Introducing educational computer programmes through evaluation: A case in South African disadvantaged schools

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ABSTRACT

I report on evaluation strategies that could be used to introduce an educational computer programme (ECP) in disadvantaged schools. The strategies include social dialogue, using the teachers' value systems such as Ubuntu together with participant evaluation methodologies, by which teachers learn about evaluation, computer skills, and the concepts the ECP presents, as well consider the curriculum issues around ECP use in teaching. The study involved 26 teachers from 23 South African disadvantaged schools.

Keywords: Evaluation of educational computer programmes; disadvantaged schools in Africa; Ubuntu

INTRODUCTION

Context

Bantu in South Africa attended schools in which a curriculum was specifically designated for them in low-income areas that couldn't afford computers. These schools produced most of the current poorly skilled teachers who teach in them. These are the disadvantaged schools where the South African Department of Education (DoE) has consistently tried various projects to improve teaching and learning, sometimes with provision of computers. My work in disadvantaged schools indicated that Bantu education had persisted against newer curricula such as Curriculum 2005, at least up to the time this research was conducted from 2001 to 2004.

Computers-based innovations are now almost culturally embedded in developed countries that drive globalisation. In contrast, teachers in Africa find computers in tertiary institutions (e.g., Blignaut & Venter, 2002: 1; Hewett, Erulkar, & Mensch, 2003: 5, 12); but even then, rarely use educational computer programmes (ECPs) (although they might use computers) during their teacher training (personal observations at the University of Kwa-Zulu Natal from 2000 – 2006).

Despite increased interest in computer use in South Africa (SA) (e.g., White Paper on ICT use in Education, DoE, 2003), my participation in education projects indicated that few teachers were equipped with basic computer skills and literature revealed little research on curriculum and cultural implications of ECP introductions and use in SA schools. For example, the University of Natal designed an ECP it named Zadarh (Amory, 2001), but the ability of teachers to use it in their lessons was still to be researched.

An Educational Computer Program (ECP) named Zadarh

Zadarh is a constructivist adventure, fun and drama game (Amory, 2001), designed to address some of the unrelenting Biology curriculum problems in SA (e.g., from Chacko, 1996 to DoE, Muwanga-Zake, 2000; to Sanders, 2002). Amory explains that explorations of Zadarh involve cognitive (interpretive) and/or social constructions (when students group-play), and model dialectic between pedagogical and game elements. Fun could increase playing time and

therefore time for scientific inquiry, around problematic concepts, hoping that students can apply these in real life adventures. Zadarh deals with photosynthesis, respiration, genetics, and evolution at school-leaving level. The challenge is whether teachers are able to identify these Zadarh objectives and use it effectively in their lessons.

Components which teachers have to understand before evaluating and implementing an ECP

I propose that the knowledge and skills needed to use an ECP in lessons can be summed up in Figure 1 below. Figure 1 shows concerns various authors raise about developing teachers and ICT use in teaching (e.g., Whittier & Lara, 2006: 3; Minaidi & Hlapanis, 2005: 241- 243; Gredler, 2001: 537). These include distinguishing between harnessing computers for curriculum objectives and the computer skills needed, in their subject of specialization and culture, economic standards, cognitive strategies, and social processes executed. Thus, Figure 1 represents teachers' competencies to evaluate and use an ECP. Such an evaluation could achieve the transformation, which Muffoletto (1996: 145) recommends is necessary to use ECP in lessons. Unfortunately, according to Minaidi & Hlapanis (2005: 245), *the majority of teachers form a didactical model without ICT and would prefer to remain with that feeling of competency*.

Rationale for this study

It appears that teachers' institutions in SA exclude the 'ICT & skill' set in Figure 1 from teacher training thus the '*didactical models without ICT'* is apparent among teachers in SA.
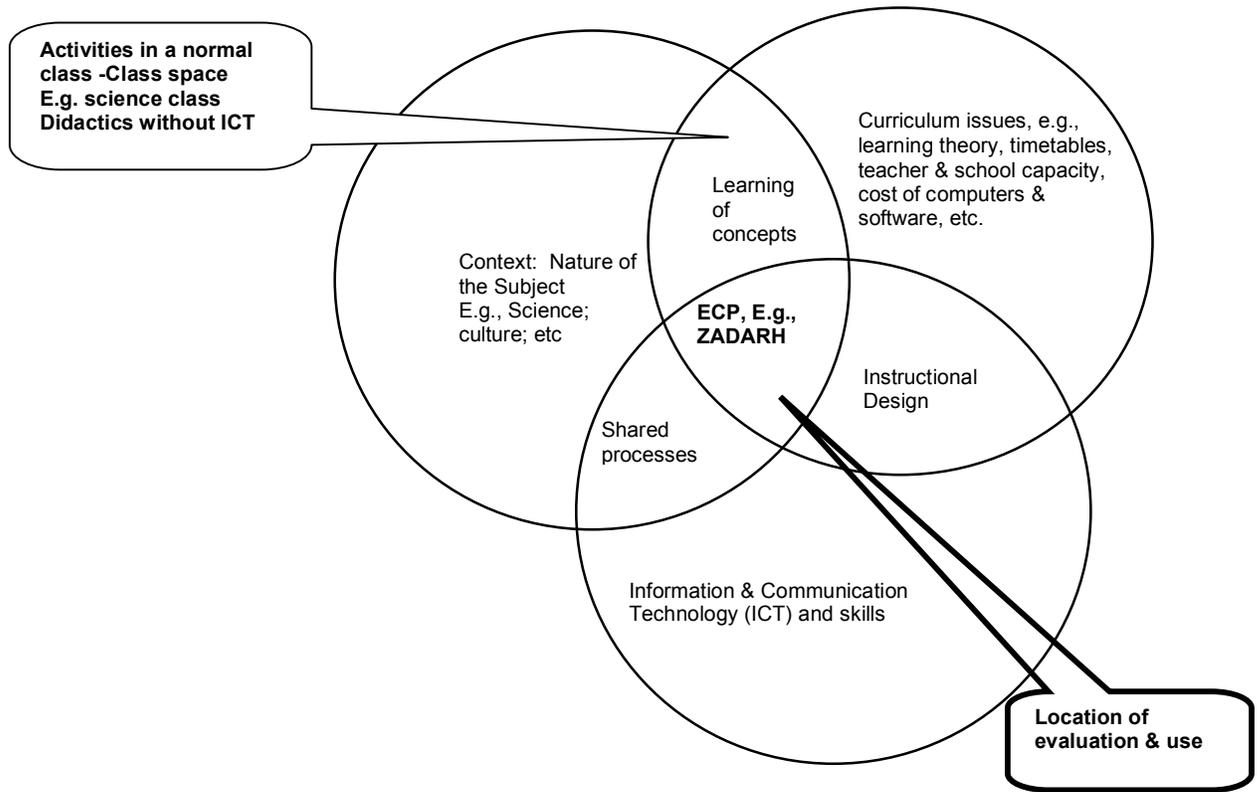
Figure 1: Elements of focus in evaluating and implementing Zadarh

Hence, the need for teacher training in ICT uses is as critical in SA as it is internationally (Mutton, Mills & McNicholl, 2006: 2). This is complicated by the varying competencies among teachers (Minaidi & Hlapanis, 2005: 242), requiring individuals to choose a technology and level of training about its use (Ottesen, 2006: 277). Nonetheless, the DoE banned out of class in-service training, arguing that teaching time is spent on teachers' professional development. Scaffolding an in situ teachers' evaluation of an ECP (Barbera, 2004, 13) could satisfy the DoE, while improving the teachers' competencies in Figure 1.

Participants

In year 2000, to each of 101 schools, the DoE provided 20 computers for teaching in a project it named Dinaledi. I worked for the Centre for the Advancement of Science and Mathematics Education (CASME), which was among those contracted to train teachers, and this gave me access and acquaintance with participants. Of these schools, using data from a Dinaledi preliminary survey, I selected 23 schools (i.e., 22.8%) with passable roads and working computers in the Eastern Cape, KwaZulu Natal, and Mpumalanga provinces of SA from which 26, Grade 12 teachers volunteered (Cates & Goodling, 1997: 30).

RESEARCH QUESTION

The evaluation of Zadarh was extensive but this paper reports on only one question: *What does introducing Zadarh in disadvantaged schools entail?* The introduction of Zadarh into schools happened as an evaluation process using the following evaluation philosophies, methodologies and methods.

ADOPTING EVALUATION PHILOSOPHIES AND STRATEGIES FOR INTRODUCING AN ECP

Evaluation as research

Evaluation and research could adopt similar strategies (e.g., LeCompte, Preissle, with Tesch, 1993; Hickey & Zuiker, 2002: 541). In this case, the evaluation was a collection of information about the worth of Zadarh (Fink, 1995: 2; Hitchcock & Hughes, 1995: 31, Greene, 1994: 530-531), against the desirability of outcomes associated with its use.

The philosophical framework

Firstly, the idea was to introduce and get teachers to use Zadarh in their teaching using an evaluation as a strategy. Secondly, with the belief that teachers' practices are *historically contingent, socially enacted, and culturally constructed* (Ottesen, 2006: 277, citing Holland *et al*.), while the teachers' local contexts, including culture (Ubuntu), poverty, and poor training in ICT use, informed the philosophical framework, it was Ubuntu that made this study unique.

Ubuntu, in relation to humanity can be viewed as a philosophy, but could be a methodology in its executions. In this case, Ubuntu was relevant in redressing social relationships, which were damaged by a repressive political past. Bantu in SA desire to emancipate themselves and their culture towards what Denzin (2001: 24) refers to as freedom from *prejudice, repression and discrimination,* but in the process, are sensitive to externally initiated innovations. It is therefore prudent to introduce such innovations through their paradigm, Ubuntu.

Ubuntu as an imperative in research and in introducing innovations among Bantu

Bantu inhabit over three quarters of Africa, from West to South Africa. An individual is a Muntu. The term Ubuntu as used in this paper is a Xhosa and Zulu reference to the social conduct of a Muntu. Other Bantu languages such as Luganda have different terms for Ubuntu. In relation to introducing innovations, Ubuntu negotiations are communal and *interrogate truths or credibility* (Louw, 2004) by analysing the facilitator's relationships with the community, as well as the credibility of the evaluation, and the ECP. According to Mkabela (2005), Ubuntu pursues consensus, which in case of the introduction, evaluation and uses of an ECP, ought to be cognisant of Bantu norms and values. Furthermore, the facilitator would be expected to become a Muntu, through explicit exposition of who s/he is and her/his intentions. A Muntu (and this includes the facilitator) flourishes through assisting and interacting, and is discouraged to take precedence over the community to the extent that innovations that would benefit a few or just the facilitator would most likely be rejected. Thus, the facilitator has to show how the community gains from the innovation.

Tutu (2004) identifies Ubuntu-based research with participative research paradigms in stating that we are bound in life. In support, Broodryk (2006: 6) emphasises Ubuntu togetherness and cooperation, including thoughts, for a common good. Ubuntu desires mutual empowerment; what in Western paradigms translates into social responsibility. The mutual benefits confers equality of purpose and of responsibility upon the researcher and participants, and ameliorates power relations to enable communal decision-making to the extent that there are no 'researched individuals or informants' but participants with a common purpose. Essentially, Ubuntu puts a human face to research, against a top-down research process, allowing the participants to state their problems (Mkabela, 2005: 183), (their poor qualifications, spirituality, poverty, culture, values, etc), so that the research addresses some of these. Greet, sit, talk, understand their needs, and if possible eat with Bantu. In short become a Muntu, and the Bantu will fully cooperate and validate your research.

It is apparent that Ubuntu is compatible with Western participative paradigms, which seek facilitator-participant collaboration in the research design and in the interpretation of results, especially coupled with a developmental social agenda. The interactive nature of Ubuntu ("mutual exposure" and respect) satisfies some requirements of reducing 'Internal Value Constraints' (LeCompte, *et al.*, 1993: 322-349).

Choosing participative research philosophies

An important competency for teachers, also recommended in teacher qualifications, is the ability to evaluate an ECP. An evaluation before the teacher uses an ECP in class is vital, but evaluation competencies were not part of Bantu education. Teachers in disadvantaged schools have to be trained to evaluate and use ECPs. The teachers' social fabric, local context, priorities, and culture have to be considered (Evans & Powell, 2007; Wells & Wells (2007: 3), because no universal truths in ICT applications in education exist (Pedro, *et al.,* 2004: v), and *technology is not value neutral, but has inbuilt assumptions and ideologies, which* influence *possible use (*Jefferies, Carsten-Stahl & McRobb, 2007: 117). Unfortunately, varied or complete lack of competences and experience complicate such training (Whittier & Lara, 2006: 3; Koedinger, Anderson, Hadley & Mark, 1997: 1). Thus, teachers' should actively participate in evaluating, planning their own training and in setting policy for ECP uses (Pedro, Enrique, Ernesto & Lucio, 2004: 3).

While Ubuntu forms the ground for entry into local schools, Western-based research paradigms are necessary, since ECPs originate from Western-based epistemology. Hence, the internationally renowned participative research philosophies were impregnated with indigenous local discourses (Pinkus, 1996), and emerged into processes that were unique and suitable for training the participants.

The philosophical frameworks that guided this evaluation

Qualitative evaluation
Quantitative evaluations similar to those carried out by both Adams (1998) and Ivala (1998) might be responsible for incongruence between evaluator's conclusions and what teachers' experiences (Randel, Morris, Wetzel, & Whitehill, 1992; Stratford, 1997) as these do not reveal discourses during the introducing, using, and evaluating ECPs. Myers (2000:2) vies that qualitative research emerged to study discourses of actors. In this case, qualitative evaluation was necessary to seek participants' social transactions and views as they used Zadarh in their schools (Savenye & Robinson, 2001: 1171-1172). Among the qualitative genre, Ubuntu could be amicable with a cocktail of the developmental, post-modern, interpretative, and constructivist approaches, as these would support teacher empowerment (Reeves& Hedberg, 2003: 31-34; Greene, 1994: 532). I submit that any evaluation process that includes teacher empowerment traverses more than one philosophy to emerge into a practical framework, mitigated by the local culture.

Contexts guiding the choice of a philosophy	Considerations	Philosophy	Methodology	Methods	Data	Data analysis
1. Indigenous discourses (Ubuntu) 2. Local realities: e.g., shortage of computers 3. Computer illiteracy: 4. Curriculum issues: e.g., Zadarh uses, timetabling, teachers' classroom strategies, etc. 5. The nature of subject in Zadarh – Biology	**Accessing and incorporating participants' values** **Empowering** teachers with evaluation / training **Learning theories and nature of biology in Zadarh -** constructivist game + experiments **Individual participant interpretations** **Actors** Teachers; Students; Myself; Designers of Zadarh	**Qualitative** *Unquantifiable social interactions* **Developmental** *Teachers develop evaluation skills; conceptual understanding; computer skills* **Post-modern** *No formalities Sensitivity to school interests and capacity* **Constructivist** *Teachers' inputs towards the evaluation process and introduction of Zadarh*	**Action** *Teachers co-evaluators; training teachers to use & evaluate ECPs in their classes* **Class visits** *Observe teachers' practices, students' interactions with Zadarh and their teacher.* **Ethical considerations** *Permission from school authorities Teacher's convenience Coded records* **Interpretive** *Teacher's subjective and contextual interpretations recorded*	Questionnaires; Interviews; (focus groups); Class observations	Interview scripts; Class notes; Video or audio records; Questionnaire responses	Constant comparative; Discourse analysis

Figure 2   Conceptualising the evaluation, mode of entry, and training process

Post-modern evaluation

Firstly, the cocktail of Ubuntu-participative paradigm approach is postmodernist in creating an approach that is not bound by research traditions. The responsibility of valuing and introducing Zadarh into school curricula lay with teachers (Nichols & Allen-Brown, 2001: 231; Yeaman, Hlynka, Anderson, Damarin, & Muffoletto, 2001: 254-256), and teachers benefited (Reeves & Hedberg, 2003: 271), without pre-sequenced progression (Dillard cited in Denzin, 2001: 29).

Developmental evaluation

Kong (2007: 69), Herrington (2002), as well as Reeves & Hedberg (2003: 275-274) argue for professional development through hands-on participation suitable for each individual teacher's level and needs. This was planned along the competencies in Figure 1. The process portrayed situated learning, interpretativism, constructivism, and action research as it happened in teachers' classrooms, and contributed towards alleviating 'external and internal value constraints' *(*Eisenhart & Howe, 1992: 660-661).

Constructivist evaluation

In a philosophical sense, we all process constructs or realities from interpreting experiences (Cobern, 1996: 304). Constructivism nurtured cognitive reflexivity, and engendered social transactions and negotiations, with teachers asking questions, which guided entry and training processes (Willis, 2000: 12), within the teachers' social norms (Jefferies, *et al.*, 2007: 113). A constructivist strategy allowed flexibility for teachers to influence their individual development (Kong, 2007: 69).

METHODOLOGY

Introduction

The methodology explains the plan of action and process (Crotty, 1998: 3). Bantu communities follow Ubuntu codes of conduct, in this case so important, considering the socio-cultural theory that *human action is mediated, and inseparable from the specifics of its cultural, historical and institutional context* (Vygotsky, 1978). For example, in Africa, *one first has to obtain permission from tribal or community* (Hewett, *et al*., 2003: 29). Ubuntu guided the following methodologies.

Ethical considerations

Among the Bantu, permission is better obtained through direct negotiations even if this follows a written request. Then 'Ubuntu' *inter alia* requires the principal to communicate and discuss this request with the teachers through social dialogue. Furthermore, it is important to state clearly how the findings would be used, and how teachers and the school benefit. People have realised that the information they provide has sometimes ended up published without their consent.

Developing the teachers because of their pivotal role as pedagogical agents of change is another ethical factor (National Research Foundation [NRF], 2004; Pedro *et al.,* 2004) that is also pertinent in Ubuntu and in disadvantaged communities, implying that the facilitator had to concurrently train participants (a process and outcome evaluation), which would contribute towards personal and social transformation of participants (Greene, 1994: 533; McKenney & Van den Akker, 2002: III, 407; Heinecke, Blasi, Milman & Washington*,* 1999).

Ethical considerations included consented preliminary surveys, to understand the teachers' needs and then plan and evaluate Zadarh with the teachers to infuse into the evaluation' their values and needs (e.g., training). This was easier because of my prior interactions (Huberman & Miles,

1994: 428-429; Myers, 2000: 3) during the Dinaledi project at CASME. These measures increased the 'Internal Value' of the activities and engendered mutual trust, and agreements about roles or responsibilities of teachers (Eisenhart & Howe, 1992: 657 – 662; Heron, 1996: 159; Maykut & Morehouse, 1994:145-147; NRF, 2004; LeCompte *et al*., 1993: 322-349). An additional ethical issue concerned the Zadarh meeting the claimed benefits and fitting into curricula (Jefferies, *et al.*, 2007: 7, 10).

Action and interpretative evaluation

Pedro *et al.* (2004: 19) believe that a working practical example might motivate teachers to try out an innovation. According to Ottesen (2006:4 citing Ludvigsen), such practice should be planned with specific consideration of the historical and socio-cultural situation, noting Denzin's (2001: 25) point that there is an increase in resistance against modernist research (often perceived as control) and a desire for an interpretive practice that persons willingly submit to. Therefore, action considered Ubuntu and the historical effects of apartheid. For example, the experience of Bantu education had increased sensitivity to curriculum innovations. Not that Bantu education supported Ubuntu; it actually violated Ubuntu and seems to have led to the demand for people-centred curriculum development. So it was better to design the introduction of Zadarh with teachers, redress Bantu education damages, and to encourage teachers to articulate their needs in view of their interpretations of the new SA curriculum then code-named Curriculum 2005, which succeeded old curricula, including Bantu education. Teachers wanted, and it was necessary for them to understand the position of ECPs in Curriculum 2005 and how the evaluation and use of ECPs such as Zadarh helped them to achieve competencies to implement Curriculum 2005. Fortunately, Dinaledi, a government project, catered for the use of ICTs, including ECPs in science classrooms, and Curriculum 2005 requires teachers' to evaluate ECPs. Hence, Dinaledi provided computers to these schools.

On the basis of Pedro *et al.'s* (2004: 19) advice and ethical requirements, the preliminary knowledge about the teachers' competencies was used to plan their development. Furthermore, interpretive stances allowed teacher-centred individual interests regarding training (see for example Table 3). Based on the views on action research in Noffke (1995) and Stevenson (1995: 207), the following activities happened at each school, considering knowing as a subjective local event, (Reeves & Hedberg, 2003: 28):
First school visit
- Discussed the responses the teachers provided in the preliminary Dinaledi survey, especially regarding their competencies shown in Figure 1
- Observed Biology classes and computer uses and advised on possible improvements
- Introduced Zadarh, answered the questions about Zadarh and left it installed on school computers
- Showed teachers how Zadarh works and the possibilities of using Zadarh
- Planned timetabling for the subsequent evaluation with the school computer manager
- Taught teachers about 'evaluation' and introduced a preliminary evaluation plan for their input

Second school visit
- Improved upon the evaluation plan using teachers' inputs, and planned subsequent evaluations with teachers including students involvement
- Facilitated the teachers' evaluation – first with the teachers alone, and then with their students

CASME workshop or third school visit in some schools
- Discussed with teachers curriculum issues with regard to using Zadarh – how to include Zadarh into Biology lessons and timetabling

- Reviewed with the teachers, the use of and students' problems with Zadarh
- Individual teachers made requests for my further visits.

Discourse analysis

To start with*, interviews are situated in complex systems of discourse, where traditional, everyday performance, text and audience come together and inform one another* (Denzin, 2001: 26). In discussing the choice of philosophies, I hinted at designing emergent discourses that are a hybrid of formal Western philosophies performed within Ubuntu. That is, the applications of Western paradigms in a Bantu community inadvertently create new challenges and discourses, for both the facilitator and the Bantu participants to analyse as they try to find a common ground of understanding the evaluation process, as well the ECP and its use. Therefore, the emergent discourses and the processes that lead to their emergence require discourse analysis, as these cannot be predicted.

Discourse analysis is very important among Bantu, as Ubuntu draws meaning from and communicate through discourses, which Foucault (e.g., in Mphahlele, 1996) said include actions, hierarchy, emotions, and attitudes. For example, such discourses could be signs of acceptance or repertoire necessary for the subsequent activities. Additionally, Bantu often seek consensus to the extent that an individual's response could represent the collective community views, and so I had to note for pointers like a teacher using 'we' instead of 'I' when s/he answers questions.

Additionally, Minaidi & Hlapanis (2005: 246) identify language as a factor because English is dominant in ICT applications, and has bred new terminologies, which provoke or exacerbate misunderstandings. An example is the 'mouse', which in ordinary English is an animal. That, English was a 'second language' to the participants, required verification of instructions and questionnaires for technical or instrument validity (Denscombe, 1998: 213-214; Reeves & Hedberg, 2003: 34), sometimes requiring translation into vernacular, which in these areas were IsiXhosa and IsiZulu.

Discourse also related to the disadvantaged status of these schools in the possibility of exaggerating the value or accepting an ECP that is free of charge.

METHODS

The procedures triangulated questionnaires, interviews, and class visits in an interpretative dialogue (Greene, 1994: 532; British Educational Communication and Technology Agency, 2001; Merriam, 1998: 71; Denscombe, 1998: 109-112), to reveal the teachers' understanding of proceedings, and what and how they benefited. I read questions where I sensed misunderstanding, and then interviewed about responses that were interesting or ambiguous. I photographed or video-recorded with consent.

Challenging tasks around problematic concepts in Zadarh (Armory, 2001), and questions during interviews, which nurture reflexivity (Willis, 2000: 12), formed the basis for dialogue that helped teachers' introspection, to analyse personal understanding of what or how they benefited. Using guidelines from Linn (2002: 40), Willis (2000: 9), and MacDonald & Farres (2003: 5I) interjections could be open-ended diagnostic questions or incomplete leading statements that scaffold to a more critical participant's thinking and reflection or included direct corrections to a misconception. Reflexive questions sought the teachers' knowledge, opinions, hypothetical predictions, or speculations. Examples included:
- How would Zadarh change your lessons?
- Does your teaching suit the use of a game?

- Do you have enough time to use ECPs?
- What factors prevent you from using ECPs?
- How has this evaluation helped you to improve your teaching strategies?
- What kind of support do you need in your efforts to use computers?

Although utopian, Denzin (2001: 24) refers to this approach as performative and conversational in that dialogue transforms *information into shared experiences,* and knowledge.

The first dialogues were about responses to the preliminary survey. The second dialogues happened during playing Zadarh, when I prompted participants for verbal predictions or descriptions about an activity they were performing (Gredler, 2001: 538). The second dialogue was also a training exercise, clarifying biology concepts and giving advice about computer skills as well as playing Zadarh. Dialogue was conducted often in isiXhosa or isiZulu.

The third dialogue sought participants' overall experiences with Zadarh and was held during the CASME workshop or in some schools in class.

DATA MANAGEMENT AND ANALYSIS

Ubuntu demanded an idiosyncratic constructivist and interpretive approach that includes my deeds in the data, and my opinions (Gay & Airasian, 2000: 204-211). All analyses were done in relation to participant benefits or problems within the framework of discourse analysis, but processed teachers' statements using the constant comparative method. The determination of recurring themes and patterns in participants' responses as suggested by Maykut & Morehouse (1994:126-144), Hitchcock & Hughes (1995: 295), and Denscombe (1998: 210) proceeded as follows:

- Statement on event / ideas and suggestions, some of them translated from vernacular
- General theme or unit of meaning, e.g., exciting
- Underlined or highlighted words or statements related to exciting and code them with a number (e.g., makes me feel good', 'not boring', 'makes me happy', all belonged to the general unit, 'exciting')
- Compared unit, e.g., compare 'exciting' against closely similar themes such as 'motivating'. These were combined if their meaning overlapped to form a new unit. Otherwise, each unit was refined where the two were definitely different. This step required setting rules of inclusion for each unit and yielded audit trails showing how it was developed.
- The rules of inclusion described the unit.

Themes emerged which I checked against the class observations and video records (especially to analyse discourses). I then derived generalisations from each unit.

FINDINGS: FACTORS THAT DIRECTLY AFFECTED ENTRY INTO A DISADVANTAGED SCHOOL

Introduction

This paper is about what one can expect when introducing or evaluating an ECP in disadvantaged schools. So, the outcomes of the evaluation are left out.

General school and classroom situations

Schools were found in two kinds of environments: 5 schools in rural villages and 18 in townships (predominantly low class Black residential areas). A chief attended an event in one of the village schools. 96% of schools had line electricity, the one using solar panels for electricity. All of them

had secure computer laboratories, which were found open on both occasions in only three schools.

Ethical issues of entry

I only managed to meet 5 principals or deputy principals out of the 23; the rest were reported to be attending meetings. However, they had delegated authority to the teacher Heads of Department, who then took me to the teacher in charge of computers, if it was not his/her responsibility. I was introduced to other teachers, where the project would be discussed. Principals and teachers were eager to state the problems facing the use of computers and in Biology.

Ubuntu was apparent in all the proceedings, such as the invitation of other teachers to participate. I.e., there were no cases where I dealt with a single teacher, concomitant with the communal Bantu nature to bring along others in such matters. Secondly, proceedings often changed into isiXhosa or isiZulu and that made participants more relaxed, accepting, and provided more inputs. A senior teacher in all cases convened meetings.

As fellow Bantu, and using ubuntu (antipositivist) methods of entry (local language and Ubuntu conduct being some of these), teachers consented to collaborative participation, and pointed out how they would prefer to be trained and about what. It was noteworthy that I was respected more for my age than for my qualifications or for where I worked. Ubuntu also meant adhering to school routines, which in 20 out of the 23 schools included meals fit for a visitor. In some schools, identifying with the DoE's, curriculum, or Dinaledi objectives supported my mission. A popular objective was how the project empowered teachers towards implementing the new curriculum.

Discussions would sometimes start by participants' national matters of concern or interests; on two occasions, by a critique of the national soccer team but mostly about the new curricula and the heavy workloads as well as needs for further training. Teachers appreciated obtaining Zadarh free of charge.

The process of evaluation

All teachers did not have the skills to evaluate Zadarh and many confused it with assessment. For example, they did not know the attributes to evaluate, and apparently had never been asked to do an evaluation of an ECP. Therefore, an overview and planning the evaluation were useful, especially as it helped teachers to scrutinise the way their students used Zadarh, to the extent that they were able to comment on the teaching style (the learning theory) applied in using Zadarh in their lessons. Unfortunately, 20 teachers felt that they would not have time to hold interviews with students and to analyse results, but could hand out questionnaires to students. Evaluations were punctuated by training in computer skills and references to Biology textbooks.

ADDITIONAL DATA FOR CONSIDERATION IN INTRODUCING, EVALUATING, AND USING AN ECP

Working out participant needs in relation to Zadarh

This is data from questionnaires applied to 26 teachers. Few teachers held degrees in teaching, and about a quarter had studied biology to Matric (Table 2).

Table 2:   A sample of qualifications of Grade 10-12 biology teachers (n=26). Key: % (n)

Teaching qualification	None	Certificate	Diploma (E.g., STD)	Degree/HDE/ACE
	0%	0%	65% (17)	35% (9)
Highest level studying Biology	Matric	Certificate	Diploma	Degree
	23% (6)	0%	54% (14)	23% (6)
Number of years teaching Biology	0- 5	6-10	11-15	16 and over
	54% (14)	35% (9)	12% (3)	0%

Forty six percent (46%) of teachers had no training in computer skills, and institutions had trained only 35% (Table 3).

Table 3:   Teacher's qualifications in computer skills

Never	Trained myself	Trained at an institution	Trained through a project	I am getting training now	Not interested	I want to be trained
46% (12)	15% (4)	35% (9)	4% (1)	15% (4)	0%	100%

Thirty eight per cent (38%) of teachers had never used computers to teach (although schools had the computers for over a year) and 35% had less than years' experience of using computers in teaching (Table 4). However the experience to teach meant providing some ECP to learners for revision or using presentation tools (e.g., Power Point).

Table 4:   Teachers' experiences in using computers to teach

Never	Less than a year	Up to 5 years	6-10 years	11-15 years	Over 16 years
38% (10)	35% (9)	12% (3)	0%	04% (1)	0%

Status of computers and teachers' opinions about the use of computers

All computers were new in 20 out of the 23 schools, but 2 of the 23 schools had lost some of their computers to thieves. However, the 20 schools were not using the computers to teach, especially because they lacked technical support as well as computer skills. Overall, computers were very few in relation to the number of students, which was as high as 624. The DoE never allocated funds for computer maintenance, and the schools' fund was too small for maintaining the computers, as computer technicians were prohibitively expensive. Having just about 20 or less working computers for the whole school was problematic. Therefore, students had to play Zadarh in groups of five or six.

Access to computers

Access was mostly to teachers with permission from the computer laboratory managers appointed from the school staff: the majority having been mathematics and/or science teachers but without training in computer networking or using computers to teach.

Use of computers in schools

Teachers complained that teaching computer skills to students in the 3 of the 23 schools, which offered 'computer science' as a Matric subject, was prioritised although Dinaledi supplied

computers for teaching sciences. These same 3 schools had bought physical science and mathematics programmes, which they were yet to use. The frequency of computer use by the students could not be established but in 19 schools, the observation that biology students had their first chance to enter a school computer laboratory via this evaluation implies that students did not have access to computers frequently.

I found 7 schools (out of the 23) with working e-mail and Internet for the principal. Shortages of e-mail and local networks (LAN) expertise, as well as lack of money to pay TELKOM for the telephone line and Internet services were major problems. TELKOM had disconnected many schools from the Internet due to non-payment of bills. I also found only 4 schools out of 23 where individual teachers, out of curiosity and interest, had set up the LANs in a working order. TELKOM had set up LANs in all the Dinaledi schools but did not train teachers on managing these LANs, and TELKOM retained management rights (through pass words). Schools were under contractual obligation not to allow non-TELKOM staff to do any repairs or changing computer and LAN settings. Faulty LANs meant installing Zadarh on each computer.

School computers and Zadarh

Basic computer skills, such as using a mouse that is fundamental to play Zadarh, were lacking among most teachers. For example, a teacher put a mouse on the screen, and another tried to move the 'Zadarh' icon to the 'start' Windows icon. Thus, training teachers included switching on the computer, logging into the computer, installing Zadarh, using a mouse, and playing Zadarh.

Compatibility of Zadarh with school computers

Zadarh was fully compatible and run well on computers supplied to the Dinaledi schools, but colours were poor and Zadarh was slow on older computers, even though Zadarh recommended such computer hardware and Windows 3.11.

Using Zadarh to teach

Teachers held varied views on when and how to use Zadarh, reflective of their teaching styles, which was mainly behaviourist (although Zadarh is constructivist). That is, I had to suggest and discuss how to use Zadarh effectively in their lessons. Furthermore, teachers viewed Zadarh as game not suitable for serious study. This view coupled with Zadarh requiring at least an hour before any tangible outcomes, relegated the students' use of Zadarh to after school periods of teaching. Unfortunately, teachers left school immediately after teaching and students rarely had a chance to play Zadarh. Nonetheless, playing Zadarh brought teachers and students together as they tried to help each other to solve problems.

DISCUSSION - *WHAT DOES INTRODUCING ZADARH INTO DISADVANTAGED SCHOOLS ENTAIL?*

Firstly, this was a case study of only 23 schools. More studies are required. The results were also biased in the use of teacher volunteers (Cates & Goodling, 1997: 30), excluding possible technophobes and those with very negative views about computers. The sample was also limited to Biology Grade 12 teachers, bearing in mind that computer managers were often mathematics and physical science teachers who were possibly more skilled in using computers. Thus, this was a sample of teachers who wished to use computers in teaching but did not have the basic computer skills.

Secondly, results apparently show that the utilisation of computers has not progressed since 1996, because The Education Policy Unit, University of Western Cape (2000), during 1996-97, also found that teachers lacked basic computer skills. This together with poor understanding of concepts in Zadarh would undermine the teachers' abilities to use Zadarh in their teaching. Apparently, some teacher training institutions excluded basic computer skills; some teachers could not even handle a mouse. These were worse than elsewhere in Africa (e.g., Hewett, *et al.*, 2003: 5, 12). Teachers had never evaluated or used an ECP in teaching before, confirming my observations (University of Kwa-Zulu Natal from 2000 – 2006). While this evaluation provided teachers with some ECP use in class and evaluation skills, the revelation is alarming, and if extrapolated, requires SA to act immediately on training teachers in ECP use in teaching.

Training should involve teachers practically (Barbera, 2004, 13), to the extent that teachers are proficient in all the aspects of the ECP as summarised in Figure 1 (Whittier & Lara, 2006: 3-16). In my view, Figure 1 encompasses the complexity that concerns Whittier & Lara (2006: 3). However, the socially constructed approach (Ottesen, 2006: 277) was undermined by the teachers' ignorance of what they needed to know – social involvement where teachers were supposed to constructively participate in designing lessons with ECP use worked only after some training.

Another drawback in these schools was finance for training, computers and ECPs, which disadvantaged schools do not have. The 20 computers were certainly not enough, and none were received during this study, which lasted over a year, that the digital gap these schools suffer might persist for some time.

Besides taking care of the above, unlike in a purely Western and developed schools, an evaluator or innovator should prepare for a lengthy negotiation process to gain entry into a school, signposted by the recognition of local cultures and discourses (Wells & Wells, 2007). For example, Bantu still wish to share a meal regardless of one's time constraints. The time spent is however worth it for long-term collaboration. I have in other occasions observed the disastrous effects of project facilitators rejecting that courtesy.

Furthermore, the qualitative approach seemed reveal more social dynamics or transactions (Myers, 2000:2) than the quantitative evaluation used by Adams (1998), as this provided deeper descriptions of local discourses and paradigms (LeCompte *et al.,* 1993: 322-349). However, the study shows that a collaborative evaluation, that gets teachers trained, can improve the success of entry and use of ECPs in teaching. The processes involved in introducing and ECP into a disadvantaged school include:
I.   Recognition of local discourses as alternative research agendas.
II.   Searching for compatibility between formal Western paradigms and local paradigms. Participative paradigms as are likely to be compatible with other local paradigms
III.   For the Bantu communities, imparting Ubuntu in the research process
IV.   Being aware of historical influences
V.   Planning for development of participants
VI.   Using reflexive questions and dialogue in interviews, with the option of translating them into vernacular
VII.   Checking the ECP-computer compatibility. Most disadvantaged schools might not have the latest software or their computers could not have the capacity to store or run some ECPs

REFLECTION, LESSONS LEARNT, AND IMPLICATIONS FOR FUTURE ECP INNOVATIONS

Data shows that the success of ECPs in disadvantaged schools depends upon the understanding teachers have of Figure 1 competences. Data also says that introducing ECPs into schools is not

a matter of taking ECPs and explaining a few things to teachers or giving workshops in remote centres. It requires collaborative evaluations with teachers at their schools, with unequivocal recognition of teachers' and school culture and needs. Teacher constructivist participation in the evaluation makes them part of curriculum development and exposes them to possibilities of using computers, but should be used after some introductory training.

Developing teachers through action training are difficult to plan and time because of varied teacher competencies, and the efforts they put into the exercise. The values they attached to the ECP or alternatively the extent to which the ECP solves their problems plays a role, but teachers could not be 'pushed'. While a push would gainsay the interpretative, developmental, and constructivist frameworks, it is important to note that Ubuntu courtesy and negotiation cannot be hastened. The above then begs the question of whether teachers have time for ECPs and training. I think that an ECP that yields outcomes in line with curricula objectives, and fits into the timetable of a school is likely to be adopted. One way is to design ECPs with episodes with designated curriculum outcomes that fit into school teaching periods.

CHALLENGES

Challenges that need attention to introduce and get teachers to use ECPs in disadvantaged schools include:
- Understanding the social, historical and economic situation
- Improving the teachers' conceptual understanding of content and learning approaches;
- Improving the teachers' abilities to evaluate ECPs;
- Improving the teachers' basic computer skills, and skills to use ECPs;
- Increasing the number of computers in schools so that ECPs can be used more frequently and effectively; and
- Developing ways of integrating ECPs into the school curricula, which requires the DoE and school administrators to be flexible with timetabling and with modes of teaching.

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