

e/merge 2006 Conference:

An Analysis of the Impact of an Authentic Assessment Strategy on Student Performance in a Technology-mediated Constructivist Classroom: a Study Revisited

Andrew Scholtz

Information and Communication Technology, Turfloop Campus, University of Limpopo
andys@ul.ac.za

ABSTRACT

Assessment performs a number of important and well documented roles in learning environments where it is used as both a formative and a summative tool. However, one of the most contentious roles that assessment plays is its role in high stakes accountability testing. Over the years a degree of standardisation of summative assessment has occurred that appears to satisfy society's need for certainty about the validity and reliability of summative assessment practices, particularly in the case of high stakes accountability testing. Promotion of competent learners at schools and tertiary institutions depends on the outcome of this assessment, as does the process of warranting learning, while employers rely on these outcomes when deciding on whom to employ. This form of assessment practice has strong roots in the behaviourist paradigm and relies on "scientific measurement of ability and achievement" for its "authority". So strong is the hold of the behaviourist approach on summative assessment practices that it is "presumed to hold the high ground" even in constructivist classrooms.

In this paper a study undertaken in 2002 that considered the implementation of a computer-mediated, constructivist learning environment is revisited in light of tensions concerning validity and reliability between the behaviourist-informed measurement community and the authentic assessment practices of the social constructivist community. The results of student performance in the assessment that took place in the original study are reassessed and discussed in terms of the behaviourist versus constructivist debate with respect to assessment. Apart from the obvious wider implications, this debate has particular relevance with respect to institutional online learning implementation via staff development programmes.

KEYWORDS

Assessment; authentic assessment; accountability; validity and reliability; measurement community; constructivist learning environments

INTRODUCTION

This study revisits an assessment strategy employed in a study undertaken in 2002 (Scholtz, 2005) which documented the design, development and implementation of a computer-mediated constructivist learning environment and its effect on students at an historically black institution. Of particular interest to the author is the tension that exists between social constructivist-informed authentic assessment practices and the belief systems and expectations of educators, administrators, employers and parents (Shepard, 2000a:1; Shepard, 2000b:6), which justify the continuation of the status quo, supported as it is by the practices of the measurement community (Shepard and Bliem, 1995:1). It is important to point out early on in this discussion that the design of the module presented in the original study – and by implication the assessment approach followed – was informed by Herrington and Oliver's (2000) work on technology-mediated authentic learning environments. Herrington and Oliver's (2000) work is, in turn, a synthesis of the ideas a number of authors in the social constructivist school, in particular Brown, Collins and Duguid's (1989) notion of situated learning and cognitive apprenticeships and Lave and Wenger's (1991) notion of legitimate peripheral participation within communities of practice. Social constructivists are adherents to Vygotsky's Social Development Theory and Blumer's symbolic interactionist point of view (Kanuka and Anderson, 1998:60; Kanuka and Anderson, 1999:online). They emphasise the importance of the role of language and communities or groups, with common interests or "shared practices", in the construction of knowledge through interaction (Kanuka and Anderson, 1998:60; Kanuka and Anderson, 1999:online). In other words, as Kanuka and Anderson (1999:online) point out:

. . . knowledge is constructed in the context of the environment in which it is encountered through a social and collaborative process using language.

Obviously the theoretical foundation on which this module was developed is important, however the discussion that this paper seeks to stimulate focuses on the issues raised by Shepard in 1991 when she asks why it is that the behaviourist-underpinned approach to assessment of the measurement community is “presumed to have the high ground” (Shepard, 1991:9).

THEORETICAL FRAMEWORK

Behaviourist psychology’s influence on education has endured for more than five decades and, while there is evidence that the influence of social constructivism on education practise in the classroom is on the increase, there is also evidence that this influence does not extend to assessment (Shepard, 2000a:4). On the contrary, Shepard (1991:1) contends that the implicit beliefs and theories of teachers, administrators and other key role-players, including parents, are so influenced by the dominant paradigm of their formative professional and lived experiences that the contemplation of alternatives to the behaviourist concept of “scientific measurement of ability and achievement” (Shepard, 2000b:5) is difficult (Shepard and Bliem, 1995:1). As Shepard, 2000b:17 points out:

The dominance of objective tests has . . . shaped beliefs about the nature of evidence and principles of fairness.

This is particularly true of high stakes accountability testing – assessment the result of which determines whether learners are promoted or their learning can be warranted (Knight, 2002:276). Born out of the need to address “embarrassing inconsistencies in teachers’ grading practices” (Shepard, 2000b:14), it is the very notion of evidence and fairness that go to the heart of the issue, namely that the behaviourist approach to assessment is “presumed to have the high ground” (Shepard, 1991:9), “shaping beliefs about the nature of evidence and principles of fairness” (Shepard, 2000b:17). Behaviourists have, over decades, developed an approach to testing that they believe measures the ability of learners objectively against a set of norms or criteria designed specifically for that purpose. This approach is based on the classic behaviourist assumption espoused by Skinner that discipline-specific knowledge can be deconstructed into discrete, “tightly specified behaviourally-stated objectives” ((Entwistle, 1988:8; Shepard, 2000b:9), the mastery of which must be demonstrated through explicit testing before learners can proceed to the next level. In this way behaviourists applied Thorndike’s principles of scientific measurement (*see* Thorndike, 1904 and Thorndike, 1927) to these tests in order to standardise their outcomes. This process of “making the study of education more scientific” (Shepard, 2000b:14) resulted in an increasing confidence in the outcome of the assessment process in the minds of teachers, parents, administrators and politicians alike.

Critics of the behaviourist approach to testing and assessment argue that such tests have had the effect of sustaining the gap between knowing and doing, and the decontextualisation of learning (Brown, Collins and Duguid, 1989:online; Ramsden, 1992:39; Laurillard, 1993:15-17; Kings, 1994:online; Herrington and Oliver, 2000:online; Herrington, Reeves, Oliver, and Woo, 2004:4). Furthermore it is asserted that behaviourist “commoditization of learning” promotes “conflicts between learning to know and learning to display knowledge for evaluation” (Lave and Wenger, 1991:112). This has, in the opinion of Shepard (2000b:3), led to the moulding of classroom activities around both the “content and format of external standardized tests”, resulting in the “complexity and demands of the curriculum” being lowered and a reduction in the “credibility of test scores.”

The social constructivist alternative to behaviourist pedagogy sees learning as the construction of knowledge within the context of real life situations and assessment integrated into the process of learning (Wild and Quinn, 1998:76-77; Brown, Collins and Duguid, 1989:online; Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:75; Laurillard, 1993:15; Herrington and Oliver, 2000:online; (Shepard, 2000b:1). In other words, if assessment is to be meaningful it should in some way reflect the practice of the profession, vocation or practice being assessed, while at the same time giving learners the opportunity to demonstrate their knowledge and skills.

Shepard describes this approach to assessment as performance based (Shepard, 2000b:43), in which, according to Shepard (2000b:3):

Teachers’ close assessment of students’ understandings, feedback from peers, and student self-assessment are a part of the social processes that mediate the development of intellectual abilities, construction of knowledge, and formation of students’ identities.

The study that this paper revisits involved the design, development and implementation of an authentic learning environment – and by implication an authentic assessment strategy – based on Herrington and Oliver’s (2000:online) nine characteristics of authentic learning environments, namely that authentic learning environments should:

1. Provide authentic contexts that reflect the way knowledge will be used in real life;
2. Provide authentic activities;
3. Provide access to expert performances and the modelling of processes;
4. Provide multiple roles and perspectives;
5. Support collaborative construction of knowledge;
6. Provide reflection to enable abstraction to be formed;
7. Provide articulation to enable tacit knowledge to be made explicit;
8. Provide coaching and scaffolding by the teacher at critical times; and,
9. Provide for authentic assessment of learning within the tasks.

The issue under consideration is whether assessment based on social constructivist principles can overcome the concerns of teachers, parents, administrators, politicians and other commentators whose thinking is so influenced by the notion of validity and reliability that is inherent in behaviourist psychology’s concept of “scientific measurement of ability and achievement.” (Shepard and Bliem, 1995:1; Shepard, 2000a:1; Shepard, 2000b:6).

THE STUDY REVISITED

Among the questions posed in the original study was one which concerned itself with the effect of an authentic assessment strategy in a technology-mediated, constructivist- informed learning environment have on the performance of students who participated in this study? Immediately in the posing of this question one is aware of the tensions between constructivism and behaviourism in this study. Before examining these tensions more thoroughly it is important to briefly describe the module designed for the original study.

The Module

Support for the design of the module that was developed for this study was drawn from a number of theoretical perspectives and represents an attempt to develop a technology-mediated authentic learning environment based on the ideas of Herrington and Oliver (2000), whose work is influenced by both Brown, Collins and Duguid’s (1989) notion of cognitive apprenticeship and Lave and Wenger’s (1991) notion of legitimate peripheral participation in communities of practice. The design process also acknowledged the importance of:

- interaction in learning environments and the influence of on student attitudes and student achievement Hillman, Willis and Gunawardena (1994), Sutton (2001) and Moore (1989) – interaction between learners and content, learners and learners, learners and teachers, learners and the interface – usually to satisfy the learner’s need for support (Ally, 2004);
- communication in support of these interactions (Anderson, 2002);
- assessment as central to the learning experience (Brown, et al., 1994; Kings, 1994; Hodgman, 1997 and Rovai, 2000), and its influence on the “choice” of learning made by the learner (Hodgman, 1997; Marton and Säljö, 1984; Dahgren, 1984 and Entwistle, 1988); and,
- the generic outcomes required by the National Qualifications Framework of the South African Qualifications Authority (undated).

At the beginning of the course a group of final year Physiology students were asked to divide themselves into groups of six members. No criteria were used in this process and students were able to choose their group mates as they saw fit. However, the class was informed that participation in the module required a degree of computer literacy and they were advised to ensure that at least one group member was reasonably computer literate, if possible. Each group member was assigned a role within the group by consensus amongst the group members. No particular thought was given to structuring the groups or the roles within the groups other than the generally acknowledged importance of group work in social constructivist learning environments. Students performing the same function within the group were brought together to learn about their particular function within the group and what was expected of them. Table 1 lists the required roles and concomitant responsibilities.

Table 1: Individual Roles and Responsibilities within a Group

Role	Responsibility
Group Leader	Group leaders were responsible for co-ordinating the group's activities and the development and implement of an action plan, in conjunction with group members, in order to ensure that the tasks set were accomplished.
Researcher - Internet	Internet Researchers were given a short course on the use of the Internet and pointed to a number of online resources dealing with Internet searches.
Researcher - Library	Library Researchers were given a tour of the University Library by a subject librarian and were briefed on how to make use of the Library to find suitable information.
Scribe	The Scribes were given a short course on the use of MS Word and pointed to a number of online resources that they would find useful in completing their role in the team.
Presenter	The Presenters were given a short course on the use of MS PowerPoint and pointed to a number of resources that they would find useful in completing their role in the team.
Assessment Co-ordinator	The Assessment Co-ordinators were advised of their responsibilities as co-ordinators of the assessment processes and their roles in guiding and understanding the processes required to complete the task. They were given access to a resource that explained assessment to them and the difference between formative and summative assessment. The assessment process was explained to this group and assessment rubrics were given to the Assessment Co-ordinators as guides to the assessment process.

After dealing with the roles and responsibilities of individuals within a group, the groups were introduced to the tasks they were to undertake. Each task was tackled by two groups so that the students could participate in the assessment process with some exposure to the subject matter and a degree of understanding of the topic. In designing the tasks an attempt was made to present these tasks in an authentic a manner as possible, situated in the real world context that Physiologists might have to contend with in their working environment. Whether this was successful or not will be considered a little later in this paper. The tasks were as follows:

- Task 1** – A spear fisherman intends diving to 30m to hunt a barracuda. He hyperventilates before the dive to ensure that he will stay down for the longest period possible. He continues the increased ventilation rate until his blood gas pressures stabilise at a level in line with this new (increased) breathing rate. Are the new values for oxygen and carbon dioxide in the spear fisherman's blood different from normal levels? If so, explain why. Explain why the spear fisherman can remain below the water for a longer period of time after hyperventilation. Why is hyperventilation considered to be a very dangerous practice?
- Task 2** – Tuberculosis is a silent disease that kills thousands of South Africans annually, even though, as often mentioned in the media, the disease can be beaten (cured). Describe tuberculosis, its causes, physiological effects, treatment of the disease and the pharmacological action of the medication used.
- Task 3** – Chronic pulmonary emphysema is a disease that affects thousands of South Africans. It is commonly associated with long-term smoking. In fact, one of the characteristics of the disease is known as the "smoker's cough". Smoking is, however, not the only cause of this disease, it can also result from long-term exposure to coal burning and dust, for example. Describe the disease, its characteristics and physiological effects on the human body.
- Task 4** – We have all heard or read the advertisements telling us about the detrimental effects of smoking on our health. It affects all of us. They talk about the effects of passive smoking, inhaling somebody else's smoke, being as bad or even worse than the effects on the smoker. Recently smoking has been banned in public places. Why is it such a bad habit and what are the effects on the human body?
- Task 5** – A friend of yours lands in hospital with a peculiar pulmonary condition. His pulmonary blood pressure and flow is normal, but he is breathing quite fast. His doctor indicates that his ventilation/perfusion rate is abnormal, but your friend cannot understand this. Explain the concept of ventilation/perfusion to your friend. Elaborate on the normal and extreme cases of this ratio. Include in your answer the alveolar partial pressures of gasses under these conditions.
- Task 6** – You are scaling (climbing) Mount Kilimanjaro with a friend of yours. At 12 000 ft above sea level, your friend complains of a headache and nausea. You become really concerned about her health when, at about 16 000 ft, she starts experiencing convulsions and has difficulty remaining conscious. What do

you suspect is wrong with your friend? Describe the physiological complications that could result from the condition. How can you help your friend?

Assessment Strategy

Groups were expected to make use of the Internet and the University Library in order to access the resources necessary to successfully complete the task. Each group was expected to submit electronically a 5-page typed report on their task, in the format required which stressed the importance of citations in the text and references at the end of the document. The documents submitted were made available to the class on the module website. These initial submissions became the focus of a formative assessment exercise undertaken by the groups and by a panel of experts made up of the class lecturers, three graduate assistants and the author as facilitator of the module. Each group was required to comment on the submission of the group doing the same task as they were, i.e. peer group assessment. An assessment rubric was made available electronically for the purpose and was completed by groups and the panel of experts alike. This rubric also contained an area where groups could post detailed comments about the submission that they were assessing. Groups were obliged to provide a detailed report justifying their criticisms as well as pointing out where improvements could be made.

In order to ensure that the process of formative assessment undertaken by the peer group was taken seriously the group was assigned a mark for their efforts. These marks were given equally to group members and assigned to a category called "Contribution to discussion and assessment of tasks."

On completion of the formative assessment process, groups were given an opportunity to reflect on the input of their peers and of the subject experts and to reconsider their submission based on what they had learned from both the formative assessment process. This reflective process culminated in the resubmission of the tasks by the groups. This resubmission was for summative evaluation, which was undertaken by the module lecturers. When undertaking this assessment the lecturers concerned themselves not only with the content but also with how the group had dealt with issues arising from the comments received on their submission. Feedback was given by the lecturers to the groups before completion of the next step, the creation of a presentation.

Subsequently, groups were required to create an oral presentation on their task for delivery to the class. The class and the panel of experts participated in the assessment of the presentation making use of an online rubric designed to guide the assessment process. Participation by the class in this process was assessed and marks allocated to the category "Contribution to discussion and assessment of tasks."

Finally, in order to ensure that students were rewarded for their participation within the group, student-participants were required to assess the contribution of each of their peers within their group. A mean of individual assessments was used and students could earn or lose up to 12% of the final mark awarded to the group, based on the results of this poll.

Students who did not participate in this process were penalised and students who did not take the process seriously, for example by awarding the same rating to each question contained in the poll or the same rating to all participants in the group, were also penalised, and the rating discounted in the final calculation. This was reflected in the assessment category called "On-going assessment of attitudes to the module."

RESULTS

Student performance in the study module, which I will refer to as Module 1, was revisited and compared to student performance in the module following the study module, which I will refer to as Module 2, in order to ascertain whether student participation in a technology-mediated constructivist learning environment had any influence on their performance when compared to performance of the same group of students in a "traditionally" presented chalk-and-talk classroom. An exploratory analysis of student performance in these modules using MSEXcel indicated that there was a difference in student performance between modules and that the degree to which student performance differed was not uniform throughout the class. Indeed, the difference in performance between the modules for the class as a whole and the performance of students at the top of the class as determined by their performance in Module 2 was not the same as that of students in the middle of the class or at the bottom of the class. While there are a number of factors that could have been instrumental in the cause of this manifestation, the pattern was compelling enough to warrant further investigation given the tensions between constructivist learning environments and summative assessment practices. In order to do so the class was divided into tertiles based on their individual performances in Module 2, the follow-on module. A paired

samples t-test was undertaken on the performances of the class as a whole in both modules and on the performances of each of the tertiles in both modules using SPSS. The results of this test are given in Table 2.

Table 2: Results of the Paired Samples t-test

Tertile	Module	Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Low	Module 1 - Module 2	38.53	10.06	2.31	33.68	43.37	16.70	18	0.00
Middle	Module 1 - Module 2	24.65	7.11	1.59	21.32	27.98	15.50	19	0.00
High	Module 1 - Module 2	11.83	7.96	2.30	6.77	16.89	5.15	11	0.00
All	Module 1 - Module 2	26.80	13.32	1.87	23.06	30.55	14.37	50	0.00

The paired-samples t-test compares the means of two variables that represent the same group at different times. In this case the two variables are the different approaches taken in the modules in which the group participated, i.e. in Module 1, the study module, students participated in a computer-mediated constructivist classroom, while in Module 2 students participated in a “traditionally” presented chalk-and-talk classroom.

Like z-scores, the paired-samples t-test standardises individual items in a population distribution by taking into account the mean and standard deviation of that population, thus allowing for comparisons to be made. From Table 2 the fact that the significance values for the difference between means of each tertile is zero, (i.e. $p = 0.00$), and the fact that the upper and lower 95% confidence interval do not contain a 0, indicates a significant difference between the means of student performance in each tertile. This also applies to the analysis for the module as a whole, i.e. that there is a significant difference between student performance in each of the modules.

Furthermore, the difference between the means for the performance in each module of the class as a whole is 26.80, while for the students in the middle tertile this difference is 24.65, which is little different from the class as a whole. However, when considering the difference between the means for the students who fell into the low tertile, we see that there is a greater difference between the difference in means between the performance of the class as a whole (26.80) and the difference in means between the performance of students in this tertile (38.53). The results of this test appear to indicate that students in the low tertile were “advantaged” by the approach taken in the study module (Module 1) over approach taken in the follow-on module (Module 2). Finally, when considering what happened to students in the high tertile, we find that the difference in their performance (11.83) when compared to the difference in means between the modules as a whole (26.80) was a great deal smaller than for the difference in means between the modules. The results of this test appear to indicate that students in the top tertile were “disadvantaged” by the approach taken and did not, or were not able to, fulfil their potential in the study module (Module 1) when compared to their performance in the follow-on module (Module 2). These results of the paired samples t-test analysis would seem to indicate that the group approach taken in Module 1 seems to have a “uniforming” effect on student performance when compared to student performance in a “traditional” chalk-and-talk classroom.

A One Way Anova analysis of the means was performed on each of the tertiles within each module in an attempt to confirm this pattern. The results are given in Table 3.

Table 3: One Way Anova Analysis of Means

		Sum of Squares	df	Mean Square	F	Sig.
Module 1	Between Groups	113.493	2	56.747	1.629	.207
	Within Groups	1671.801	48	34.829		
	Total	1785.294	50			
Module 2	Between Groups	7037.830	2	3518.915	84.490	.000
	Within Groups	1999.151	48	41.649		
	Total	9036.980	50			

In the Anova analysis of the modules one can see that the difference in means between the tertiles in Module 1 was not significant ($p < 0.05$). While for Module 2 the difference in means between the tertiles was indeed significant ($p = 0$). This indicates that students in the bottom tertile performed statistically significantly worse than those in the middle tertile. Students in the top tertile performed significantly better than those in the middle tertile. In other words, there is a significant difference in student performance depending on which tertile students find themselves. When the situation in Module 1 is considered there is no significant difference between the mean results obtained by the students in any of the tertiles, in other words there is not statistically significant difference in the results obtained by the students in each of the tertiles. In other words, there is no significant difference in student performance regardless of which tertile students find themselves.

This would further suggest that the assessment strategy in Module 1 had the effect of “advantaging” the poorer performing student as determined by student performance in Module 2; had little effect on the participants in the middle tertile and “disadvantagied” the top students as determined by student performance in Module 2. This seems to be a further indication of the “uniforming” effect on student performance of the group approach taken in Module 1 when compared to student performance in a “traditional” chalk-and-talk classroom.

Of course this is an analysis of results of a study that was not designed to answer the questions that are now being asked and further investigation is required. However, it would seem that an argument can be made for what appears to be an interesting influence of the assessment approach taken in the module under review (Module 1) on student performance, namely that that the weaker students were “advantaged” by the approach at the expense of the stronger students, while the students in the middle of the class were generally unaffected.

DISCUSSION

The assessment approach used in the study can certainly be criticised on a number of counts. Firstly, the tasks themselves were little more authentic than the traditional tasks that learners are subjected to in Mathematics which begin “A train travelling . . .”. and it would be as well to reconsider them, possibly making use of the case-study approach. Secondly the over-reliance on group assessment used needs to be reconsidered, affording students opportunities to show individually what they are capable of doing. Thirdly, this preoccupation with group assessment will tend to have a “uniforming” effect on the performance of a group and, ultimately, on the performance of a class. Finally, it is clear that more consideration needs to be given to the theory with respect to authentic tasks and collaboration in authentic learning environments.

However, these criticisms should not detract from the issue at hand, namely that:

The dominance of objective tests has . . . shaped beliefs about the nature of evidence and principles of fairness.

(Shepard, 2000b:17)

Clearly the results obtained from revisiting aspects of this earlier study – no matter how flawed they might be – lend credence to the concerns that the measurement community have about authentic assessment practices, particularly with respect to the validity and reliability of high stakes summative assessment practices. It would appear that these concerns regarding assessment are shared by many who otherwise embrace social constructivist learning environments, hence the concern raised by Shepard (2000:5) and others that traditional testing remains the predominant form of assessment, even in constructivist classrooms. This is of particular concern given that the literature is fairly unanimous in its support of social constructivism as the pedagogy of choice in support of technology-mediation in learning. Successfully challenging the implicit beliefs and theories of teachers, administrators and other key role-players is therefore a vital step if alternative or authentic

assessment practices are to gain acceptance in the modern classroom. In order to do so analysis of these assessment practices need to present a more convincing picture, particularly as far as the validity and reliability of the outcome of these practices are concerned. It is interesting that, while constructivist literature is fairly clear about what learning is and the sort of learning environments we need to create in order to bring learning about, little seems to be written about how we determine whether learning is, in fact, taking place and, if so, to what degree.

If authentic assessment is to acquire the sort of legitimacy that the assessment practices of the measurement community have acquired then we as critics of these assessment practices need to find ways and means of confronting the criticisms levelled at alternative assessment. Perhaps the answer lies in the sentiments expressed in one of the many quotes attributed to Albert Einstein:

We can't solve problems by using the same kind of thinking we used when we created them.

CONCLUSION

This paper attempts to raise issues regarding assessment in constructivist learning environments that appear not to get the attention they deserve, probably because these issues go to the heart of our high stakes accountability testing system. However, if we are to advance the cause of the pedagogy best suited to supporting technology-mediated learning environments – one in which assessment is central to learning – then a great deal more energy needs to go into consideration of the issues surrounding high stakes accountability testing and the implicit beliefs and theories of the all participants in that assessment.

FOOTNOTE

One of the reviewers of this paper was kind enough to include a reference list along with comments made. Unfortunately, given the tight deadline for final submission and the fact that all except one of the references listed are books – requiring that I make use of my institution's inter-library loan service, I have not been able to do justice to many of the worthwhile comments received from this reviewer. In any event I list these references here for the reader's information, with thanks to the reviewer for going to such lengths:

Bruffee, K. A. (1993). *Collaborative learning: higher education, interdependence, and the authority of knowledge*. Baltimore, Md.: Johns Hopkins University Press.

Bruner, J. S. (1996). *The culture of education*. Cambridge, Mass.: Harvard University Press

Gipps, C. V. & Murphy, P. (1994). *A fair test?: Assessment, achievement and equity*. Milton Keynes: Open University Press.

Lave, J. (1996). Teaching, as learning, in practice. *Mind, Culture, and Activity*, 3(3), 149-164.

Torrance, H. (Ed.). (1995). *Evaluating authentic assessment: problems and possibilities in new approaches to assessment*. Buckingham: Open University Press

Piaget, J. & Inhelder, B. (1973). *The psychology of the child*. London: Routledge & Kegan Paul.

Vygotsky, L. S. (1978). *Mind in society: the development of higher psychological processes*. Cambridge, Mass.: Harvard University Press

Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge: Cambridge University Press.

REFERENCES

Ally, M. (2004). Foundations of Educational Theory for Online Learning. In: Anderson, T and Elloumi, F. (2004). *Theory and Practice of Online Learning*. Athabasca, Canada: cde.athabascau/online_book. Athabasca University. 454p. [Accessed online] http://cde.athabascau.ca/online_book/. 24/02/2004.

Anderson, T. (2002). An Updated and Theoretical Rationale for Interaction. ITForum Paper Number 63. [Accessed online] <http://it.coe.uga.edu/itforum/paper63/paper63.htm>. 01/10/2002.

Brown, J. S., Collins, A., and Duguid, P. (1989). Situated Learning and the Culture of Learning. *Education Researcher*, 18(1): 32-42. [Accessed online] http://www.slofi.com/Situated_Learning.htm. 01/03/2004.

Brown, S., Rust, C., and Gibbs, G. (1994). *Strategies for Diversifying Assessments in Higher Education*, Oxford: Oxford Centre for Staff Development. [Accessed online] <http://www.lgu.ac.uk/deliberations/ocsd-pubs/div-ass5.html>. 20/05/2002.

Bruner, J. (1996). *The Culture of Education*, Cambridge, MA: Harvard University Press.

- Cognition and Technology Group at Vanderbilt, Learning Technology Center. (1993). Integrated media: toward a theoretical framework for utilizing their potential. *Journal of Special Education Technology* **12**(2), 76-85.
- Dahlgren, L-O., (1984). Outcomes of Learning. In: Marton, F., Hounsell, D., and Entwistle, N. (Eds.). (1984). *The Experience of Learning*. Edinburgh: Scottish Academic Press.
- Entwistle, N. (1988). *Understanding Classroom Learning*. London: Hodder and Stoughton.
- Herrington, J., and Oliver, R. (2000). An Instructional Design Framework for Authentic Learning Environments. *Educational Technology Research and Development*, **48**(3), 23-48. [Accessed online] <http://elrond.scam.ecu.edu.au/gcoll/4141/HerringtonETRD.pdf>. 08/03/2004.
- Herrington, J., Reeves, T. C., Oliver, R., and Woo, Y. (2004). Designing Authentic Activities in Web-based Courses. *Journal of Computing in Higher Education*, **16**(1), 3-29.
- Hillman, D. C. A., Willis, D. J., and Gunawardena, C. N. (1994). Learner-Interface Interaction in Distance Education: An Extension of Contemporary Models and Strategies of Practitioners. *The American Journal of Distance Education*, **8**(20), 30-42.
- Hodgman J. (1997). The development of Self- and Peer-assessment Strategies for a Design and Project-based Curriculum. Ultibase Articles. [Accessed online] <http://ultibase.rmit.edu.au/Articles/dec97/hodgm1.htm>. 21/04/2003.
- Kanuka, H and Anderson, T. (1998). On-line Social Interchange, Discord and Knowledge Construction. *Canadian Association for Distance Education. Journal of Distance Education*, **13**(1), 57-74.
- Kanuka, H and Anderson, T. (1999). Using Constructivism in Technology-Mediated learning” Constructing Order out of the Chaos in the Literature. *Radical Pedagogy*, **1**(2). [Accessed online] http://radicalpedagogy.icaap.org/content/issue1_2/02kanuka1_2.html. 23/04/2003.
- Kings, C. B. (1994). The Impact of Assessment on Learning. *Proceedings of the AARE Conference 1994*, Newcastle, Australia, November 1994. [Accessed online] <http://www.aare.edu.au/94pap/kingc94179.txt>. 02/10/2004.
- Knight, P. T. (2002). Summative Assessment in Higher Education: Practices in Disarray. *Studies in Higher Education*, **27**(3), 275-286.
- Laurillard, D. (1993). *Rethinking University Teaching: A Framework for the Effective Use of Educational Technology*. London: Routledge.
- Lave, J., and Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.
- Marton, F., and Säljö, R. (1984). Approaches to Learning. In: Marton, F., Hounsell, D., and Entwistle, N. (Eds.). (1984). *The Experience of Learning*. Edinburgh: Scottish Academic Press.
- Moore, M. (1989). Three Types of Interaction. *American Journal of Distance Education*, **3**(2), 1-6.
- Ramsden, P. (1992). *Learning to Teach in Higher Education*. London, United Kingdom: Routledge.
- Rovai, A. (2000). Online and Traditional Assessment: What is the Difference? *The Internet and Higher Education*, **3**(3), 141-151.
- Scholtz, A. T. J. (2005). Computer Mediation in Support of a Constructivist Learning Strategy at an Historically Black University in Limpopo, South Africa. Unpublished masters thesis, University of Kwazulu-Natal, Durban, Kwazulu-Natal, South Africa.
- Shepard, L. A. (1991). Psychometricians' Beliefs About Learning. *Educational Researcher*, **20**(6), 2-16
- Shepard, L. A. (2000a). The Role of Assessment in a Learning Culture. *Educational Researcher*, **29**(7), pp. 4-14.
- Shepard, L. A. (2000b). *The Role of Classroom Assessment in Teaching and Learning. CSE Tech. Rep. 517*. Los Angeles: CRESST/University of Colorado at Boulder.
- Shepard, L. A., and Bliem, C. (1995). Parents' Thinking About Standardized Tests and Performance Assessments. *Educational Researcher*, **24**, 25-32.
- South African Qualifications Authority. (undated) The National Qualifications Framework: An Overview. <http://www.saqqa.org.za/nqf/overview01.html>.
- Sutton, L. A. (2001). The Principles of Vicarious Interaction in Computer-mediated Communications. *International Journal of Educational Telecommunications*, **7**(3), 223-242. [Accessed online] <http://www.eas.asu.edu/elearn/research/suttonnew.pdf>. 01/10/2002.

Thorndike, E. L. (1904). Introduction to the theory of mental measurement. New York : Science Press
(Cattell's).

Thorndike, E. L. (1927). The Measurement of Intelligence. New York: Teachers College Press.

Wild, M., and Quinn, C. (1998). Implications of Educational Theory for the Design of Instructional Multimedia.
British Journal of Educational Technology, **29**(1), 73-82.