

Towards a Research Framework for ICT Use in Developing Contexts

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ABSTRACT

The *digital divide* describes the gap among individuals, households, businesses and geographic areas on socio-economic level, as well as unequal opportunities to access information and communication technologies (ICTs). Castells holds the view that *informationalism* of shifting global networks creates a volatile and ruthless world. Those who do not contribute to the new world economies are discarded. Consequently, much of Africa is condemned to information black holes as Africa becomes the graveyard of failed ICT development programmes. However, by sharing expertise and goodwill, worldwide university networks of science and technology can reverse the inequities brought about by informationalism. We have a shared academic responsibility to explore feasible research frameworks on the use of ICT in developing contexts. Bronfenbrenner maintains that the ecology of human development is experimental by nature and design. From his *Human Ecological Systems Theory* we propose a research framework for the development of socially transformative ICT goals for implementation and validation at the School for Continuing Teacher Education at the North-West University, South Africa.

Keywords: Information Communication Technology (ICT); Human Ecology; Human Development; Developing Contexts; Learning Technologies; Education, interdisciplinary research framework, interdisciplinary research, Castells Networks.

1. INTRODUCTION

The question often arises how the School of Continuing Teacher Education (SCTE) should advance its programmes into the digital era, and improve its quality of teaching and learning through the use of learning technologies. An off-the-shelf solution does not fit this context. The longer we are confronted with the inherent challenges and infinite possibilities, the more multifaceted concerns come to my attention. The title of this address suggests the integration of at least four paradigms of knowledge areas: positioning of specific research within a paradigm, the use Information and Communication Technologies (ICTs), human development and education. Integrated interdisciplinary research frameworks can address challenges of developing environments, while their concrete implementation provides opportunities for empirical work and control of the process. However, creating an interdisciplinary research framework is not simply a matter of juxtaposing disciplines, or continuously forcing interaction, or inventing an illusion of combination, but rather de-

veloping a dynamic and specific mode for research. Deonchat [1] maintains that defining an environment to build and manage interdisciplinary research frameworks foster knowledge.

2. RATIONALE AND REALITIES

Although the proposed framework may be useful to other on-campus or off-campus higher education institutions, the framework directly speaks to the context of the SCTE at the North-West University. The Faculty of Educational Sciences at the NWU's African partner university, the University College of Iringa at the University of Tumaini, Tanzania, constitutes an integrated part of the formative evaluation of this research framework with one operational research project in progress.

Just over half of the South African population lives in cities spread over nine provinces. The total land area of South Africa is about 1.2 million square kilometres and mid-2007 estimates the South African population at 47.9-million. The population is diverse: ethnicities, cultures, languages and beliefs. About 38 million are Africans (79.6%), 4.3 million white (9.1%), 4.2 million coloured (8.9%), and 1.2 million are of Indian or Asian (2.5%) descent. More than three-quarters of South Africa's black African population are neither culturally nor linguistically homogenous, but nonetheless they have a great deal in common in terms of background, culture and descent. IsiZulu is the mother tongue of 23.8% of South Africa's population, followed by isiXhosa at 17.6%, Afrikaans at 13.3%, Sepedi at 9.4%, with English and Setswana each at 8.2%. This means that around 40% of the population speaks either isiZulu or isiXhosa. Various other African, European and Asian languages are also spoken [2]. Even in the best of all possible words, these statistics show the daunting task.

In 2002, former Education Minister Kader Asmal proclaimed the transformation and restructuring of the country's higher education landscape into 23 public higher education institutions [3]. After this the newly formed North-West University comprises three campuses: Potchefstroom, Vaal Triangle and Mafikeng campuses. The SCTE is situated on the Potchefstroom campus and delivers, as part of its portfolio, three in-service programmes for under and un-qualified teachers currently in the teaching profession: the National Professional Diploma in Education (NPDE), the Advanced Certificate in Education (ACE), and the Honours Baccalaureus Degree in Education (HonsBED) [4]. The school is responsible for the delivery of 186 individual modules (courses) and services approximately 20 000 students.

These students live across South Africa and Namibia and are linked to 29 learning centres in South Africa and six in Namibia. About 70% of the students are black, and most live in remote and rural communities; 67% are female, and the average age of students is 41. They are mostly practicing teachers improving their qualifications [5]. The current teaching and learning model dictates that a student receives a pack consisting of information booklet, year plan, study guides, textbooks, and DVDs via the mail; two visits to the learning centres annually from facilitators; a course-DVD containing additional information, e.g. PowerPoint™ presentations and video footage, as well as extensive summer and winter schools. Each learning centre contains a small, but well-equipped, dedicated library of relevant and pre-scribed books. Many also offer from 2 to 150 desktop computers linked to the Internet via an ADSL line.

In 2004, South Africa published its first policy document on the use of technology in education, the White Paper on e-Education: Transforming Learning and Teaching through Information and Communication Technologies (ICTs) [6]. In her foreword to the document, the Minister of Education, Naledi Pandor, describes the role of e-education in South Africa:

Digital media has revolutionised the information society and advances in ICTs have dramatically changed the learning and teaching process. This has opened up new learning opportunities and provided access so educational resources well beyond those traditionally available [6].

The goal of the e-education policy states:

Every South African manager, teacher and learner in the general and further education and training band will be ICT capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need as lifelong learners to achieve personal goals and to be full participants in the global community) by 2013 [6].

However, the reality of SCTE is that continuous polling through an array of strategies, for example enrolment forms, web statistics, individual and focus group interviews, and end-of course surveys, indicate that the web connectedness of our students does not go much beyond 10%. This not only reflects students' personal web accounts, but also the availability of the Internet at Internet cafés, as well as the schools where these teacher-students teach. Approximately 40% of schools are classified as poor or very poor, and in 2009 more than 60% of schools exempted their learners from school fees [7]. Of the 26 292 South African schools, approximately 60% have electricity and 70% have telephone lines [8]. The recent SITES 2006 study indicates that only 38% schools have computers available for teaching and learning activities [9]. A consolidation of these statistics reveals little more than 20% of schools meet the three basic prerequisites of telecommunications connectivity: grid electricity, exchange telephone lines and two or more computers. Some provinces are worse off than others — the Northern Province lags behind the Western Cape Province [10].

How highly does the South African government value the e-education policy and initiative, and how much support can we expect for the integration of ICTs in schools? In its November 2006 medium term budget policy statements, the South African government regarded the National ICT Programme as important and positioned it seventh in terms of its national priorities. At this time, the Department of Education (DoE) described ICT policy issues in the following terms:

- ICT is central to improving the competitiveness of South Africa, growing the economy, creating jobs and supporting social development.
- ICT learners will be able to participate in the knowledge society before they leave school and be better equipped for workplace and higher education.
- Funding will be used for conducting a feasibility study and researching ICT [11].

However, two years later in December 2008, Duncan Hindle, the Director General of Education, published new educational priorities for 2009 [7]. Support to the national education portal, Thutong [12], is listed in the 20th position of national priorities. It therefore seems that the use of ICTs in education is no longer an educational priority for South Africa in 2009. Many other important issues cloud the troubled horizons of South African education. However firmly we believe in the added value of ICTs in education and its potential advances for education, it would be callous to petition funding for additional computer infrastructure and extended support for professional teacher development for the integration of ICTs in schools when issues such as drug and substance abuse prevention, awareness and education pose life threatening risks to learners.

Distance education plays a significant role in South Africa, particularly in higher education. It affords access to a large and diverse student population – about 36% of all higher education students in the country study through distance education. e-Learning in South Africa is represented by scenarios, from large sophisticated implementations of learning management systems, to complete absence of technology in learning. For many of the reasons already mentioned, SCTE falls into the category at the far end of the continuum where the use of ICTs can create an enriched learning environment. e-Learning does not replace teachers. It enhances the quality and scope of teaching and reduces time spent on administrative chores. e-Learning activities should be balanced with other teaching and learning strategies. A match should be established between its suitability to individual learning, teaching styles and strategies [6]. Here lies the clue to finding an appropriate framework for researching the benefits of using ICTs in teaching and learning while SCTE adopts corresponding e-learning practices.

3. EVOLVING RESEARCH FRAMEWORKS

March and Smith maintain that a research framework is a representation of how things are ... The concern of a framework is utility, not truth ... Constructs [in a framework] constitute a conceptualisation used to describe problems within the domain and to specify their solutions ... They form the specialized language and shared knowledge of a discipline ... They define the terms used when describing and thinking about tasks [13]

March and Smith further maintain that constructions present entities, attributes, relationships, identifiers and constraints in data modelling, and aids in consensus, participation and satisfaction in cooperative work. Deconchat et al. [1] believe interdisciplinary research frameworks should develop from a theoretical analysis of how research is conducted, addressing questions of scales and models, as well as practical constraints that shape research activities. Besides dealing with key practical factors in the framework, it should also address “fuzzy” and “soft” issues from dealing with people, not objects. Data sets from nested projects should inform the different embedded dis-

ciplines. One should anticipate evolutionary development of a research framework, as its final form cannot be prearranged.

Constructing an interdisciplinary framework is a long and sometimes laborious task that requires regular updating; longitudinal studies collect evidence of small but discrete changes. Framework flexibility and responsiveness should be balanced against rigidity and ungainliness of unstructured frameworks, which may lose sight of its initial objectives. An over-integrated framework allows little flexibility. To establish an integrative framework cannot mean to develop an overarching theory, because this would try the impossible. The question, therefore, is how to achieve some practical degree of interdisciplinarity [1, 14] from sound theoretical underpinning.

In summary, interdisciplinary research frameworks offer the benefit of structure to development and research in an environment of a developing context such as SCTE experiences. The concept of a developing environment, and not a “grand theory”, guided us to exhume the previously often-used, but now almost forgotten Bronfenbrenner’s framework of human ecology.

4. HUMAN ECOLOGY AND DEVELOPMENT

Urie Bronfenbrenner, an American developmental psychologist and co-founder of the *Head Start Programme* for disadvantaged pre-school learners, founded the *Ecological Systems Theory* in his book *The Ecology of Human Development: Experiments by Nature and Design* [15]. Ecological systems theory, also referred to as development in context or human ecology, recognises four concentric systems that influence and shape human development: Microsystems, Mesosystems, Exosystems, and Macrosystems. He later added a fifth dimension, the Chronosystem (Fig. 1) [16]. These systems contain guidelines for human development throughout life.

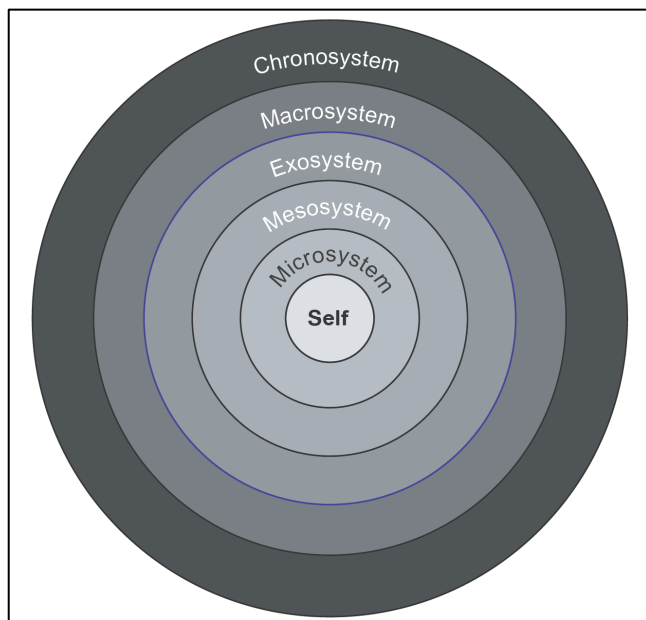


Fig. 1 Consecutive Human Ecological Systems

Bronfenbrenner’s work combines diverse fields of developmental psychology, sociology, anthropology, economics, education, political science, human biology and health, in order to

provide a holistic understanding of human development. Although these diverse knowledge areas use his development framework, very little is available on the use of this framework for ICT for development for the inquiry of questions relating to epistemology, methodology and morality [14, 17]. Bronfenbrenner’s definition draws heavily from a host of other theorists in a variety of disciplines, and relies heavily on the concept of human ecology as consecutive developmental foci:

The ecology of human development involves the scientific study of the progressive, mutual accommodation between an active, growing human being and the changing properties of the immediate settings in which the developing person lives, as this process is affected by relations between these settings, and by the larger contexts in which the settings are embedded [15].

Bronfenbrenner does not view the developing person as a *tabula rasa* shaped by environment, but as a dynamic entity that re-structures its milieu. Simultaneously, the environment exerts its influence, demanding mutual accommodation. Steiner and Nauser [18] consider the interaction between people and their environment the critical elements in their human ecological framework. The environment is not a single immediate setting, but incorporates interconnections between settings. Bronfenbrenner views the ecological environment as a set of nested structures, like a set of Russian dolls. At the inner level rests the developing person. Both meaning and context emerge from people’s interactions with their environments [19]. Contexts can be the home, classroom or places of work. Within any culture or subculture, contexts tend to be alike, but may differ among cultures [15]. Bronfenbrenner describes development as “a lasting change in the way in which a person perceives and deals with his environment” [15]. Therefore, changes in the context result in changes in behaviour and development. A person’s development is profoundly affected by events in contexts where the person is not even present. Research in Africa demands different cultural and communication skills than in First World countries. The capacity of a context to function as a framework for development depends on the social interconnections between contexts, including joint participation, communication and the information each context shares with another. South Africa is perfect example of contexts of different ethnicities and languages constantly rubbing shoulders. A theoretical concept of the environment extends beyond individual behaviour to systems both within and between contexts. Systems can also be modified and expanded. Ecological transitions describe shifts in role or setting, which occur through life. In the words of Bronfenbrenner:

An ecological transition occurs whenever a person’s position in the ecological environment is altered as the result of a change in role, setting, or both [15].

The Microsystem

A microsystem embraces the complex interrelations within a person’s immediate context. Bronfenbrenner defines the setting where people interact, their activity, and their interpersonal relations that constitute the building blocks:

A microsystem is a pattern of activities, roles, and interpersonal relations experienced by the developing person in a given setting with physical and material characteristics [15].

We would like to expand on three elements of this definition and choose first to comment on the physical and material characteristics for ICT for development.

Physical and Material Characteristics of the Developing Context: As far back as 1984 William Stover [20] made the case that “The computer is a recent addition to information technology, and less developed countries can find many applications for computers in accomplishing their developmental objectives. While developing countries find it difficult to manage information, economies of advanced industrial countries manage information through sophisticated information systems. The computer is the most important tool for helping the Third World Nations in this process.” Although some would not agree with this, it still rings true in 2009. This indicates that our main objective is to move forward and provide ICT in every corner of South Africa. Or not? Let us reconsider: What are the assumptions we make while planning research to address this problem? What is the point of departure of this research? What questions are we asking? One can approach research for ICT for development from many epistemological stances, and the choice of methodological truthfulness and ethical responsibility is both intricate and important.

To complicate matters further, we live in the information age where economy, society and culture intertwine. In this regard, McLaren argues that capitalism has become an “unrepentant universal system and the global arbiter of the public good” [21]. He explains the relationship between the local economies and globalisation as the case where the “domestic economy has become a means of extracting resources to finance the global operation of capital” [21]. In the West, globalisation rapidly divides

societies into two sharply differentiated social classes in a similar fashion to the general trends in the Third World ... [where] the rich are getting richer and the poor are getting poorer [21].

The gap of the riches of the northern hemisphere and the poverty of the southern hemisphere plagued the 20th century and has not diminished in this millennium [22]. The same sociotechnical developments that produced the global network society responsible for restructured and aggravated poverty holds the prospects of social development and mobilization at grassroots [23]. In his magnum opus, *The Information Age: Economy, Society and Culture*, Castells maintains that the information era holds the potential for vast increases in productivity and fulfilment but also creates a more volatile and ruthless world where those with nothing to contribute to the network society are discarded. One-third of the world’s population survives on the equivalent of about a dollar a day [23]. Human prosperity depends on the power of information, while most of Africa is left in a technological apartheid. While technology does not solve social problems, information and communication technologies are essential for economic and social development. The role of ICTs in stimulating development is a two-pronged approach that allows countries to leapfrog stages of economic growth by modernizing production systems and by improving education systems. The Asian Pacific economies are examples of such progress. On the other hand, those economies unable to adopt new technologies will falter. Castells sees little chance to develop without leapfrogging into the information age [23]. Modernization has increased the proportion of the poor in most countries and poverty and misery continue unabated in many countries.

The global village requires highly skilled labour. At the same time, jobs and living standards depend on the globalized sector of the economy. Education, information, science and technology

create value in the informational economy. Nevertheless, most schools in developing countries cannot or do not deliver a labour force prepared for the global economy. As we indicated earlier, South Africa has neither the cultural nor the technological environment to produce workers who can contribute to the global economy. Inappropriate education and lack of informational infrastructure lead to a vulnerable economy. Investment in education benefits everyone, as an educated labour force nurtures more productivity. Long before the 21st century and the promises of ICT for development Bronfenbrenner predicted:

If the children and youth of a nation are afforded opportunity to develop their capacities to the fullest, if they are given the knowledge to understand the world and the wisdom to change it, then the prospects for the future are bright. In contrast, a society which neglects its children, however well it may function in other respects, risks eventual disorganization and demise [24].

Castells, on the other hand, holds little faith that all children will receive a fair deal:

The 21st century will not be a dark age. Neither will it deliver to most people the bounties promised by the most extraordinary technological revolution in history. Rather, it may well be characterized by informed bewilderment [25].

Yet the interaction between economic growth and social development in the information age is still more complex [23] and demands research that takes into account the local context. Most of what we have said under this heading also reflects Bronfenbrenner’s macrosystem as well as the microsystem. However, as these systems fit into each other, these issues directly influence the microsystem where grassroots research at can take South Africa into the information era.

Pattern of Activities, Roles, and Interpersonal Relations: Distance education gets delivered across the Internet as e-learning [26], and educates a large and diverse student population of both mature students and school leavers. The word “virtual” that has become associated with what is done over the Internet, creates comparison. “Virtual reality” is like reality, “virtual teaching” is like actual teaching [27]. The inevitable question is: How good is virtual teaching when compared with actual teaching? Russell, [28] over many years and in more than 500 cases, shows that the medium of instruction causes no significant difference in student performance. We should not compare technology and classroom-based delivery modes with each other unless we want to contribute yet another case study to Russell’s report on the no significant difference phenomenon. Similarly, Clark [29] advocates the separation of medium and methodology in research on educational technology. He contends that it is the method, rather than the medium, that influences learning. Kozma (1994), on the other hand, argues that certain media attributes demand specific methods and that it is worthwhile pursuing these cases. Technology provides efficacy to education and practitioners should consider technology solutions where appropriate. Nevertheless, in 1997 Mabry already publishes evidence that “support[s] the efficacy of applying conceptual models of communication developed for explaining face-to-face interaction to mediated environments. This is another instance of corroboration for the utility of mediated communication providing communication resource opportunities similar to those expected from face-to-face interaction” [30]. e-Learning scholars agree that the virtual reality of online classrooms provides similar learning experiences to real classrooms [31]. Mature learners often contend that online learning experi-

ences are more personal and satisfactory than real classroom experiences [32]. Practical issues like issues of time, place and customised learning play a role in this evaluation. Many scholars agree that finding the right degree of interaction between the student, the facilitator and the virtual learning environment should drive the research agenda [33].

Contemporary research on e-learning examines the role of the facilitator [34, 35], the learner [36], the learning environment [37, 38], and the relationships [39, 40] in virtual learning spaces [39, 41]. This is an exiting and dynamic field that draws young enthusiastic scholars. However, in the South African developing context, the paramount question remains: In a developing context such as at the SCTE, how much will this research contribute towards the development of remote students that do not have access to the prerequisites of the information grid, or the required English Second Language skills to participate in their development? What will ICT for development bring to remote and rural SCTE students? What will remote and rural SCTE students bring to ICT for development? And, what are the learning needs of remote and rural SCTE students for ICT development? How can virtual learning communities assist developing learners leapfrog into the information era?

Ubiquitous and manipulative technologies have a long tradition in education. Even before embedded technologies, one of a teacher's most powerful tools is a concrete, physical model. Seymour Papert's decisive work on controlling the movements of a toy turtle through the LOGO programming language took digital manipulatives into education and simultaneously supported the pedagogy of constructionism. The theoretical work of Papert [42, 43] became a natural extension of the early work of Jean Piaget in 1966 [44]. Constructionism suggests that effective learning is achieved most effectively through participation with the constructs of artefacts. The artefact acts as a thinking tool to explore and express ideas. Manipulative and ubiquitous technologies are futuristic tools to assist Africa's leapfrog into the next era where technology can assist in the development of everyday skills such as reading, arithmetic, navigation, and identification of business opportunities [45].

Bronfenbrenner's "pattern of activities, roles, and interpersonal relations" within the microsystem approach to human ecology provides opportunities for urgent grounded research on ICT for development. The words of the United Nations Secretary General, Kofi Annan echo "South Africa is a country in which one can expect the unexpected ... What makes it possible is the determination of the people of South Africa to work together ... to transform bitter experiences into the binding glue of a rainbow nation."

The Developing Person: Bronfenbrenner views the experiences of the developing person equally important to their connections among other people present in the context. The nature of these links, as well as their indirect influence on the developing person through their effect on those who deal with the developing person, are foci for research [15]. However, in 1988, Bronfenbrenner [46] acknowledged that he in 1979, in a deliberate attempt to prioritize the impacts of physical and social environments on human development, neglected to focus on the individual as the centre of the human ecology. It was Lee [47] who shifted the microsystem outwards to accommodate the "ecological self" who intentionally interacts with the microsystem and mesosystem, and who is reflectively aware of

the indirect relationships with the exosystem and macrosystems [48].

Regardless of whose perspective one accepts, the critical term is the individual's *experience* while studying the developing person. When people develop ICT knowledge, skills and expertise, they develop everyday and professional skills. The question is, how do ICTs affect human development over a person's life. Some areas of development research include security, identity, responsibility, authenticity, power and freedom [49]. From my field of research, how do virtual classrooms support identity development of online students? How can ICTs facilitate personal responsibility for oneself and one's community? Also, if we accept Castells' hypothesis that social and political movements are role players in power conflicts in networks and collective identities [50], we should also ask: What is the role of ICTs for development of personal power and competition in the workplace? Castells upholds that "It is not technology that produces inequity, but it's so powerful that it amplifies the effects of inequity" [Castells in 25]. Although this list of developmental issues is not conclusive, they highlight trans-disciplinary research of ICT for development, developmental psychology and educational psychology.

Culture collectively programs the mind and distinguishes people from others [51]. According to the anthropologists Kroeber and Kluckhohn [52], cultures are patterns of behavior, acquired and transmitted by symbols which channel human psychic energy into socially useful activities. The way nomadic Mongolians navigate the desert at night does not exclude the possibilities of modern navigation systems. A Global Positioning System can make obsolete the cultural skill of reckoning by the stars [19].

To return to the South African context and the emerging research framework, the e-Education White Paper describes the developing a person as a continuum — a process that takes students and teachers through learning about ICTs (exploring what can be done with ICTs); and learning through the use of ICTs (using ICTs to support new ways of teaching and learning); and supporting and simultaneously enriching one another. "e-Learning is about learning and teaching philosophies and methodologies within the context of outcomes-based education, using ICTs in the learning environment" [6].

The Mesosystem

A mesosystem comprises the interrelations among two or more settings in which the developing person actively participates (such as ... for adult, among family, work and social life) [15].

The mesosystem is a system of microsystems, for example, when a person moves from one microsystem into a new one: in terms of ICT for development research, a person's experience with a new technology, e.g. the experiences of black disabled women in rural contexts emancipating through technology. Persons may also participate in more than one system, e.g. international researchers' different perceptions and observations of the same developing context colour their interpretations differently. These examples recommend a phenomenological approach to the research design. Therefore, the mesosystem is defined in more abstract terms as it extends beyond the situation directly affecting the developing person — it also includes the objects to which a person responds or the people with whom the person interacts [15, 19].

The Exosystem

An exosystem refers to one or more settings that do not involve the developing person as an active participant, but in which events occur that affect, or are affected by, what happens in the setting containing the developing person [15].

This system may include ICT use in developing contexts where users do not have an input into the choices of the type and application of technology. An immediate researchable question from a more radical humanist perspective for consideration: Is there some inherent good or benefit in the use of these ICTs? And before one gets carried away with assumptions of the global advances of ICTs, one should recognize that technology is neutral. There is nothing inherently good about ICTs: “When all you have is a hammer, everything looks like a nail.” In a context of limited resources (time, money, brainpower), does the benefit of ICTs override the educational priorities of the context? What other needs might be more important in a person’s development? Would they complain if the technology was gone? Would they be willing to pay to get the technology back? Does the technology empower, or does it create dependency?

The Macrosystem

The macrosystem refers to consistencies, in the form and content of lower-order systems (micro, meso, and exo) that exist, or could exist at the level of subculture or the culture as a whole, along with any belief systems or ideology underlying such consistencies [15].

Within a given society, systems are formatted to function from the same blueprints, but often analogous differences appear beyond the microsystem. Consistent patterns of differentiation form within each of these societies. These intrasocietal differences also present microsystem differences [15]. For example, the different threads of the same online course where virtual learning groups form their own code of conduct, and the way they would, for example, deal with flaming comments of a peer

in the online classroom. Yet, all the virtual learning groups function within the broad code of conduct of online ethics [30]. Another example is the use of SMS short language has advanced to official SMS shortcut dictionaries. Much ICT for development research relate to the Microsystem.

The Chronosystem

Bronfenbrenner added a fifth system called the *Chronosystem* — the evolution of the external systems. The Chronosystem also includes the patterning of environmental events and the transition of the individual and group. The Chronosystem is a research model that “makes possible examining the influence on the person’s development of changes (and continuities) over time in the environments in which the person is living” [16]. Bronfenbrenner emphasized that contextual influence on individuals can be better understood when the dynamic relation between the context and individual is considered. The Chronosystem is best achieved within the framework of a longitudinal research design. The longitudinal design examines the cumulative effects of a sequence of developmental transitions in an individual’s “life course”, hence characteristics of the individual can be perceived and explained through a developmental lens [16]. The International Association for the Evaluation of Educational Achievement’s (IEA) longitudinal studies document the use of ICTs in teaching and learning in schools across the world. The third module in the longitudinal Second Information and Technology in Education Study (SITES 2006) study indicates that South Africa’s learners increasingly lag behind [9].

5. THE RESEARCH NICHE AREA EDUCATIONAL TECHNOLOGY FOR EFFECTIVE TEACHING, LEARNING AND FACILITATION

On 12 May 2008 the Niche Area Educational Technology for Effective Teaching, Learning and Facilitation (NAETETLF)

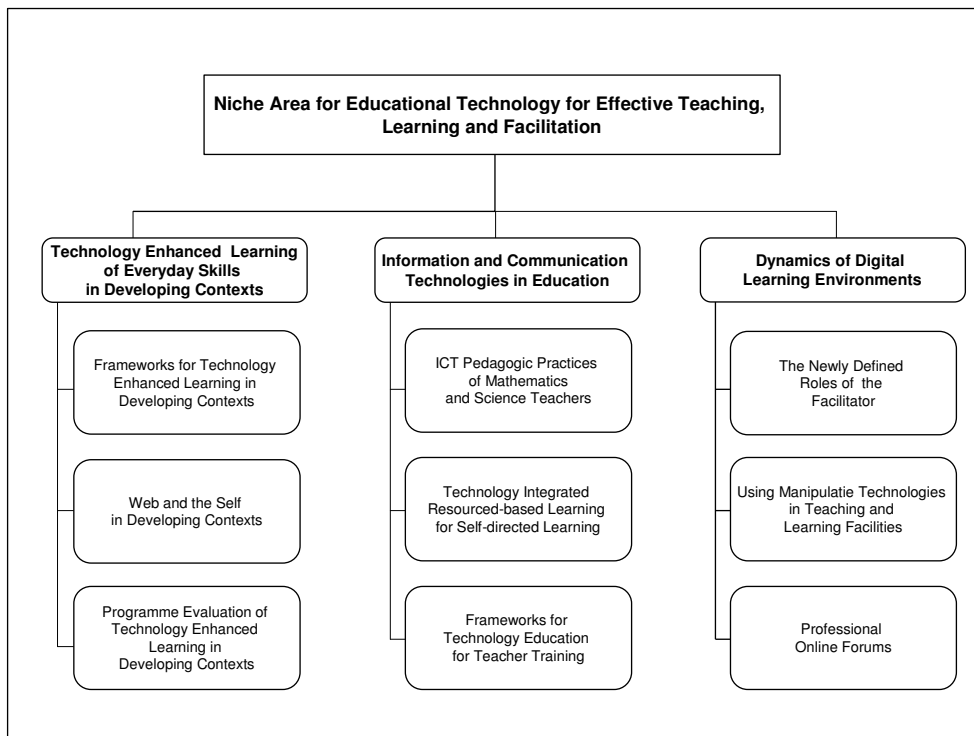


Fig. 2 The structure of the Niche Area

became an official research Niche Area of the North-West University and the first NWU niche area in the Faculty of Educational Sciences. The NAETETLF currently comprises three programmes:

- Technology Enhanced Learning of Everyday Skills in Developing Contexts
- Information and Communication Technologies in Education
- Dynamics of Digital Learning Environments.

Fig. 2 shows the structure of the programmes and the related nine projects of the Niche Area. In most cases, more than one researcher contributes to a project. The three programme leaders, the Niche Area leader and the Niche Area assistant form the executive committee of the Niche. The project, ICT Pedagogic Practices of Mathematics and Science Teachers, receives funding from the National Research Foundation in terms of their Institutional Research Development Plan. Three Masters' and five PhD students carry out their research projects within one of the NAETETLF programmes. The 2008 research outputs of this new Niche Area includes six presentations at conferences, and five accredited articles — a trend carried forward into 2009. We have already presented and published at international conferences and in recognised internationally and nationally accredited journals.

Table 1 Analysis of Niche Area Programmes and Projects

Programmes and Projects	Micro	Meso	Exco	Macro	Chrono
Technology Enhanced Learning of Everyday Skills in Developing Contexts	√	√	√	√	√
Frameworks for Technology Enhanced Learning in Developing Contexts	√			√	
The Web and the Self in Developing Contexts	√				
Programme Evaluation of Technology-enhanced Learning in Developing Contexts	√	√		√	√
Information and Communication Technologies in Education	√	√	√	√	√
ICT Pedagogic Practices of Mathematics and Science Teachers	√		√		√
Technology Integrated Resourced-based Learning for Self-directed Learning	√			√	
Frameworks for the integration of ICTs in Teacher Training	√			√	
Dynamics of Digital Learning Environments	√	√	√	√	√
The Newly Defined Roles of the Facilitator	√	√	√		
Using Manipulative Technologies in Teaching and Learning Facilities	√	√		√	
Professional Online Forums	√	√	√		

Table 1 indicates how the Niche Area programmes and projects reflect to the Bronfenbrenner's [15] framework of human ecology. On a macrosystem level these three sub-programmes relate to research on the continued development of in-service teachers through educational technology, the pedagogical use of ICTs at school level, and the development of digital virtual learning communities at higher education institutions. This table also indicates that projects overlap between the programmes, with other foci in the Faculty of Educational Sciences as well as with other disciplines from other faculties. This indicates that the

research encompassed within the NAETETFL has truly become interdisciplinary and trans-disciplinary.

6. A FINAL WORD

We addressed the question of how a progressive institution with first-class infrastructure makes a difference to the development of its more than 20 000 off-campus students spread out across South Africa. We have not come up with a step-by-step solution but have put together an emerging framework of interdisciplinary pegs and niches for appropriate and responsible research. Research on the use of ICTs in teaching and learning speaks to the heart of the work of every facilitator who constantly meets the demands and faces the realities of how learning technologies affect their students' performance. In this paper we indicated how a classical theoretical framework remains current, and how other theoretical and conceptual frameworks dovetail to underpin theory for research.

7. REFERENCES

- [1] M. Deconchat, A. Gibon, A. Cabanettes, G. d. B. de Warnaffe, M. Hewison, E. Garine, A. Gavaland, J.-P. Lacombe, S. Ladet, C. Monteil, A. Ouin, J.-P. Sarthou, A. Sourdril, and G. Balent, "How to Set Up a Research Framework to Analyze Social-Ecological Interactive Processes in a Rural Landscape," *Ecology and Society*, 12, <http://www.ecologyandsociety.org/vol12/iss1/art15/>, [9 February 2008, 2007].
- [2] SouthAfrica.info. "South Africa: Fast Facts. Gateway to the Nation," 09 February, 2009; http://www.southafrica.info/ess_info/sa_glance/facts.htm.
- [3] K. Asmal. "Asmal: Transformation and Reconstruction of Higher Education System (09/12/2002)," 11 February, 2009; <http://www.polity.org.za/article/asmal-transformation-amp-reconstruction-of-higher-education-system-091-22002-2002-12-09>.
- [4] Department of Education. "Media Release Issued By The Department of Education: Unqualified And Underqualified Educators Should Improve Themselves Before The Year 2001," 16 February, 2009; [http://www.search.gov.za/info/previewDocument.jsp?dk=%2Fdata%2Fstatic%2Finfo%2Fspeeches%2F1998%2F99104_6589910009.htm%40Gov&q=\(+\(dc.Date%3E%3D1998%2F01%2F01\)%3CAND%3E\(dc.Date%3C%3D1998%2F12%2F31\)+\)%3CAND%3E\(category%3Ccontains%3Es\)&t=EDUCATION%3A+UNQUALIFIED+AND+UNDERQUALIFIED+EDUCATORS](http://www.search.gov.za/info/previewDocument.jsp?dk=%2Fdata%2Fstatic%2Finfo%2Fspeeches%2F1998%2F99104_6589910009.htm%40Gov&q=(+(dc.Date%3E%3D1998%2F01%2F01)%3CAND%3E(dc.Date%3C%3D1998%2F12%2F31)+)%3CAND%3E(category%3Ccontains%3Es)&t=EDUCATION%3A+UNQUALIFIED+AND+UNDERQUALIFIED+EDUCATORS).
- [5] C. Thomen, "Education Practitioners' Understanding of Professional Development and Associated Competencies," *South African Journal of Higher Education*, vol. 19, no. 4, pp. 813-821, 2005.
- [6] Republic of South Africa, "White Paper on e-Education: Transforming Learning and Teaching through Information and Communication Technologies (ICTs)," August, D. o. Education, ed., Government Printing Works, 2004, pp. 1-70.
- [7] D. Hindle. "Director General, Duncan Hindle and Department of Education Officials Briefing to the Media regarding Department of Education Programmes, Priorities and State of Readiness for 2009," 9 February, 2009; <http://www.info.gov.za/speeches/2008/08120514151001.htm>.
- [8] Department of Education, "South African Country Paper," in 16th Conference of Commonwealth Education Minis-

- ters: Access to Education for the Good of All, Cape Town, 2006.
- [9] N. Law, W. J. Pelgrum, and T. Plomp eds., "Pedagogy and ICT Use in Schools around the World: Findings from the IEA SITES 2006 Study," Hong Kong: Springer and Comparative Education Research Centre, Universities of Hong Kong, 2008, pp. 296.
- [10] E. Holcroft. "SchoolNet South Africa," 20 March, 2007; http://www.idrc.ca/en/ev-71274-201-1-DO_TOPIC.html.
- [11] Department of Education. "Education Priorities and the Medium Term Budget policy Statements (MTBPS) of the Department of Education: 1 November 2006," 9 February, 2009; <http://www.google.co.za/search?hl=en&q=EDUCATION+PRIORITIES+%26+THE+MTBPS%0BDEPARTMENT+OF+EDUCATION&btnG=Google+Search&-meta=>.
- [12] Thutong Educational Portal. "Developing an Educational Portal for the National Department of Education: Detailed Project Report," 03 September, 2009; <http://www.thutong.doe.gov.za/>.
- [13] S. T. March, and G. F. Smith, "Design and Natural Science Research on Information Technology," **Decision Support Systems**, 15, http://66.102.1.104/scholar?hl=en&lr=&q=cache:ST5eeZh3dIJ:www.nacuheal.net/vshaw/Files/For%2520Jorn/Marc_h_Design%2520and%2520natural%2520science%2520research%2520on%2520IT.pdf+March+and+Smith, [12 February 2009, 1995].
- [14] C. J. Steiner. "The Technicity Paradigm and Scientism in Qualitative Research," 14 September, 2005; <http://www.nova.edu/ssss/QR/QR7-2/steiner.html>.
- [15] U. Bronfenbrenner, **The Ecology of Human Development: Experiments by Nature and Design**, Cambridge: Harvard University Press, 1979.
- [16] U. Bronfenbrenner, "Ecology of the family as a context for human development: research perspectives," **Developmental Psychology**, vol. 22, pp. 723-742, 1986.
- [17] P. Dillon, "Creativity, Wisdom, and Trusteeship: Niches of Cultural Production," **Creativity, Wisdom and Trusteeship: Exploring the Role of Education**, A. Craft, H. Gardner and G. Claxton, eds., pp. 105 - 118, Thousand Oaks, CA: Crown Press, 2008.
- [18] D. Steiner, and M. Nauser eds., "Human Ecology: Fragments of Anti-fragmentary Views of the World," London: Routledge, 1993, pp. 365.
- [19] P. Dillon, P. Bayliss, I. Stolpe, and L. Bayliss, "What Constitutes 'Context' in Sociocultural Research? How the Mongolian Experience Challenges Theory," in Cultures in Transit Conference, Liverpool, 2008, pp. 16.
- [20] J. S. Stover, **Information Technology in the Third World: Can I.T. Lead to Humane National Development?**, Boulder, Colorado: Westview Press, 1984.
- [21] P. McLaren, "Traumatizing Capital: Oppositional Pedagogies in the Age of Consent," **Critical Education in the New Information Age**, M. Castells, R. Flecha, P. Freire, H. A. Giroux, D. Macedo and P. Willis, eds., pp. 1-36, Lanham: Rowman & Littlefield, 1999.
- [22] M. Castells, R. Flecha, P. Freire, H. A. Giroux, D. Macedo, and P. Willis, **Critical Education in the New Information Age**, Lanham: Rowman & Littlefield, 1999.
- [23] M. Castells. "Information Technology, Globalization and Social Development," 17 November, 2008; [http://www.unrisd.org/80256B3C005BCCF9/\(httpAuxPages\)/F270E0C066F3DE7780256B67005B728C/\\$file/dp114.pdf](http://www.unrisd.org/80256B3C005BCCF9/(httpAuxPages)/F270E0C066F3DE7780256B67005B728C/$file/dp114.pdf).
- [24] U. Bronfenbrenner, **Two Worlds of Childhood: US and USSR**, New York: Penguin, 1975.
- [25] J. Fischer, "Manuel Castells' Brave New World: Feeling Lost in the Information Age? A Berkeley Professor is Trying to Figure Out Where We Are and Where We're Headed," **West**, 1999.
- [26] M. J. Rosenberg, **e-Learning: Strategies for Delivering Knowledge in the Digital Age**, New York, NY: McGraw-Hill, 2001.
- [27] J. C. Cronjé, "Metaphors and models in Internet-based learning," **Computers & Education**, vol. 37, no. 3, pp. 241-256, November, 2001.
- [28] T. Russell, **The No Significant Difference Phenomenon**, 5th ed., Littleton, CO: Arello, 2001.
- [29] R. E. Clark, "Media Will Never Influence Learning," **Educational Technology Research and Development**, vol. 42, no. 2, pp. 21-29, 1994.
- [30] E. Mabry, "Framing Flames: The Structure of Argumentative Messages on the Net " **Journal of Computer-Mediated Communication** 2, <http://jcmc.indiana.edu/vol2/issue4/mabry.html>, [13 February 2008, 1997].
- [31] R. J. Marzano, D. J. Pickering, and J. E. Pollock, **Classroom Instruction that Works**, Alexandria, VA: ASCD, 2001.
- [32] P. M. A. Baker, and A. Ward, "Community Formation and Dynamics in the Virtual Metropolis," **National Civic Review**, vol. 89, no. 3, pp. 203-215, 2000.
- [33] T. Anderson, "Getting the Mix Right Again: An updated and Theoretical Rationale for Interaction," **The International Review of Research in Open and Distance Learning**, 4, <http://www.irrodl.org/index.php/irrodl/article/view-Article/149/230>, [10 February 2008, 2003].
- [34] T. Anderson, L. Rourke, D. R. Garrison, and W. Archer, "Assessing Teaching Presence in a Computer Conferencing Context," **Journal of Asynchronous Learning Networks**, vol. 5, no. 2, pp. 1-17, September, 2001.
- [35] A. S. Blignaut, and S. Lillejord, "Lessons from a Cross-cultural Virtual Learning Community," **South African Journal of Higher Education**, vol. Special Issue, pp. 1350-1368, 2006.
- [36] L. Nagel, A. S. Blignaut, and J. C. Cronjé, "Read-Only Participants: a Case for Student Communication in Online Classes," **NILE: Interactive Learning Environments**, vol. In Press: Manuscript ID: 249974, 2008.
- [37] P. Banerjee, "Creating a Virtual Community Using Electronic Discussion Lists," **American Journal of Health Behaviour**, vol. 26, no. 5, pp. 394-395, 2002.
- [38] L. Nagel, "The Dynamics of Learner Participation in a Virtual Learning Environment," **PhD proposal**, 2005.
- [39] L. Nagel, A. S. Blignaut, and J. C. Cronjé, "Methical Jane: Perspectives of an Undisclosed Virtual Student," **Journal of Computer Mediated Communication**, vol. 12, no. 4, pp. 1346-1368, July, 2007.
- [40] G. Collison, B. Elbaum, S. Haavind, and R. Tinker, **Facilitating Online Learning: Effective Strategies for Moderators**, Madison, WI.: Atwood Publishing, 2000.
- [41] A. W. Bangert, "The Seven Principles of Good Practice: A Framework for Evaluating On-line Teaching," **The Internet and Higher Education**, vol. 7, pp. 217-232, 2004.
- [42] S. Papert, **Mindstorms: Children, Computers, and Powerful Ideas**, New York: Basic Books, 1980.
- [43] S. Papert, "Constructionism: A New Opportunity for Elementary Science Education," A proposal to the National Science Foundation, 1986.

- [44] Learning and Teaching. "Piaget's Development Theory," 17 February, 2009; <http://www.learningandteaching.info/learning/piaget.htm>.
- [45] E. Sutinen, "Diverse Technologies for Diverse Learner Needs," European Union, 2008.
- [46] U. Bronfenbrenner, "Foreword," **Ecological Research with Children and Families: From Concepts to Methodology**, A. R. Pence, ed., pp. x-xix, New York: Teachers College Press, 1988.
- [47] D. L. Lee, "Body-environment Coupling," **The Perceived Self: Ecological and Interpersonal Sources of Self-knowledge**, U. Neisser, ed., pp. 43-67, New York: Cambridge University Press, 1993.
- [48] U. Neisser, "Introduction," **The Perceived Self: Ecological and Interpersonal Sources of Self-knowledge**, U. Neisser, ed., pp. 3-21, New York: Cambridge University Press, 1993.
- [49] C. S. Pearson, **Awakening the Heroes Within: Twelve Archetypes to Help Us Find Ourselves and Transform our World**, San Francisco: Harper Collins Publishers, 1991.
- [50] M. Castells, **The Power of Identity**, Oxford: Blackwell Publishers, 1997.
- [51] G. Hofstede, and G. J. Hofstede, **Software of the Mind: Intercultural Cooperation and Its Importance for Survival**, New York: McGraw-Hill, 2004.
- [52] A. L. Kroeber, and C. Kluckhohn, **Culture: a critical review of concepts and definitions**, New York: Random House, 1952.