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Digital immigrant teacher perceptions of an extended Cyberhunt strategy

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This quantitative and qualitative interpretive exploratory case study investigates whether exposure to an Internet based *Extended Cyberhunt* strategy enables teachers to attain a set of outcomes similar to Prensky's 'Essential 21st Century Skills' and the 'Critical Outcomes of the South African National Curriculum Statement (NCS)'. The outcomes referred to include effective planning, designing, decision making and goal setting; improved computer and data searching skills; enhanced confidence, interest, reflective ability, collaboration, judgment and creative and critical thinking; as well as effective problem solving and the ability to communicate and interact with individuals and groups. The Extended Cyberhunt strategy, which focuses on enabling participants to become the designers of questions on curriculum related topics at different cognitive levels of Bloom's *Taxonomy*, was introduced to teachers who were first time users of the Internet, Microsoft *Word* and *PowerPoint*. The intention was to ascertain these teachers' perceptions of the utility of the strategy in terms of assisting them to implement the critical outcomes described above with school level learners. Data on their perceptions and experiences related to these outcomes were generated and triangulated by means of a pre and post-Likert scale questionnaire, an open ended questionnaire, qualitative semi-structured interviews, reflective journal writing, and implementer reflections. Positive gains were revealed in terms of all of the above outcomes after exposure to the Extended Cyberhunt strategy. These findings are considered in terms of differences between the approach used and traditional teacher-centred teaching, and the strategy is examined using activity theory as a lens. While we are aware that many alternative approaches exist that may be just as successful in terms of attaining the desired outcomes, we believe that the Extended Cyberhunt strategy is both a fruitful extension of *WebQuests* and other existing Internet-based approaches, and a relatively easily implementable and viable way of attaining the desired outcomes.

Introduction

Prensky (2009) contends that the learners of today need to develop several 'Essential 21st Century Skills' to prepare them for life using technology. These skills include thinking critically, setting goals, having good judgment, making good decisions, planning, solving problems, communicating and interacting with individuals and groups, thinking creatively, designing and reflecting. These skills are similar to the key competencies that individuals should be prepared for as indicated by the OECD (Organisation for Economic Co-operation and Development), which refer to the ability to use tools (language, text, symbols, knowledge, information and technology related) interactively, interacting in heterogeneous groups (relate well to others, ability to cooperate, manage and resolve conflicts) and acting autonomously (act within the bigger picture, form and conduct life plans and personal projects, ability to assert

rights, interests, limits and needs) (Rychan, 2003; Rychan & Saganik, 2003). These competencies have sub-categories which refer to the skills mentioned by Prensky. Similarly, Alexander (2010) argues that learners of today need to be exposed to strategies that go beyond the traditional way of looking at literacy, as many texts have not only become more complex and demanding, but at the same time there are such a great number of different literacy mediums that have to be explored and engaged with in a critical manner in order to obtain deeper understanding. Technology, especially the Internet or web, has changed concepts of learning and epistemology, as well as who is viewed as authorities of knowledge (Dede, 2008). New skills are required to deal with knowledge in a critical manner to ascertain what is 'truthful' and can be trusted (Alexander, 2010).

The South African Department of Education has stipulated a number of critical outcomes which include critical and creative thinking, working together in teams, managing themselves responsibly, collecting and analysing information, communicating effectively, using science and technology effectively, seeing the world as set of related contexts, employing effective learning strategies and becoming responsible citizens (Department of Education, 1997, 2002, 2004). While the role that information and communication technology (ICT) can play in achieving these goals and the concomitant need for teacher development is acknowledged (Department of Education, 2004), there is a paucity of information on how to go about achieving these ends (Hodgkinson-Williams, 2005). In practice, the time frames for ICT implementation in South African schools, as reflected in the *Draft White Paper on e-Education* (Department of Education 2004), have not been realised and many schools are without computers and Internet connections, nor have the teachers been exposed to ICT related skills and practices. In the Eastern Cape Province for example, 90% of the schools are without a computer centre, let alone an Internet connection (Department of Education, 2009).

Nevertheless, there is an increasing number of schools now provided with ICT infrastructure, and there is a growing need for teacher professional development in terms of ICT. As such there is a need for information on ways to support teachers, particularly those who are digital immigrants, to cope with the demands of the curriculum and the 21st century skills implied therein. This paper provides a snapshot of the perceptions of a group of digital immigrant teachers who were provided first-time access to computers in their schools and who participated in a development program which focused on an extended Cyberhunt strategy (Du Plessis, 2010; Du Plessis & Webb, 2011). The study aimed at ascertaining whether the use of such a strategy could promote essential 21st century skills among the participating teachers, and interpreting the dynamics of the context (Lim & Hang, 2003; Hardman, 2005a, 2005b, 2007) in order to suggest a possible *'how to'* strategy to address current ICT curricular demands. The findings are interpreted within activity theory (Hardman, 2005a, 2005b, 2007) and motivational theory (Keller, 1983; Malone & Lepper, 1987) frames of reference, as these ideas underpinned the original design of the extended Cyberhunt strategy.

Extended Cyberhunts and learning by design: Theoretical perspectives

Traditional Cyberhunts are online learning activities designed by teachers to introduce the Internet to school learners by providing questions that learners answer by

exploring the provided hyperlinks in an online browser (Rechtfertig, 2002). Teachers may use the Cyberhunt to introduce a new topic or for enrichment purposes (Slayden, 2000). However, we are of the opinion that the traditional Cyberhunt concept can be extended effectively when learners become the designers of Cyberhunts (Du Plessis & Webb, 2011; Du Plessis, 2010). Extended Cyberhunts require a shift in focus from the teacher as the traditional designer and transcend merely exploring an activity to using learner-created activities to clarify misconceptions and assist peers who do not have an adequate understanding of a given topic.

They can also be used to explore aspects or topics within the curriculum that the teacher is not able to cover because of time constraints. Learners are expected to explore a given topic by generating keywords and key phrases, assessing the appropriateness of the resources found online, and composing questions based on different cognitive levels as per Bloom's revised taxonomy (Anderson & Krathwohl, 2001). The process includes introducing the participants to the notion of different cognitive levels, identifying key verbs associated with each level, and developing a clear assessment memorandum. We argue that the last two aspects, namely a deliberate attempt to engage learners in composing questions on different cognitive levels supported by a clear memorandum, are what makes Extended Cyberhunts novel.

The Extended Cyberhunt strategy consists of 12 *w's*: wowing, wanting, wondering, webbing and wreading, wiggling, weaving, wrapping-up, waving, wmail or wupload, and wising (Du Plessis & Webb, 2011), with a high premium placed on journal writing and reflection throughout the process, in order to facilitate learners to articulate their thinking, their needs and their learning. This strategy was developed by using ideas from learner hypermedia design as proposed by the Lehrer (1993) framework, the design ideas of Allessi and Trollip (2002) and Liu (2003), the DDDE (decide, design, develop and evaluate) multimedia design framework of Ivers and Baron (2006) and the Eight Step Project Based framework of Lamb, Smith and Johnson (1997). These were used as the basis for conceptualising the learning as design aspects of the Extended Cyberhunt strategy. This newly developed strategy consists of twelve *w's* whereas Lamb et al.'s (1997) strategy consist of eight *w's*.

In a previous paper (Du Plessis & Webb, 2011) and in Du Plessis (2010), comprehensive overviews regarding the theoretical perspectives of Cyberhunts, the underlying philosophy, process of implementation, the knowledge and cognitive dimensions as well as how Cyberhunts differ from WebQuests were presented. The Extended Cyberhunt strategy shares certain aspects similar to WebQuests, but it is important to note that it is not a WebQuest. Below follows a short overview of the theoretical perspectives as well as how it relates to the Extended Cyberhunt strategy.

The theoretical perspectives that underpin the Extended Cyberhunt strategy are 'learning as design' or construction (Perkins, 1986), constructivist principles (Harel & Papert, 1991; Marlowe & Page, 2005; Slavin, 2003), constructionism (Stager, 2005, Ackerman, 2001; Harel & Papert, 1991), reflection (Kafai, 1996), collaboration (Vygotsky, 1978; Wisnudel, 1994) as well as motivation and interest (Keller, 1983; Malone & Lepper, 1987). Constructivism becomes constructionism when learners are actively involved to design artefacts (Harel & Papert, 1991); hence participants became active designers of extended Cyberhunts within this study. Reflection is an important aspect during and after the *'constructionist'* design process as it assists in making

learning more meaningful and guides further action (Kafai, 1996), hence the use of journals with pre-determined questions as one of the data tools in order that participants could reflect at the end of each session.

The collaborative dimension of the process comes into play when learners make meaning socially, hence giving learning a social constructivist dimension, and offering possibilities to enhance cognitive and social skills (Wisnudel, 1994; Vygotsky, 1978). Hence, participants were encouraged to work in groups of two to four in order to discuss and assist one another – bringing the social dimension to the fore. During the design process, being motivated and interested are also important, as motivational aspects such as fun, attention, challenge, competence, relevance, choice, voice and novelty have the possibility to enhance learning (Keller, 1983; Malone & Lepper, 1987). Therefore, participants were given opportunities to make their own decisions for example the topic that they want to choose, they could voice and share their progress with their peers and the facilitator as opportunities were provided for this. In addition, the participants were challenged with something new (the Internet, Microsoft *Word* and *PowerPoint* as well as the design of Extended Cyberhunts) and at the same time provided with facilitator and peer assistance in order to try to achieve personal competence or mastery.

Learning as design is based upon the principle that learners should be actively involved in the knowledge creation process, something which emphasises both process and product (Bruner, 1996). Hokanson and Hooper (2000) point out that the design process results in using ICTs as a generative constructivist tool, enabling learning and thinking as participants become the active constructors of artefacts (Jonassen & Reeves, 1996). Hence, participants were actively involved while designing their collaborative Extended Cyberhunts. The use of journals for reflective purposes that the facilitator could read enabled not only critical reflection and the identification of current assumptions, but also afforded the opportunity for the facilitator to be aware of the support to provide for the challenge – challenge in the sense that the participants were exposed to a new way of learning where they had to identify problems and possible solutions, implying participation in a transformative learning process (Mezirow, 1997; McGonigal, 2005).

Research suggest that a collaborative design process - which consists of constructing, modeling, composing, writing (typing), exploring Internet based resources and reflecting - provides opportunities for learners to develop complex mental skills (Carver, Lehrer, Connell & Erickson, 1992; Du Plessis, 2004; Du Plessis, 2010; Kafai, 1996; Lehrer, 1993; Lehrer, Erikson & Conell, 1994; Liu, 2003; Wisnudel, 1994). These complex mental skills refer to, for example, the development of project management skills, research skills, presentation skills and reflection skills (Lehrer et al., 1992; Lehrer, 1993; Lehrer et al., 1994; Liu, 2003; Du Plessis, 2004). Studies also suggest that the design of artefacts by learners also provides for better retention and comprehension of content materials (Beichner, 1994; 1999; Yildirim, 2005), greater higher order thinking skills (Liu, 2003), increased self-esteem and confidence (McGrath et al., 1997), ownership (Lehrer, 1993; Du Plessis, 2004; 2010), and greater awareness of audience (Liu, 2003; Du Plessis, 2004, 2010; Beichner, 1994). Other benefits of the design approach are commitment and enthusiasm (Beichner, 1994), improved motivation, interest and cooperation (Turner & Dipinto, 1992; Lehrer, 1993; Turner & Dipinto, 1997; Liu, 1998; Du Plessis, 2004), and internalisation of design skills (Liu & Hsiao, 2002; Liu, 2003; Du Plessis, 2004).

Activity theory and the Extended Cyberhunt intervention

Activity theory is the investigation of human activity (Murphy & Rodriguez-Manzanares, 2008) in which the activity system is the basic unit of analysis (Hardman, 2005a, 2005b). The interacting components within the mediational triangle (See Figure 1) of an activity system are the subject, object, tools, community, rules and division of labour (Murphy & Rodriguez-Manzanares, 2008). Hardman (2005a, 2005b) states that within such a system learning is not viewed as transmission, but as transformation, hence learning within an activity system could be seen as an evolving process mediated by tools and social interaction. Learning within the activity system occurs thus at two planes, namely the social and psychological (Lim & Hang, 2003; Lim & Chai, 2004). In an activity system, unmediated elementary and higher level interactions and functioning occurs at the base of the triangle (See Figure 1) while mediated higher level functioning and actions occurs at the vertex at the top of the triangle among the subject (individual), object (task) and tools, where the tools provide a mediational function (Hardman, 2005a; Lim & Chai, 2004).

The Extended Cyberhunt design can be framed with reference to activity theory (Figure 1). The contradictions at the apex of the triangle highlight the differences between the traditional 'chalk and talk' context and the learning-as-design context where the computer and Internet is used as mediated tools. The contradictions indicated at the base of the triangle highlight the differences between learning in the traditional context and the learning-as-design context with special reference to rules, community and division of labor (also referred to as 'roles').

The rules, community and roles have an unmediated function. Within this study, the subjects are the participating teachers from disadvantaged township schools with little previous computer and Internet experience. The mediational tools are the computer, Internet, software, participant journals, language, facilitator and constructivist principles. The social community is the context in which the participants participate; the rules refer to the requirements to which the participants had to adhere to; and the division of labour refers to the shared planning and shared responsibilities of the participants. The object refers to the critical outcomes related to the design skills, and the outcomes to whether the participants have been empowered with reference to the object (See Figure 1).

The learning as design approach is an active knowledge creation process which focuses on the process and the product during the learning process, hence complementing the activity theory notion that learning does not have a final start and end point. In this study the personal cognitive processes, motivation and interest, and collaboration during the design process are mediated by the tools (ICT) in the apex and the tools are supported by the functions at the base, namely rules, community and division of labour. The interactions between these functions have been shown to result in authentic learning experiences (Du Plessis & Webb 2008) which could be attributed to the different learning context of learning-as-design as opposed to the traditional 'talk-and-chalk' context (See Figure 1). At the same time it is important to note that learning within activity theory is seen as a transformation process (See Figure 1, the rectangular box to the left of the outcomes box).

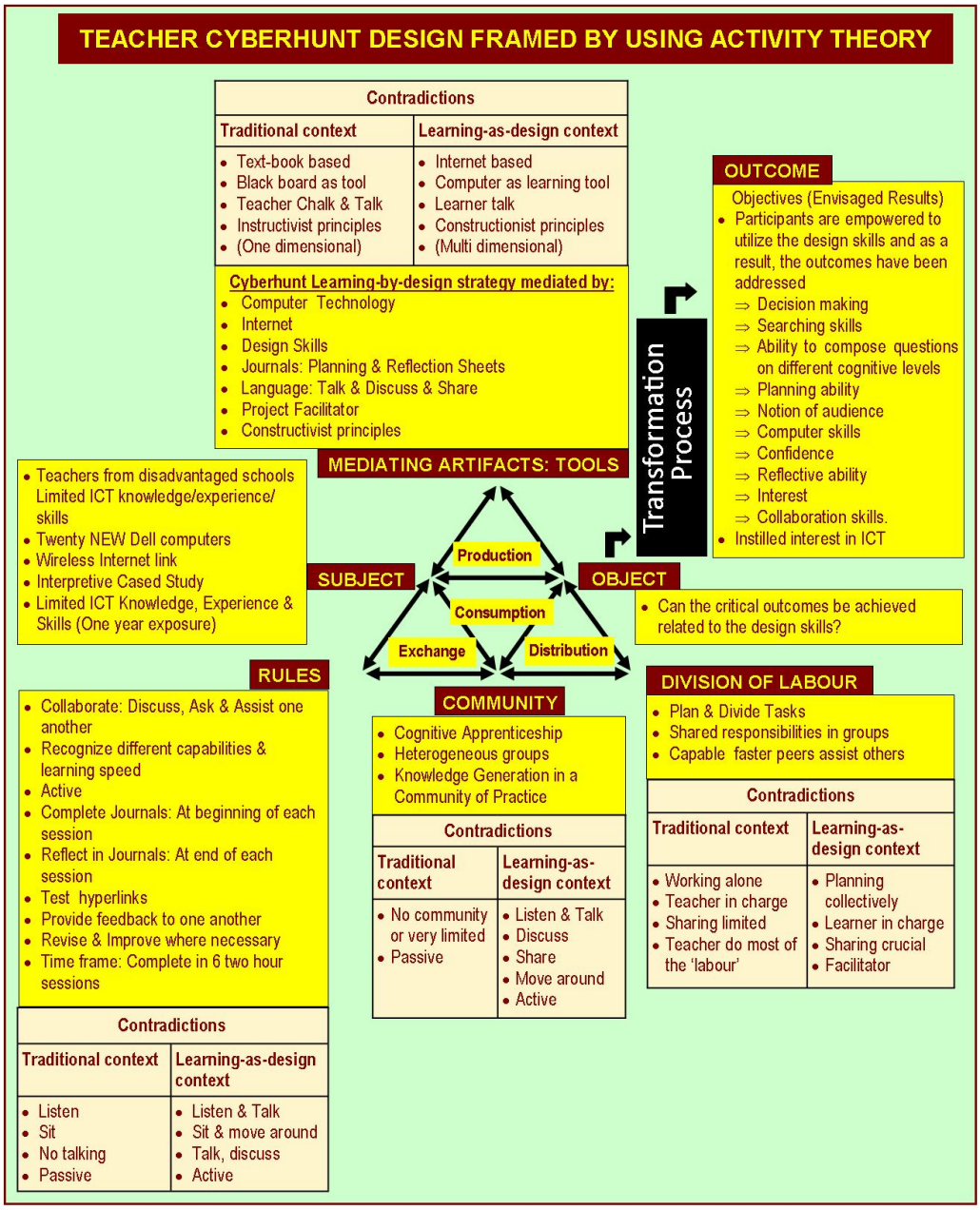

Figure 1: Activity theory and the Extended Cyberhunt intervention

Rationale, teaching aim and theoretical perspective

In this study (March to September 2008), teachers from disadvantaged schools in Port Elizabeth in the Eastern Cape province of South Africa, who had very little or no experience of computers and the Internet, were required to construct Extended

Cyberhunts on their choice of topic linked to the South African National Curriculum Statement. As noted earlier, only 10% of the schools in the Eastern Cape Province have a computer centre. The schools which participated in this study were provided with computers, wireless Internet connection hardware, Internet connectivity and teacher training. The intervention, apart from the donation of computers by the DELL Foundation, was funded by the Hermann Ohlthaver Trust (SA) and executed by members of the Nelson Mandela Metropolitan University.

The thinking behind the intervention process was to enable the participating teachers to use computer software such as Microsoft *Word* and *PowerPoint* as well as *Internet Explorer* as a browser in an authentic learning context. Hence, the participating teachers were afforded opportunities to not only learn computer skills hands on, but were also shown how the computer and Internet could be used as a learning tool.

The teaching aim that followed from the rationale was to empower the participants to design collaborative Extended Cyberhunts through the use of Microsoft *Word* and *PowerPoint* in order to address a particular set of outcomes, i.e. to provide the participants with opportunities for decision making, searching, posing questions, planning, gaining knowledge pertaining to using the computer as a teaching and learning tool, understanding the notion of an audience, gaining computer skills, practising reflection, developing interest and experiencing the fruits of collaboration.

The intervention was informed by a community of practice model embedded in cognitive apprenticeship (Brown, Collins & Duguid, 1989) within a social constructivist socio-cultural community (Overall, 2007), embedded by knowledge sharing and creation (Nonaka, 1994; Nonaka & Takeuchi, 1995). In communities of practice a major focus is on sharing and learning from one another. When participants work collaboratively, it opens possibilities for knowledge creation as a result of the interplay between the modes of knowledge creation, namely from tacit to tacit, tacit to explicit, explicit to explicit and explicit to tacit (Nonaka, 1994; Nonaka & Takeuchi, 1995). The interaction among participants creates opportunities for the sharing of ideas (socialisation), combining knowledge to test ideas (combination), the emergence of new ideas (externalisation) and developing new ideas through learning by doing (internalisation) (Nonaka, 1994; Nonaka & Takeuchi, 1995). Hence, it was proposed that they design collaboratively in groups of two or three in order to establish a community of practice.

The intervention and ethical aspects

Teachers from six disadvantaged township schools (four primary schools and two high schools in the Port Elizabeth Missionvale area) formed the convenience sample used in this study. Each of these six schools received 20 computers each from the Dell Foundation. From each school approximately six teachers participated. Teachers from other disadvantaged schools in the same township, who did not receive computers, were also invited to participate. The project commenced with 38 participants over a period of seven months, resulting in approximately eighteen sessions. The average attendance per session was 27 participants.

Formal approval for the project was solicited and received from the Director of the Port Elizabeth District Office. Thereafter, principals and representatives from their respective schools were invited to attend a number of meetings where the research

project was explained. Participation was voluntary and the schools determined which of their staff members would participate (not more than seven teachers per school due to the size of the training venue). A letter was sent to each school which explained the project and teachers were invited to volunteer on the basis that they could terminate their participation at any point in the process (eighteen two and a half hour sessions from March 2008 to September 2008 followed by classroom support). Training was conducted for 38 volunteers at the Nelson Mandela Metropolitan University's (NMMU) Missionvale Campus which is situated close to their schools (within a 3 to 10 km radius from the campus). The teachers were expected to design Extended Cyberhunts in groups that could be used by either other teachers or school level learners. A website [http://www.nmmu.ac.za/cyberhunts/] was created as a support tool.

During Phase 1 the participants were introduced to the Microsoft *Word* suite, the Internet, search engines and Boolean searches. In the design-modeling-copy-tool phase (Phase 2) the project-facilitator modeled the process step by step. *Internet Explorer* was used as the web browser to explore the Internet via *Google* and Microsoft *Word* was used as the design tool for the Extended Cyberhunts. Capable peers were identified to assist the project-facilitator in order to render a more efficient service to other participants in need of assistance. The teachers were also introduced to *PowerPoint* as a design and presentation tool. After several project-facilitator modeling sessions, the participants started to design their own Extended Cyberhunts in groups of two to four members, during which time they were afforded opportunities to plan, to design, to share and to reflect collectively. They also were also provided opportunities to showcase their finished Cyberhunt products and to obtain feedback from their peers. The feedback served as informal assessment with a view to indicating where improvements could be made and to acquire feedback on how the tester experienced the completed product. At the same time, those who had not yet completed their product had the opportunity to obtain further assistance from more capable peers. In Phase 3 the teachers identified areas in which they would require more assistance, and were provided with additional opportunities to indicate how they experienced the process and to make suggestions for future sessions.

Data gathering tools, data analysis, interpretation and trustworthiness

The data gathering tools used were a pre- and post- Likert scale questionnaire, semi-structured interviews, facilitator observation notes, teacher journal writing, and a semi-closed, open-ended questionnaire. The Likert scale questionnaire data on decision making, searching, posing questions on different cognitive levels, planning, knowledge pertaining to using the computer as a teaching and learning tool, the notion of an audience, computer skills, reflection, mental effort, interest and collaboration, were analysed using Microsoft *Excel* and *Statistica*. Cronbach *alpha* was determined as an estimator of reliability and probability (p) values were determined for the grouped items to ascertain whether mean changes were statistically significant, while Cohen's *d* scores were calculated to determine effect size. The data were analysed by the Statistical Services Unit at the University. In addition, Likert scale statements which had shown a 25% increase or more in the pre- and post Likert scale (See Appendix A), were also included as reference will be made to some of these statements in the 'Results' section.

In order to promote validity and trustworthiness, multiple sources of evidence were used (quantitative and multiple qualitative data sources) in order to establish a chain of evidence (Yin, 2003a, 2003b) and to ascertain whether the results were consistent between the data collected from the multiple sources (Merriam, 2009). The qualitative data were typed by a third party in Microsoft *Word* from the digitally recorded observations, as were the handwritten teacher journal writing and a semi-closed, open-ended questioniare. The digitally recorded semi-structured interviews were also transcribed by a third party and the researcher then made regular checks to ascertain whether the data was transribed verbatim in order to ensure credibility (Ary, Jacobs & Razavieh, 2006; Merriam, 2009). The data were then imported into a demonstration version of *MAXQDA*, a qualitative data analysis software package. The qualitative data were then analysed by using pre-determined codes related to the categories of the Likert scale questionnaire mentioned earlier. The main purpose was to ascertain whether the qualitative data corroborated the quantitative findings, whether the qualitative data illuminated aspects that the quantitative data did not, and/or whether the qualitative data suggested new insights (Kelle & Eisenberger, 2004; Flick, 2006, 2007).

Although generalisability in the statistical sense cannot be claimed in this small and exploratory case study, we believe that modest extrapolations which could lead to applicability in other similar, but not necessarily identical, situations are possible (Patton, 2002).

Results

In this section the results are presented by firstly indicating a summary of the overall results as portrayed by the pre- and post Likert scale questionnaire (Table 1). The data were clustered according to decision making, searching, research and reading attitude, knowledge and skills related to composing questions on different cognitive levels, planning, audience, computer skills and design, confidence in using computer as a teaching and learning tool, and reflect and evaluate, motivation and interest, and collaboration. Secondly, each data cluster is then presented by referring to aspects associated with each of the clustered elements from the quantitative Likert scale questionnaire as well as qualitative data that either support or extends the quantitative results.

Regarding the quantitative Likert scale questionnaire, the higher above 0.5 the Cronbach *alpha* value, the higher the reliability of the grouped items is considered to be (Ary et al., 2006). Overall the Cronbach *alpha* (α) scores were high, suggesting that the questions are reliable. The standard deviation (σ) was also determined as it is a measure of the variability or dispersion of a population. A low standard deviation suggests that the data points tend to be very close to the same value, while high standard deviation indicates that the data are spread out over a large range of values (Ary et al., 2006; Gravetter & Walnau, 2002). The data suggest a high standard deviation in this study. Probability (p) values were determined for the grouped items to ascertain whether mean changes were statistically significant or not. The p values are all greater than $p \leq 0.01$ indicating a high degree of statistical significance, and the effect sizes (Cohen's *d* values) are all large (Ary et al., 2006; Gravetter & Walnau, 2002). Despite the small sample (n=26), the data that have been presented in this paper are highly motivated statistically and indicate a significant effect across the sample (see Table 1).

Table 1: The reliability of the pre- and post-intervention questionnaire Cronbach *alpha* scores, mean pre- and post- intervention questionnaire scores, mean gain scores, standard deviations and the statistical (probability) and practical (*d*) significance of the statistical data

Data clustered elements	Cronbach *alpha*		Mean scores				Inferential statistics			
	Pre-α	Post-α	Pre-	Post-	Gain	σ	t value	df	p	Cohen's *d*
Decision making (n=26)	0.58	0.69	2.71	3.57	0.86	0.91	4.83	25	0.000	0.95
Searching, research and reading attitude (n=26)	0.89	0.93	2.88	4.09	1.21	0.68	9.07	25	0.000	1.78
Knowledge and skills related to composing questions on different cognitive levels (n=25)	0.86	0.69	2.53	3.87	1.34	1.07	6.24	24	0.000	1.25
Planning (n=26)	0.90	0.85	2.92	4.13	1.21	0.70	8.86	25	0.000	1.74
Audience (n=26)	0.84	0.77	3.10	4.06	0.96	0.70	6.98	25	0.000	1.37
Computer skills and design (n=24)	0.98	0.93	2.32	3.67	1.35	1.03	6.41	23	0.000	1.31
Confidence in using computer as a teaching and learning tool (n=24)	0.95	0.95	2.12	3.86	1.74	1.12	7.64	23	0.000	1.56
Reflect and evaluate (n=26)	0.88	0.91	3.31	4.21	0.90	0.91	5.05	25	0.000	0.99
Interest (n=26)	0.74	0.74	3.07	3.78	0.70	0.54	6.67	25	0.000	1.31
Collaboration (n=26)	0.92	0.81	3.44	4.05	0.61	0.62	5.00	25	0.000	0.98

In the following sub-sections, the quantitative data and qualitative data are presented in an integrative manner.

Decision making

At the beginning of the project, participants indicated that it was not easy to decide upon a topic for a project, but this increased from 11% to 62% in the pre- and post Likert scale questionnaire (See Appendix A). A similar trend was observed for deciding upon the creation of questions after information was read about a topic (35% in the pre-test and 88% in the post-test indicated that they found this aspect easy). Interview data suggest that decision making was not always easy due to being being in a group where the teachers were not all teaching the same learning area (subject). Teachers had to select with whom they would like to participate in a group, hence some opted to work with familiar colleagues, who were not necessarily teaching in the same learning area. This became evident in interview data when a participant stated, "We didn't choose the topic on my learning area - that is why it was difficult for me." Personal recorded observations resonated with these perceptions as it was noted that initially participants struggled, but that this changed as a result of guidance given by the project facilitator on how to approach this challenge. The questionnaire data corroborated the above with three participants stating that working together with teachers from different grades initially made decision making regarding a topic, and the type of questions to be posed, difficult.

Searching

Initially, searching for information on the Internet was not experienced as easy (this was the participants' first time, hands on experience of the Internet) with only 27% of them indicating that they found it easy. However, this figure increased to 72% in the

post-test (See Appendix A). Interview data highlighted this observation when participants stated:

> In general before having this class … it was not easy to find information because we were lacking a lot of skills … [such as] how to go about browsing. After some two or three lessons then it was much easier and clearer.

> For us it was just not easy to find information because we were lacking a lot of skills such as how to go about browsing. After some two or three lessons then it was much easier and clearer and we were able to browse and explore. So now we could find information anytime even if somebody whispers something in my ear in my sleep I will stand up and go to my computer.

Another aspect noted was that participants did not create keywords to make the searching for information process easier, nor did they find it easy to create keywords for searching purposes. However, the pre-post Likert scale questionnaire highlighted that there were substantial improvements related to creating and using keywords to find information and when using keywords.

The data indicated that initially only 12% knew where to find relevant information for a project, but this increased to 77% at the end of the project. Participants also indicated that when doing projects, they struggled to find good or relevant information on the Internet, as indicated by 12% at the beginning of the intervention. However, the post-test data revealed that there was a positive change to 65%. Interview data supported the notion that finding relevant and useful information on the Internet is not always easy, especially when ICT is new to participants. As one participant stated:

> For us it was just not easy to find information because we were lacking a lot of skills such as how to go about browsing. After some two or three lessons then it was much easier and clearer and we were able to browse and explore. So now we could find information anytime even if somebody whispers something in my ear in my sleep I will stand up and go to my computer.

Search skills involve not only finding information but also ascertaining whether the information is relevant, useful, reliable and truthful. Initially, 42% of the participant indicated that they often question whether information that they have gathered is accurate, reliable and truthful, a figure which increased to 81% by the end of the intervention. Some participants struggled to determine whether the information found was relevant, with some merely looking at the date of publication to determine whether the information was outdated:

> It is not easy to see that the information is correct or not. But if you get it [online information] and then sometimes they [project facilitator] tell you if you look at the document and you scroll down they [the website] usually tell that this information is outdated [by looking at the date on the website] or this information is very old. It is not easy to say this information is relevant.

While searching for information, participants had to do a great deal of reading. Only a small positive increase was noted related to the statement 'I enjoy spending time reading about a wide range of topics related to a project'. Nevertheless some teachers seemed to appreciate reading opportunities, and stated that "It was very exciting to read information from the Internet" and "Using the Internet is like a new world that you are going to."

Knowledge and skills related to composing questions on different cognitive levels

Participants indicated that they did not have enough knowledge on how to formulate questions for higher levels of thinking, one of the main foci of the Extended Cyberhunt strategy. Initially only 15% of the participants indicated in the pre-test that they had enough knowledge to formulate higher order thinking questions, but this figure increased to 73% post intervention (See Appendix A). This change probably can be attributed to the fact that the intervention required participants to pose questions on different cognitive levels related to the content that they had explored, and because they had been provided examples of the different cognitive levels and the associated related verbs in both printed form and as an online web resource [http://www.nmmu.ac.za/cyberhunt/].

Planning

The pre- and post Likert scale questionnaire revealed that the intervention had a significant impact – increases of 40% and more - related to the participants' thinking about personal goal setting, the benefit of goal setting for learners by learners, and the achieving of goals set for themselves (See Appendix A). Journal entries revealed that as the Cyberhunt project continued, the teachers spent more time on the goal setting aspects of the project. This may possibly be attributed to the project facilitator having focused continually on this aspect. Journal entries revealed that the participants did not particularly enjoy completing their journals, although they stated that it had significant value and enabled them to set goals for various aspects of their work. The journals provided an opportunity for participants to set goals and to reflect on whether they had achieved the goals that they had set for each session. The journals also contained a section where participants had to state how they planned to finish their Cyberhunt projects on time. This enabled them to regularly reflect upon this aspect, which resulted in responses such as preparing questions in advance, collaborating more, learning from mistakes, searching differently for information, working on typing skills, etc.

The pre- and post-tests also reveal that there were positive increases related to skills pertaining to planning, planning for projects, thinking about what can be done to finish on time with projects, and discussing what each person should do in their respective groups. These data were corroborated by the journal data. Interview data also supported these notions as participants noted "I think it [the journal] puts us on the right path in that you know what you want to achieve at the end of the day" and another one concurred when saying "Ja [Yes], from my point of view they [the journals] were helpful, because I managed to reflect on what I did so that my facilitator can see where I struggle, so that in the next session he will be able to help." At the same time, one participant noted that the journals also had value for the project facilitator, as the responses could be used to determine with which areas in which they had struggled. One teacher noted that using the journal to set goals was not always a comfortable process, because it revealed when one was not reaching one's goals. In her words:

> Sometimes you know what you want and you set goals for that, then you realise that you have done some of them but not the way you wanted to. So it means you did not reach your goal and it frustrates you. You are reminded again that you have to go back. It is uncomfortable to write it down, you know.

However, she immediately added that she felt that journal writing had value by stating "It does have a positive, because you also started to have a direction with your goal. It does help you to focus."

The notion of catering for an audience

The data from the pre- and post Likert scale questionnaire suggest participants became more aware of the prospective audience for whom they were designing their Extended Cyberhunts. They indicated at the end of the intervention that they found it easier to present their ideas to other people than before. In addition, there was also a 50% increase related to presenting information in such a manner that people would easily understand what their project is about (see Appendix A). Data from the questionnaire suggest the participants thought about their audience while they were working in their groups, but also added that they thought about the level of their learners (audience) for whom they were designing. Journal data also supported the notion of thinking about audience or prospective users, as the teachers stated that they were thinking about posing relevant questions (mentioned 13 times) which will be appropriate for their learners, the level of their learners (mentioned 27 times), and also how to create interest (mentioned 9 times).

Computer skills

The pre- and post-test data indicate that participants became more comfortable using the computer, as initially only 29% indicated they found it easy to use, a figure that increased to 92% at the end of the intervention (see Appendix A). There was also a 45% increase related to having the skills to use the computer effectively as well as having the necessary skills to help learners who have difficulty. Interview data highlighted the fact that the participants had learned a great deal during the intervention:

> In fact when I came here I didn't know anything about computers, but as time goes on I became an expert myself. I learned the following: word program [Microsoft *Word*], Internet, saving information, and searching for information.

Another teacher concurred when she stated "I learned computer basics because when I come here it was my first time to use a computer." Journal data concerning help received from either their peers or the facilitator revealed that participants had learned basic computer skills such as copy, paste and fonts; Internet skills; typing skills; Cyberhunt design process; saving information and finding saved information; and finding and inserting pictures from the web. The journal data also revealed that they felt that they became more competent as, towards the end of the intervention, they wrote comments such as "Today things were easy I am becoming competent now"; "[No problems] Nothing so far I am slowly getting there"; and "Not at all [No Problems] at least everything was fine. I did not struggle that much as before."

Confidence when using the computer as a teaching and learning tool

The pre- and post-test data indicate that confidence levels in using computers as teaching and learning tools showed a significant increase, from 17% to 75% (see Appendix A). Initially, only 8% of the participants indicated that they had adequate knowledge about using computers in their classroom for teaching and learning, but this figure increased by 67% by the end of the project. Similar trends were found related to confidence in managing learning within the ICT classroom, and being

confident to provide appropriate feedback to their learners. Questionnaire data highlighted that participants were aware that Extended Cyberhunts would require a different approach to the traditional "chalk and talk", and that the new approach would require learners to get information quickly and independently.

Reflection

The Likert scale questionnaire data indicated that 77% of the participants had used feedback from their fellow participants to improve their Cyberhunt projects, and that this feedback had assisted them to provide useful feedback to other participants when it was required (see Appendix A). They also indicated that they reflected a great deal about what others might think about their project, and there was a large increase for the item concerning the making of changes to Cyberhunt projects in order to make them more attractive/ appealing. More than 80% indicated at the end of the project that they would recommend the use of journal or reflection sheets for learners and teachers during projects.

Interview data revealed that participants highlighted the importance that their journals sheets had to be returned to them at the beginning of each new session in order to review their previous goals. The participants also stated that the journal reflection sheets provided opportunities for the facilitator to determine where they needed assistance. A teacher mentioned that:

> They [journal reflection sheets] are of value, because it is very important to the participant to know in order to repeat what you [the participant] left out in the past lecture.

He added:

> It is important for me, because the instructor is trying to make me understand ... [so when I have a problem, I can indicate the problem in the journal] and [then the project facilitator can] explain clearly that particular question that I do not understand.

Interest and empowerment

Overall, the questionnaire data suggest that participants responded very positively to the following statements: 'Doing projects helps me to learn in an interesting way' (increase from 54% to 81%), 'I like to work on projects' (increase from 50% to 76%) and a similar trend (an increase from 54% to 77%) was noticed from 'I really enjoy projects as a way of learning about a subject' (Appendix A). It seems therefore appropriate to make the claim that doing and working on projects was experienced in a more positive light as a result of participating in the Cyberhunt design project. Questionnaire data provided reasons as to why there was a positive gain related to interest and motivation - teachers felt that being part of the project made them feel empowered, that they were able to realise a goal, they felt that they have achieved a dream (using computers and the Internet), they learned new skills, they saw it as a new way of teaching and learning that links theory with practice, they experienced a sense of competence, it opened new possibilities and different ways of thinking, the design process developed creativity, they were able to find interesting information, they felt they had some control over what they wanted to do, and lastly the presentational style of the training sessions was motivational.

The data suggest that the 'Learning-as-design' tool context in which the computer, Internet and reflective journals were used was experienced as positive, and the teachers noted differences between their traditional way of teacher-centred teaching and the learner-centred Cyberhunt context.

The different rules and the division of labour (also referred to as 'roles') that this intervention require, seem also to have been playing a positive role, as the learning context was experienced as different from the traditional teaching and learning context to which the participants were accustomed. This became evident when participants stated during interviews that what they liked and what was interesting to them during the project, was the fact that children become more independent thinkers, the classroom context is different, as is the role of the teacher – the teacher becomes a facilitator, suggesting that they experienced the learning as more relevant within a context with which they can relate well to. The above become evident when participants stated:

> In class the learners have to listen to what you are telling them to do but during Cyberhunts they are actively involved in their learning. So there is a difference between those two classrooms, teaching and the Cyberhunt.

> In normal class you are just told what to do, but in Cyberhunts you go to the computer and search … using the computer it is really different from a normal class.

In addition, the use of capable peers as co-facilitators, i.e. participants who started to assist participants in other groups due to the fact that they became confident, seems also to have a positive impact, as participants were free to ask any person for assistance. Hence, this was different from the traditional 'teacher-in-charge' classroom where the teacher is active and the learners are passive, i.e. the division of labour was different from the traditional learning context.

> You ask the person sitting next to you. If he doesn't know you ask the other group and all the time they are willing to help you. The one [peer-facilitators] who knows is always willing to help some of them [who struggled], they [peer-facilitators] even stand up and go around.

The above suggests that the division of labour within the learning context provided opportunities for participants to have some control over their learning, for example who to ask for assistance and at what point in time. Similarly, journal data seem to concur, as participants responded that they asked the peer-facilitators for assistance when the facilitator could not assist them immediately:

> I do ask Teacher C [peer facilitator] because I've noticed that he has got more knowledge about this.

> Teacher Z [peer facilitator] has experience in working with computers as she is teaching computers in her school.

Participants also felt empowered by being part of this intervention. This became evident in the words of one female participant when she mentioned during an interview:

> I have learned a skill that nobody will take from me. It's just like learning how to drive a car. I learned to work with others, move, help and discover information for myself.

Collaboration

Data from the questionnaire reveal a positive increase of 30% on average related to asking other participants for assistance - not only from their own groups, but also asking for assistance from other groups (Appendix A). The participants felt comfortable asking either their peers or the facilitator for assistance and, by the end of the intervention, felt positive about working in groups. Interview data supported findings, for example:

> When working in a group, I ask the fellow group members and if they don't understand, I ask the facilitator because if you carry on without understanding you won't complete your work and you must do it correctly.

> You ask the person sitting next to you. If he doesn't know you ask the other group and all the time they are willing to help you. The one [peer-facilitators] who knows is always willing to help some of them [who struggled], they [peer-facilitators] even stand up and go around.

Reasons why they felt comfortable asking their peers for assistance were that they could relate to their friends in their group, the facilitator did not always explain to them in a manner that they understood [their mother tongue is Xhosa, the facilitator's English], group members explained in a clearer manner and group members understood them better. Other responses from the semi-closed, open-ended questionnaire suggested that collaborative work was valuable as it assisted with sharing of knowledge among one another, "In a group there is always someone who would know things that you don't know" and another participant added "You can easy get to know the concept from other group members. One contributes with what you know." Journal data concurred when, for example, one participant wrote, "I gain more knowledge from group work" and another one stated, "It's exciting because we share the knowledge."

In addition, participants suggested in the semi-closed, open-ended questionnaire that collaboration made the learning process easier, for example, "It is more easier and I get help where I stuck so I find it interesting and communicable." This also became evident from the journal data when participants mentioned, "It makes things easier" and "Work became easier than being alone. You get help from the group." The hands on, collaborative training and learning also assisted with personal first hand experience or trialability, "Working in the groups gave me an understanding of what to expect when working with the learners at school". In addition, working in groups helped to create a feeling of confidence, "I would participate because I will have more confidence about the Cyberhunt" and another participant concurred when he indicated in the semi-closed, open-ended questionnaire "They [peers] are willing to assist and the groups are encouraging." Journal data entries supported these perspectives, for example one participant stated that working collaboratively within groups led to "Confidence".

Discussion

The quantitative and qualitative data suggest that the subjects (digital immigrants, i.e. teachers as learners) of this intervention achieved the specified objectives, as indicated in the activity theory triangle (Figure 2). Although the sample was small (n =26 for quantitative Likert scale questionnaires), statistical analyses revealed statistically

significant gains in developing each teacher's decision making, searching skills, ability to compose questions on different cognitive levels, planning ability, notion of audience, computer skills, confidence, reflective ability, interest, and collaboration skills. The findings affirm the research claims that a collaborative ICT learning as design context affords opportunities to develop complex mental attributes such as research skills, presentation skills and reflection skills (Lehrer et al., 1992; Lehrer, 1993; Lehrer et al., 1994; Liu, 2003; Du Plessis, 2004), increased self-esteem and confidence (McGrath et al., 1997), ownership (Lehrer, 1993; Du Plessis, 2004; 2010) as well as a greater awareness of audience (Liu, 2003; Du Plessis, 2004, 2010; Beichner, 1994). Furthermore, the data corroborate the findings that a design approach has the ability to create interest and to work collaboratively in a positive manner (Lehrer, 1993; Liu, 1998; Du Plessis, 2004, 2010).

An activity theory lens combined with theoretical perspectives from motivational theory was used in order to ascertain possible reasons as to why the participants experienced this intervention as positive, and to try to provide reasons why there was such a positive change from the pre- and post Likert scale questionnaire results with reference to above-mentioned skills. With reference to motivational theory (Keller, 1983; Malone & Lepper, 1987), the positive impact could be attributed to the elements of challenge, competence, relevance, choice and voice, aspects that have the potential to enhance learning (Keller, 1983; Malone & Lepper, 1987), as suggested by the data in the interest section. Using an activity theory lens, the data suggest that using the computer and Internet as mediating tools, have allowed the participants to experience contradictions between the traditional context characterised by the text-book, chalk board and 'teacher chalk-and-talk', and the 'Learning-as-design' context characterised by the computer, the Internet as a tool and reflection sheets, as suggested by the data in the 'Interest' sub-section within the 'Results' section. Participants frequently indicated that they experienced the learning process and the tools being used as different to their traditional experiences, hence the strong articulation of how the Extended Cyberhunt context contradicts the traditional text-book, chalk board and 'teacher chalk-and-talk' context. The rules and the division of labour (Murphy & Rodriguez-Manzanares, 2008; Hardman, 2005a, 2005b) were experienced as different, as participants indicated that they were not confined to one place, but could move around, ask questions and were assisted by peer-facilitators from other groups, not just from the facilitator. This became evident in the interest and collaborative results section, as the data suggest the formation of a sense of community (see Activity Theory triangle, Figure 1) as a result of the sharing of ideas, asking for assistance, by listening to problems that were experienced, i.e. active learning in a community.

It seems that there was interplay between the rules and division of labour, assisting with the development of a community of learners (see Figure 1). This inference is based upon the fact that the data suggest that knowledge and skills transfer had occurred as a result of cognitive apprenticeship, i.e. more capable peers assisting one another in their own groups as well capable peers who started to assist participants within other groups (Brown, et al., 1989) and that knowledge generation occurred when participants had opportunities to make their tacit understandings explicit (Nonaka, 1994; Nonaka & Takeuchi, 1995). The sharing of ideas, asking for assistance, the listening to one another's problems as well as the critical reflection through journal writing also seem to suggest that transformative learning had taken place (Mezirow, 1997; McGonigal, 2005), as participants indicated that they had experienced a new perspective of learning during this intervention.

We therefore argue from an activity theory perspective that the unmediated functioning at the base of the triangle (See Figure 1) through the division of labour and the negotiation of rules – which were experienced as different from the traditional context, as well as the development of a learning community - assisted with the establishment and creation of a milieu contributive to learning (Du Plessis & Webb, 2008; Du Plessis, 2010). The data revealed that outcomes related to motivation and interest, collaboration, decision making, searching skills, ability to compose questions on different cognitive levels, planning ability, notion of audience, computer skills, confidence and reflective ability showed positive increases from the pre- and post-Likert scale questionnaires. Hence, it is argued that the 'learning-as-design' Extended Cyberhunt strategy that made use of computers, the Internet and journal writing as mediated tools enabled the teachers to participate in an exciting and fruitful learning experience within the unmediated functioning of the rules, roles and community. Hence, we are of the opinion that the positive increases in the above stated outcomes probably could be attributed to the interactions between Vygotsky's (1978) unmediated and mediated functioning, i.e. the interactions between the higher order mediated elements (language, computer, Internet and other ICTs, as well as the journals) and the unmediated tools (rules, community and division of labour) at the base of the triangle (Du Plessis & Webb, 2008; Du Plessis, 2010).

Conclusion

The findings of this study suggest that the Extended Cyberhunt strategy, where school learners (or even university or college students and teachers) are the designers of their own Cyberhunts and develop questions at different cognitive levels of Bloom's *Taxonomy*, has the potential to address a number of desired educational outcomes. In addition, it appears that the learning as design context made the participants aware of the contradictions that are associated with the traditional teaching context (Figure 1), and aware of the positive possibilities that a different ICT related strategy may provide for learning.

While we are aware that many alternative approaches exist that could be just as suitable to address these outcomes and associated 21st century skills, we are of the opinion that this particular strategy is worth disseminating for further testing as a fruitful extension of WebQuests and other existing Internet based approaches (Du Plessis, 2010; Du Plessis & Webb, 2011). We suggest that further research focusing on the use of the Extended Cyberhunt strategy at primary school, high school and university or college level will contribute meaningfully to the debate around technology based learning and support or refute our claims. However, in doing so we must highlight the caveat that the implementation of ICT related strategies cannot be a once-off event, and that the participants need different levels of support and training (professional ICT teacher development), usually in a structured manner, to achieve the confidence and competence required to use new ICT strategies successfully.

Appendices

Appendices A-D are contained in the accompanying file 'duplessis-appendices.pdf', URL http://www.ascilite.org.au/ajet/ajet28/duplessis-appendices.pdf

Appendix A: Pre- and post Likert scale results
Appendix B: Weekly journal sheets

Appendix C: Samples of open ended questionnaire questions
Appendix D: Sample of interview questions

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