higher order questions (f=52%), which were categorised as analysis (f=16%), synthesis (f=27%) and evaluation (f=9%) type questions.

Learners also generated fewer questions to interrogate the two texts, with the highest number of questions from a learner being 29 while the lecturer asked 55 questions. This finding appears to indicate that learners are not yet approaching text as active cognising agents, who appreciate their own role in constructing meaning from text. Hence, learners' general lack of active questioning is certainly suggestive of a passive mode of engagement with text. It is interesting to note that J, the learner who asked the most questions (n=29), performed extremely well on the PTEEP test (82%), while T, the learner who asked fewest questions (n=6) performed poorly on the PTEEP test (39%). This pattern held for 19 out of 20 of the participants. However, an anomaly from group 2 was recorded where H asked 27 questions yet achieved 52% on the PTEEP test. Closer investigation of the kinds of questions asked by H indicate that 89% of her questions were lower order, knowledge type questions, while only 68% of J's questions were lower order knowledge type questions. Consequently, although these learners indicated that they could actively interrogate text, 32% of J's questions were higher order while only 11% of the questions H asked could be classified as higher order.

The ability to successfully interrogate academic text requires that one view the text as open. However, while text requires that one critically interrogate it, textual interpretation is not infinitely open. Rather, textual interpretation is constrained by the authorial question(s), which have led to the generation of the text. In order to engage successfully with text, learners must be able to uncover these essential question(s) that define the parameters of interpretation of a specific text. Although learners were explicitly instructed to uncover the essential, gen-

erative question underlying the 2 texts such as, for example, "How is knowledge constructed?" and "What are the processes underlying the construction of knowledge?" only 3 of the 20 participants were able to do so. This failure to uncover the essential question suggests that learners will struggle to engage appropriately with academic texts.

CONCLUSION

One of the expressed aims of the new South African government is to achieve equitable access to higher education for previously disadvantaged learners, with diverse educational backgrounds. In order to meet the challenge of democratisation in education, university's in South African have had to change, facilitating equitable access to tertiary learning institutions for those who have been previously excluded as well as implementing models of learning and teaching that are sensitive to the differing learning needs of heterogeneous learners. Preliminary findings from this study indicate that learners studying for the BEd honours degree are unable to interrogate text appropriately. In order to meet the need to scaffold questioning skills to these learners, a computer based questioning environment in which learners are expected to engage in question and response sessions with their class and the lecturer, is being piloted throughout this year. Ultimately, the goal of this project is to use computer technology to help learners become autonomous questioners, capable of critically engaging with academic texts in order to successfully complete their post graduate studies.

ACKNOWLEDGEMENTS

Funding from the University Research Council of the University of Cape Town supported this work. The ideas expressed herein are not endorsed by and may not be representative of positions endorsed by the Council. The authors are extremely grateful to Professor Kevin Rochford for his useful feedback on earlier versions of this article.

APPENDIX A

TEXT 1:**THE CONSTRUCTION OF KNOWLEDGE**

Knowledge is not determined strictly by the knower, or by the objects known, but by the exchanges or interactions between the knower and the objects (between organism and the environment). The fundamental relation is not one of simple association but of assimilation and accommodation; the knower assimilates objects to the structures of his actions (or of his operations), and at the same time he accommodates these structures (by differentiating them) to the unforeseen aspects of the reality which he encounters (Piaget 1992).

TEXT 2:**EQUILIBRATION**

The study of regulation has shown us how equilibration is achieved in its three forms: between the subject and the objects, between the schemes or sub schemes on the same hierarchic level, and between their differentiations and their integrations into superior totalities. We must stress that cognitive equilibration never achieves a stopping point, even on a temporary basis, and that this situation is not to be regretted ... The fact that states of equilibrium are always exceeded is the result, on the contrary, of a very positive force. Any knowledge raises new problems as it solves preceding ones. This is evident in the experimental sciences where the discovery of the causality of a phenomenon raises the question of the cause of the causality and so forth. ... By no means does an equilibrium constitute a stopping point, since any finished structure can always give rise to new requirements in fresh substructures or to integrations in greater structures (Piaget 1977:11–12).

REFERENCES

- Bloom, B, Englehart, M, Furst, E, Hill, W & Krathwohl, D 1956. *Taxonomy of educational objectives: the classification of education goals. Handbook 1: Cognitive domain*. New York: Longmans Green.
- Bradbury, J 1997. Cognitive functioning in a Questioning engagement with textuality, *Journal of Cognitive Education* 6(2):115–125.
- Bradbury, J & Griesel, H 1994. Text as impetus for learning, in Adey, D, Steyn, P, Herman, N & Scholtz G (eds) *State of the art in higher education*. Pretoria: Unisa.
- Bruner, J 1966. *Toward a theory of instruction*. Cambridge, MA: Harvard University Press.
- Bruner, J 1990. *Actual minds, possible worlds*. Cambridge, MA: Harvard University Press.
- Craig, A P 1989. The conflict between the familiar and unfamiliar. *South African Journal of Higher Education* 3 (1):166–172.
- Piaget, J 1977. *The Development of Thought*. Oxford: Blackwell
- Kozulin, A 1990. *Vygotsky's psychology: a biography of ideas*. Cambridge, MA: Harvard University Press
- Luria, A R 1976. *Cognitive development: its cultural and social foundations*, edited and translated by Cole, M. *et al.* Cambridge: Harvard University Press.
- Miller, R 1984. Reflections of mind and culture. Inaugural lecture. Pietermaritzburg: University of Natal Press.
- Shoffner, M B, Jones, M & Harmon S 2000. Implications of new and emerging technologies for learning and cognition. *Journal of Electronic Publishing* 6(1):1–17.
- Strohm-Kitchener, K 1983. Cognition, metacognition and epistemic cognition. A three level model of cognitive processing. *Human Development* 26:222–232.
- Vygotsky, L S 1978. *Mind in society: the development of higher psychological processes*. Cole, M, John-Steiner, V, Scribner, S, & Soubberman, E (eds). Cambridge, MA: Harvard University Press.
- Wertsch, J V 1991. *Voices of the mind: a sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.
- Wilson, G, Brent 1997. Reflections on constructivism and instructional design, in Dills, C R & Romiszowski, A A (eds) *Instructional development paradigms*. Englewood Cliffs NJ: Educational Technology Publications.
- Ng'ambi, D 2002. Dynamic intelligent handler of frequently asked questions, in *Proceedings of the International Conference on Intelligent User Interfaces*, San Francisco, 2002:210–211.