

An African Research Agenda for Computers in Education

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Abstract: This article presents an overview of research into computers and education undertaken at the University of Pretoria since 1995. It seeks to explore the patterns that have emerged and to indicate potential directions for future research. In response to a call for research in the field to be taken seriously the article identifies the main themes that have been researched over fifteen years. The analysis shows that the main themes addressed are “Didactic/Pedagogical Issues and Teaching/Learning Strategies” and “Architectures for Educational Technology Systems”. Finally the paper recommends the development of a taxonomy of terms to be used in the classification of research on e-Learning.

Keywords: Didactics; Pedagogy; Teaching/Learning Strategies; Architectures for Educational Technology Systems

1. Introduction

This article responds to Simsek's (2005) research into *Perceptions and Opinions of Educational Technologists Related to Educational Technology* and the suggestion that “findings related to the issue of associating the field of educational technology with specific subject areas in international area can provide various perspectives to those who are performing their careers in the field of educational technology” (Simsek, 2005, p.181). The research reported here classified the keywords used by graduate students at the University of Pretoria from 1995 to 2010. The canon of reported research that forms the basis of this article consists of masters' theses and half-theses, as well as doctoral dissertations prepared under the supervision or co-supervision of the author. The aim of the article is to explore the patterns that have emerged over the past fifteen years and to consider how these patterns constitute a research agenda. This article is the first step in an attempt to take a serious look at the way in which a particular longitudinal cohort of students has been researching the field. This article is intended to present to the readers of this journal a brief summary of work that may resonate with their own research.

The main question driving this study is “What research agenda, in terms of educational technology and e-Learning, has emerged at the University over a period of fifteen years? This question was refined by two sub-questions:

- How can the keywords extracted from 15 years of research be classified into distinct categories regarding educational technology and e-Learning?
- What is the range of themes that were investigated by the students under each category?

The rationale for this research is that it should contribute to our understanding of the field of e-Learning by presenting the research agenda of a select group of students in an over-arching design research context, while at the same time resonating with the special issue on “Grand challenges and Research Directions in e-Learning of the 21st Century (*Educational Technology & Society* 16(2)).

The research falls into what Tom Reeves calls the product of “isolated researchers, most often doctoral students and new faculty members, who conduct individual studies that are rarely linked to a robust research agenda” (Reeves, 2001, p.4). Traditionally in the South African university system a student is assigned a single supervisor or advisor, rather than an advisory committee as is done in the USA. Students are by the head of the academic department. In the cases described here most students were recruited by the supervisor who then requested the departmental head to assign them, or the students requested the head to assign the particular supervisor. Students usually have a free choice of their topic, or negotiate the topic with the

supervisor, so a pre-determined research agenda is hard to achieve. This article thus is an *ex post facto* attempt at extracting a research agenda to see what the implicit connecting threads may have been, so that a more robust research agenda might be suggested.

2. Conceptual framework

This research is inspired by Reeves’s (2001) explanation of socially responsible research, as well as Reeves, Herrington & Oliver’s (2005) description of design research. For research to be socially responsible, it needs to be concerned with both a search for understanding, and with usefulness (Stokes, 1997 – see Figure 1).

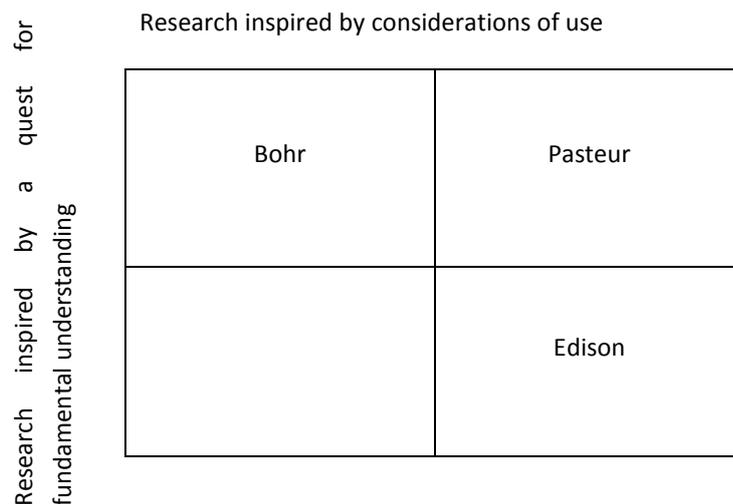


Figure 1 Pasteur’s quadrant – Stokes, 1997

For Reeves, Herrington & Oliver “...at some level, all instructional technology research can be said to focus on questions of how people learn and perform, especially with respect to how learning and performance are influenced, supported, or perhaps even caused by technology” (2005, p. 100-101). They further identify the following six characteristics of design research:

- A focus on broad-based, complex problems critical to higher education, focus on broad-based, complex problems critical to higher education,
- The integration of known and hypothetical design principles with technological affordances to render plausible solutions to these complex problems,
- Rigorous and reflective inquiry to test and refine innovative learning environments as well as to reveal new design principles,
- Long-term engagement involving continual refinement of protocols and questions,
- Intensive collaboration among researchers and practitioners, and
- A commitment to theory construction and explanation while solving real-world problems.

(Reeves et al., 2005, p. 103)

3. Method

This article is a subjective reflection on research done in a rapidly-changing field. As such it falls into Reeves’s (2001) postmodern paradigm. The research aim was to explore rather than to describe. It is hoped that the topography that emerges may be useful for future researchers to develop an understanding of the emerging themes that are uncovered from this exploration. The author’s role in this research is that of a reflective practitioner, reflecting upon the outcome of research supervision over a number of years. As such the author

acknowledges his position as a source of bias. Nevertheless, the goal is not to defend any position the outcome of the research does not affect the author in any way. A further potential limitation of this research is that it covers a limited cohort all supervised, or co-supervised by the same person. Once again, this is no different from teacher-researcher who would research the response of an undergraduate class that they may have taught.

The research procedure was to do a search through the University's digital library for half theses, theses and dissertations in the field of Educational Technology. Once that was done the keywords and abstracts were copied into a spreadsheet to enable further classification. Two different methods were used to answer the two sub-questions.

To answer the first question, "how can the keywords extracted from classified into distinct categories regarding educational technology and e-Learning?" the 525 keywords supplied by the students in their theses and dissertations were sorted alphabetically and grouped into 21 groups of similar themes.

Firstly the students did not assign the same number of keywords each. Some students assigned three, others as many as seven. The unequal distribution of keywords meant that the picture that was being coloured in, was the set of themes rather than the actual studies conducted by the students. The unit of analysis, in other words, is the keyword, not the thesis or dissertation. Essentially the question says, given an unlimited choice of number of keywords, what keywords were selected, and how can these keywords be grouped?

Secondly, the students could use any keywords they liked, which meant that the keywords did not necessarily line up with any pre-determined code book. The matter was further complicated by relatively neutral words such as "Internet", "computers" or "technology". These words were put under the closest corresponding theme. "Internet" went to "Web-based Instruction", while "computers" were classified under "Interactive learning environments". In cases where it was hard to decide where best to put a certain word the abstract of the thesis was consulted. A second round of coding took place where topics with fewer than 35 assigned keywords were removed and the keywords were reassigned to the next closest theme. It must be stressed here that the purpose of the exercise was to identify a number of themes, and not to develop a quantitative match of keywords and topics. Once the categories were identified the second sub-question could be attempted.

The second question, "What is the range of themes that were investigated by the students under each category?" was answered by considering the titles and abstracts of all the theses and dissertations and then through reflection determining which of these studies represented a salient point in the research journey of the cohort. These works were then classified under the various categories and some logical pattern was determined. A problem that occurred here was that most of the theses or dissertations spanned a number of categories. For instance, the doctoral thesis of Willie Cilliers (1999) is entitled: *An experiential learning process for the advancement of previously disadvantaged employees in an industrial context*. This thesis touches on three topics, *Learning by doing*, *Cultural Issues in Educational System development* and *Methodologies for Development of Educational Technology Systems*. In this case the thesis is discussed under each topic. In other cases though, only the main thrust of the thesis was classified.

4. Discussion

4.1 How can the keywords extracted from 15 years of research be classified into distinct categories regarding educational technology and e-Learning?

The synthesis of the student keywords into nine topics is shown in Figure 2.

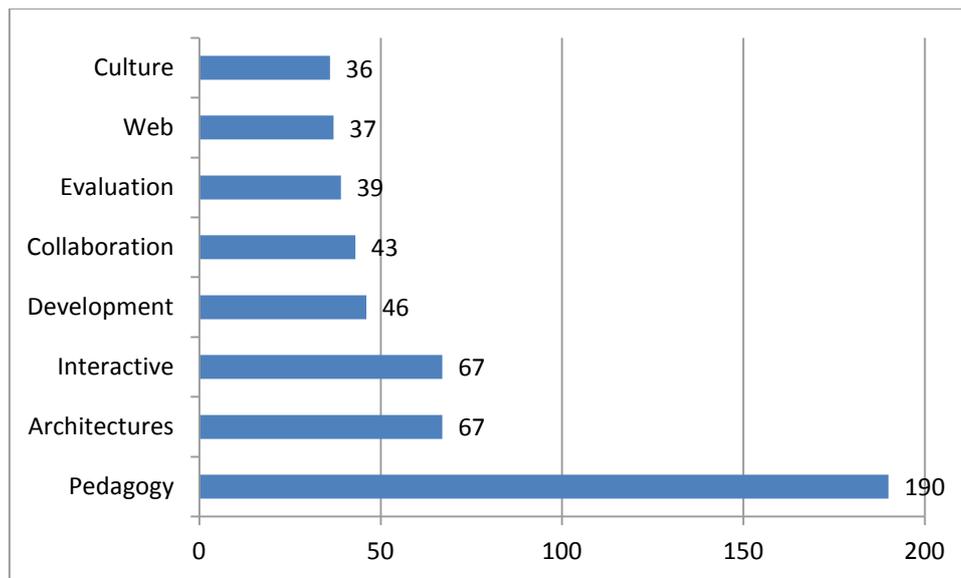


Figure 2 Classification of themes

The eight themes, represented in Figure 2, shows an initial attempt at the extraction of a research agenda in terms of the keywords supplied by the students. The main items on the agenda are, in reverse order:

- Cultural Issues (36)
- Web Based teaching and learning (37)
- Evaluation (39)
- Cooperative/Collaborative Learning (43)
- Development of e-Learning Systems (46)
- Interactive Learning Environments (67)
- Architectures of e-Learning systems (67)
- Pedagogical Issues and Teaching/Learning Strategies (190)

4.2 What is the range of themes that were investigated by the students under each category?

The following eight sections will be devoted to a qualitative discussion of the type of research done by students of the University over the past fifteen years, as it relates to the eight topics identified above.

4.2.1 Cultural Issues

Within the context of globalisation in education, spurred on by the growth of Internet-based education, and given the multi-cultural nature of South Africa and its position as a meeting point of well-resourced and under-resourced learners it is clear why cultural issues would play a very important role. A number of studies considered the role of the Internet in crossing either cultural or financial divides (De Swardt 2010, Mbambo 2002, Giladi, 2004, Cossa, 2002, Reynolds 2005). There were also a number of country-specific, or even province or region-specific studies (Steyn, 2004, Thomas 2006, Alexander 2005) as well as studies that considered the development of a unique Internet-based culture that is independent of the learner's home culture (Meyer (salome) 2005, Du Plessis, 2006, Clarke, 1998)

4.2.2 Web Based teaching and learning

At least 14 keywords in this topic contain the word *web* in some way or another, while the word *Internet* appears 10 times and *online* eight times. Nevertheless not all the keywords with *web* in them were included here. *Web Development*, for instance, was classified under *Methodologies for Development of Educational Technology Systems* while *WebCT* went to *Architectures for Educational Technology Systems*. Other terms include distance education and distributed students. Perhaps the most interesting study in this category was that of Gabrielle De Villiers (De Villiers 2001) who investigated the use of the Internet for university students as well as school learners, both as a classroom resource or as a stand-alone classroom, in the field of hard sciences and the humanities. Her thesis ends with an impressive table in which she integrates what was learnt from all these different combinations. Another noteworthy project was a joint effort by three PhD students to investigate what happens when one plays learning games with a group of students over the Internet. Van Ryneveld (2005) investigated the role of the game metaphor, while Adendorff (2004) considered the activities of an online facilitator and Meyer (2005) wanted to understand why online learners would support one another, even in a competitive environment. Nagel (2008) followed up on this study a year or two later with an investigation into learner participation in an online environment.

At a subject-specific level Carr (2002) investigated the usefulness of the Internet as a resource for Mathematics teaching in a face-to-face foundation course, while Coetzee (Helene 2000) and Mbambo (2002) considered the use of the Internet for small, medium and micro industries in dairy farming and textile manufacture respectively. Van Eeden (2002) on the other hand, considered the use of Web-based training at a multi-national corporation.

4.2.3 Evaluation

The keywords that were classified under evaluation included those of assessment of learner performance, as a subset of the evaluation of learning interventions or systems. Arguably the most comprehensive text in this category was an exploratory study by Fresen (2005) on *Quality assurance practice in online (web-supported) learning in higher education*. De Jager (2003) focused on "An integrated and holistic approach to assessment in outcome-based learning in South Africa". An even more focused study was conducted by Marks (2008) who considered the effect of randomisation of multiple-choice items on the performance of test takers.

Two major evaluations took place of interactive learning environments, (Cronje 2008, Thomas (K) (2006) but these will be discussed under that heading.

4.2.4 Cooperative/Collaborative Learning

Given South Africa's position as an emerging economy, and given the relatively high cost of technology it is not surprising that cooperative or collaborative learning was viewed as a way to increase the efficiency of use of a scarce resource. Nevertheless much of the research done on learning together focused on the social and pedagogical benefits of this mode of learning, rather than on the cost saving. In fact, there have been no studies that focused on economic considerations at all. Rahimi (2010) mentioned earlier, considered the value of peer tutoring. One of the earlier studies that focused primarily on cooperative, constructivist learning at school level was Seekola (1996), while Viljoen (2003) investigated a school where the regular timetable was suspended in favour of a "theme day" where they integrated computers, cooperative learning and constructivism across the curriculum by organising academic "theme days".

The research, however, was not limited to classroom situations. The Web-based gaming project of Adendorff (2004), Meyer (2005) and Van Ryneveld (2005) as well as the work of Nagel (2008) are examples of learning communities at Masters' level, while Mc Kay (2008) created a virtual community of practice consisting of high-school teachers who supported one another in the improvement of their teaching practice.

4.2.5 Development of e-Learning Systems

The key to the assignment of keywords to this category was the so-called "ADDIE" model of Educational Technology systems development. Addie stands for *Analysis, Design, Development, Implementation* and *Evaluation*. Since *Evaluation* is a free-standing topic in this article only the first four elements were considered. The keywords in this category range from the development of learning events using technology, online learning resources to full-on learning packages. On the other hand the keywords talk to the implementation of technological solutions into classrooms, schools, districts, corporations or even countries.

For her doctoral research Janse van Rensburg (1999), led a major research project that investigated the appropriateness of computer-integrated learning of mathematics for disadvantaged learners. Three Masters' students contributed. Oosthuizen (1996) investigated the use of shareware and freeware drills and games. Moolman (1996) considered the use of spreadsheets, and Rootman (1996) developed a fully-fledged interactive adventure game in which learners had to solve mathematics problems before moving on to the next stage.

The use of existing software was studied inter alia by Moila (2007) at primary school level, Molotsi (2008) secondary, and Xakaza (2007) and Lamprecht (2002) at university. Ilse du Preez (1999) investigated the use of databases in a primary school, De Jager (Masters) 1997 at high school and Van Harmelen (1997) at university. Gerrit Wissing (1998) wrote a program for Sunday school learners. Johann Fouche (1995) developed a multimedia tutorial to teach basic principles of electricity at high school, while Steyn, Adolf (1997) developed a companion game. Bothma (2007) developed a virtual community-based interactive working space.

Then there were those who studied the implementation of an entire system into a classroom, district or even corporation. Morgan (2001) investigated the implementation of computers in a school. Pam Miller (1997) developed a taxonomy of implementation of computers into high schools, while Herbert Thomas (2006) did a retrospective evaluation of the implementation into schools in an education district ten years after the project had been terminated.

Cossa (2002) investigated the introduction of computers into schools in Mozambique, Mkansi (2004) and Addo (2002) considered the training of teachers during an implementation at district and provincial levels respectively. Meyer (Masters) (2000) did a literature survey about the implications of educational technology for higher education. Lazenby (2000) described the process of implementing a virtual campus at a university, while Korpel (2004) and Cilliers (1999) investigated the implications of elearning in the corporate sector.

4.2.6 Interactive Learning Environments

This category can be distinguished from the previous one in that it is the actual functioning of the learning environment that is being studied rather than its development. Although there are quite a number of keywords represented here, there are relatively few research projects of which this topic was the main thrust. Research in this area was concerned mainly with determining what happens during the use of such an environment. Ackermann (2004) for instance, in the teaching of histology to medical students, investigated the feasibility of replacing a traditional microscope with *PowerPoint* slides. Cloete (2002) developed a training resource for the in-service training of library cataloguers.

The first study to investigate the nature of interactivity was by Clarke (1998). She did an analysis of the messages sent by students during a web-based course that was done using HTML coding and an automated mailing list, rather than a dedicated learning management system. Her research pre-dates the availability of WebCT. Pienaar (1998) developed a web portal for academics, and Bothma for information specialists.

The suitability of two learning platforms, *Blackboard* and *Moodle* was investigated by Thomas K (2006) and Cronje (2008) respectively.

4.2.7 Architectures of e-Learning Systems

Although this category accounts for the second-most number of keywords very few theses or dissertations had it as the main thrust. What follows instead is a breakdown of eight issues that were discussed across the various theses and dissertations, as they were distilled from the keywords. The first issue under discussion was the use or not of open source software and open courseware. In the context of a developing country the costs involved in the purchase of proprietary software has to be measured against the cost of in-house development. Secondly the researchers discussed the attributes of media – be it text, images, animation, video or audio. The third major theme concerned delivery mechanisms, which ranged from free-access Internet kiosks, computer laboratories, mobile devices such as laptops and tablets, all the way to mobile phones. Then there was discussion around the actual delivery channel, be it direct emails, mailing lists or “listservs”, chat rooms, bulletin boards, blogs, and static websites.

The fifth topic regarded timeframes – synchronous or asynchronous, and the appropriateness of each. Then followed a theme that we will call didactic orientation under which the term *blended learning* will resort. In essence what was discussed here was the nature of mediation, administration or facilitation of learning, and whether the aim was direct instruction or resource-based learning. Under direct instruction the most popular keyword was *elearning*. *Elearning* comprised course management systems, as well as tutorials, drills, simulations and games. The degree of fidelity, from text to virtual reality also played a role. Under resource-based learning came digital artefacts, digital libraries, information portals, online information services, inquiry tools, digital research environments, as well as information and knowledge management.

4.2.8 Pedagogical Issues and Teaching/Learning Strategies

Since the main thrust of the research was educational, rather than technological it is not surprising that the majority of keywords fell under this topic. Moreover, as was the case with the previous topic the keywords are generic and cut across various theses and dissertations. Three major divisions can be identified, *age groups*, *subject specific applications* and *general pedagogy*. The age groups could be classified from pre-school, primary school, high school, tertiary education and corporate training. Subject-specific applications included mathematics, physical science and chemistry, geography, languages (first, second and foreign) as well as a number of university-specific courses such as histology, anatomy, nursing, agriculture, and finally some work-place related issues such as computer skills, HIV and AIDS, marketing, information skills and teacher professional development.

By far the majority of the keywords in this section, however, concerned general issues of teaching and learning using technology. These were classified into eight sub-categories.

4.3 Learning and instructional theory

The Masters’ course in Computer-integrated education that formed the foundation for most of the theses and dissertations that are analysed here was started in 1992. It then comes as no surprise that the rise of popularity of constructivism is quite evident. This is amplified by the fact that, in response to changing educational needs, the South African Government after 1994 embarked on a major programme of educational reform, that included the development of a new curriculum with strong emphasis on outcomes-based education and constructivist pedagogy. Nevertheless there were a number of studies that were still very much interested in the place of drill and practice within the context of outcomes-based education.

A very comprehensive study was undertaken by De Villiers (Ruth PhD) (2002) on *The dynamics of theory and practice in instructional systems design*, in which she developed a meta-model of six concepts or pedagogical dimensions to be considered in investigating pedagogical issues.

4.4 Behaviourism, Cognitive learning, Constructivism

Herselman (1999) considered the use of computer-based drill and practice games in second-language English teaching within the context of outcomes-based constructivist education.

Seekola, (1996) studied the use of cooperative learning from a cognitive perspective. De Jager (M.Ed) (1997) investigated the use of a constructivist paradigm in teaching high school chemistry while Strehler, (2008) investigated the relationship between cognitive style, cognitive load and animations in a multimedia context. Under Strehler's guidance, Smith, (2008) *Factors in the measurement of cognitive load of multimedia learning*. Nordhoff (2002) investigated *(T)he design and implementation of a computer-based course using Merrill's model of instructional design*.

An important development in this time was an investigation into the relationship between constructivism and behaviourism as complementary, rather than opposing theories. This research followed the publication of a position piece by the author (Kussumua 2007) which argued that constructivist and instructivist characteristics of a learning event should be plotted at right angles, thus producing four quadrants, (Instruction, integration, chaos and construction). Two theses investigated the feasibility of such an idea, Burger (2006) and Kruger (2003).

4.5 Learning by doing

Authentic tasks, situated cognition and practice-based experiential learning have always been key drivers in the ethos of the masters' and doctoral programme in Computer-Integrated Education at the University. The coursework preceding the half-dissertations, as well as the suggested readings and compulsory seminars for the research-based masters' and doctoral programme have always modelled the process of learning by doing. It is therefore not surprising that students, in their research projects, would have explored the possibilities of computers in real or simulated situations. Many students entered the programme with a research project already in mind these were often related to business-performance, organizational learning or related problems that they experienced at work (Cilliers, 1999, Broos 2008, Fresen 2005, Steyn 2002). Added to this there has also been an interest in the autodidactic nature of computer skills. Research that may be highlighted include a number of investigations into the "Digital Doorway" (Herselman 1999) project of the Meraka Institute where computers were made available in disadvantaged communities and users were allowed to experiment with minimal invasion (Furstenburg 2005, Author & Burger 2006). A doctoral thesis also investigated the extent to which first-year students at a University in a disadvantaged community were able to make themselves computer literate through trial and error and spontaneous peer tutoring. (Rahimi 2010).

4.6 Effective and Conative factors

Rauscher (2005) made an analysis of email messages sent during an online course, and classified these according to various levels of Krathwohl's taxonomy of the affective domain. Steyn (2002) investigated Csikszentmihalyi's "Flow" theory and its effect on the motivation of knowledge workers. Wissing (1998) investigated the development of moral values through a tutorial programme for pre-schoolers.

As a part of her investigation into the introduction of computers into a middle-class suburban high school, Miller (1997) investigated the inhibiting role of computer anxiety.

The role of motivation, both intrinsic and extrinsic was covered in a large number of theses, as sub-sets of the main research problem more notably Labuschagne (2003) and Meyer (Salome Masters) (2000).

Meyer's doctoral study was chiefly concerned with affective considerations and their contribution to the retention of online learners. Much has been written about why students drop out of online learning, but very little about why they stay. In a thesis entitled *The conative aspects of elearning* Helena Schoeman asked students to describe that moment when they gave up on their studies, but took it up again. Then she asked "Why". In the process elements such as intelligence, volition, internal drive, self regulation, self-efficacy and support were identified.

4.7 Curriculum

Investigations into Curriculum dealt with the integration of computers into the curriculum (De Jager (PHD 2003), and Adendorff (Debbie Masters 2004); the development of curricula for online learning (Eduardo 2007) and with the curricula of computer studies and even the curricula of the subject of instructional design Stone (1995) De Villiers (Ruth PHD 2002), Reynolds, (Masters 2005), Nordhoff (2002).

Bartho Brittz(2004) investigated aspects to consider in developing a "real-life" curriculum for computer science, where high school learners were asked to develop software that would be useful to their schools, for instance in arranging an athletics meeting, or a morning market. Broos (2008) did a large-scale analysis of the Information, communication and technological competencies of middle managers in the Netherlands defence organisation.

A number of theses and dissertations touched on aspects of curriculum design as a subset of the incorporation of computers into subject areas. The subject areas included chemistry (De Jager Masters 1997), geography (Du Preez, 1995), language (Ferreira 1996), (Herselman 1999), statistics (Lamprecht 2002), mathematics, (Moolman 1996), (Moila 2007) and electricity (Fouche 1995, Steyn 1997).

4.8 Learning environments

Much was researched regarding where learning took place. The concept of environment ranged from online environments, home schooling, classroom ecology, computer laboratories, large classes, disadvantaged communities, and rural schools generally. Cronje (2008) combined two of the above when he investigated the suitability of *Moodle* as a platform for home schooling, and Thomas (K 2006) investigated the use of *Blackboard* in dealing with large classes. Miller (PhD 2003) investigated how knowledge was geographically dispersed in a high school classroom, Kruger (2003) did an interesting study in determining different uses for three computer laboratories at one primary school. He proposed a division into a laboratory for behaviourist drill and practice, one for general, integrated teaching, and one for constructivist exploration.

4.9 Educators

The term educator is the preferred word for South Africans who teach. Thus under this term we will include teachers, lecturers, instructors, facilitators, etc. Three doctoral studies of note here include Adendorff's enquiry into the characteristics of an online facilitator, and De Jager's assessment of the competencies of educators who participated in an Advanced Certificate in Computer-Integrated Education, while Addo (2003) investigated the quality of training given to teachers during the large-scale implementation of computers at selected schools. As has been reported previously Stone (1995), Mkansi (2004), McKay (2008) concentrated on the professional development of pre-service, or in-service training of educators.

Reynolds, (2010 PhD) on the other hand, considered the role that context played in the extent to which teachers embraced technology. Pienaar (1998) was interested in the information needs of academics.

4.10 Learners

As has been mentioned earlier South African education underwent a radical educational reform in the late 1990s. A key shift in educational focus was the shift towards learner-centred education. No wonder then that the key word *Learner-centred* appears at least six times. The studies also investigated how learners worked individually or in groups. But while many studies followed a learner-centred pedagogy there were a few studies that were focused specifically on learner characteristics.

A study that concentrated entirely on learner characteristics was that of Kafanabo (2006) who conducted *(A)n investigation into the interaction between multiple intelligences and the performance of learners' in open-ended digital learning tasks*. Miller (2003) investigated how learners *acquire, recall, process and present information in a digitally enabled environment*. Meyer (2005) and Schoeman (2006) asked why online learners stayed online.

4.11 Pedagogy – Teaching and Learning

In essence all the research reported in this article was about creating benefit for society by using technology to improve teaching and learning. As such each thesis or dissertation was about teaching and learning, so it would make more sense to concentrate in this section on the types of keywords that were selected, rather than on the theses and dissertations. The first group of keywords is *effective teaching and learning, guidelines for teachers* and *guidelines for classroom use*. These words refer to both teaching and learning. Then there are two other sets of keywords, those that refer mainly to teaching, and those that refer mainly to learning.

Under *Teaching* are, (in alphabetical order): *Computer-integrated lesson, computer-integrated theme day, constructionist, information processing, knowledge creation, minimally invasive education, multi-dimensional methods, open-ended digital learning, pedagogically well-designed software, play, practicals, project based learning, projects, synthesis and tasks*.

Under *Learning* are: *Active learning, effective learning, learning (x5), learning behaviours and self-directed learning*.

From the keywords one can see that a clear focus has emerged on teaching and learning with computers. Computers were seen as delivery vehicles of self-standing courses, as well as internet and email-based communication channels, and, of course, as information processors using various applications such as word processors, spreadsheets, databases, etc. In terms of teaching, both objectivist, constructivist and integrated teaching methods were investigated, with computers playing either a central or an ancillary role. In terms of learning it was the cognitive and affective domains that received special attention with learner characteristics and conative issues being on the forefront. The question is two-fold: "What makes people learn with computers, and what makes them keep on learning?"

4.11.1 Synthesis

The purpose of this research was to uncover an *ex post facto* "agenda" for research over fifteen years. In analysing the foregoing paragraphs it would seem that there are three the main trusts with Education taking a very firm lead, technology second, and community forming the background and context. The classification of the keywords are shown in Table 1.

Education	Teaching Learning Theory Behaviourist Cognitive Constructivist Doing Affective Conative Curriculum Environment Educators Learners
Technology	Architectures Development Evaluation Web
Collaboration	Interaction Collaboration Culture

Table 1: A classification of the research

5. Conclusions and recommendations

5.1 Methodological reflection

This study is primarily the result of the personal reflection of one person on a canon of 91 theses and dissertations presented at one university. As such it is influenced by the biases of the person doing the reflecting. The main threat in the study is to reliability, in that another person, with another mindset, may well come up with another classification. Nevertheless the appendices are presented for control purposes. The article is an exploration of the topics under investigation, rather than a statistical analysis of the theses themselves. The number of times a topic is addressed gives an indication of the popularity of the topic, rather than of its relative importance.

5.2 Reflection on the findings

These findings indicate that the theses and dissertations investigated in this article are strongly biased towards the themes of education and pedagogy, which is in keeping with the generally held view that teaching with technology, should be about teaching rather than about technology.

In conclusion the following trend emerges. Masters' and doctoral students in this programme have tended first to investigate the educational application of new technologies as they emerged. Then they tried to improve their educational effectiveness, and sometimes tried to add value by the development of software or courseware. In a few instances the research has reached the level of evaluating existing implementations and their influence on society.

5.3 Recommendations for improved policy and practice

A weakness of this research lies in the vague nature of the keywords that were assigned by the authors to their research projects. In further research it may be wise to develop some standard set of descriptors that will work throughout the e-Learning community.

5.4 Recommendation for further research

The development and standardisation of a taxonomy of terms for e-Learning may be useful. Research leaders could then encourage their cohorts to stick to this taxonomy. In this way a very clear picture of the key issues and trends in the field would emerge to satisfy Simsek's suggestion that "research and applications related to educational technology should go beyond the narrow framework of traditional educational paradigms" (2005, p. 190).

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