Article 5

Seamless Support:
Technology Enhanced Learning
in Open Distance Learning at NWU

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ABSTRACT
Frantic attempts of investing in technology to demonstrate willingness to educate for the knowledge society may result in failure to address the real requirements. This paper presents the main features of a framework for integrating Technology Enhanced Learning in Open Distance Learning at North-West University, South Africa. Support towards building trust to attempt using technology, exposure to technology and promoting accomplishment is presented as a focus in the framework. Large numbers of practising teachers improving their qualifications through distance learning are not yet using electronic learning technologies. To overcome the digital divide in developing contexts requires responsible planning, commitment and empowerment on the part of university management in conjunction with pre-emptive support in response to changing people-centred requirements through continuous feedback. The one-sided nature of top-down interventions on the part of the university contrasts with necessary unobtrusive pre-emptive support as a result of requirements identified through bottom-up feedback. The framework emerged from an adapted design-based research approach of design cycles to identify aspects to include in the framework on how to address a satisfactory attempt. Support to enable living and learning using technology is required to shift teacher-students and faculty with declared intentions to use technology to progress towards adoption.

KEY WORDS
Technology enhanced learning, Learning technology integration, e-learning implementation, social transformation, student support, faculty training; teacher-students.

INTRODUCTION
The position of this paper is that to empower faculty and students in a developing context to overcome the digital divide (Dutta & MIA, 2011; Mutula, 2008; Norris, 2001) requires support characterised by a strategy with dual approaches. From a top-down as well as a bottom-up approach, firstly the university as institution should officially sanction technology enhanced learning (TEL) as a considered teaching and learning priority. Bold initiatives are required demonstrating evidence of responsible planning, commitment and empowerment on the part of the higher education institution (HEI). Through declarative visible interventions this top-down approach should demonstrate intent aimed at initiating action and gaining trust. On the other hand, unobtrusive pre-emptive support must be established in response to changing people-centred requirements through continuous feedback. This bottom-up approach should transform HEI environments as a result of listening to latent, unuttered requests of involved stakeholders and provide pre-emptive sustained but evolving support towards people-technology interaction. Productive and pleasurable educational transactions by students and faculty will testify to the success of HEI initiatives towards successful integration of TEL. Empowerment initiatives in the form of comprehensive support should aim to enable effortless technology enhanced teaching and learning experiences.

We would argue that such empowerment could be labelled *seamless support*. When driving across a bridge, ultimate functionality in civil engineering design is apparent when driver and passengers are unaware of the structure or the inconvenience. Bridges may be designed to impress with elaborate superstructures, but then the aim is not only functionality. In the analogy applied to this paper, functional learning technology support is effective when participants in the learning experiences are unaware of the efforts and costs involved in the provision of enjoyable and lasting learning experiences. There may be advanced learning goals where problem-based learning requires students to become aware of difficulties in order to build their competence, but that would follow once they have confidence in their ability to navigate the familiar. Obstacles in the learning path should be avoided unless they serve a learning purpose. Open distance learning (ODL) aims to remove unnecessary barriers and provide learning, focusing on the requirements of learners (Butcher & Wilson-Strydom, 2008). These learners may be busy with a full time occupation and have many personal responsibilities, pursuing further studies amidst considerable personal sacrifice (H D Esterhuizen, 2011-2012).

Especially in developing contexts, large numbers of students are trapped beyond the digital divide by technological disadvantage and digital illiteracy. Although universally accepted, HEIs require transformation (Blin & Munro, 2008; MacKeogh & Fox, 2008; Taylor, 2001). The diversity of areas in need of transformation may result in paralysis if left solely to evolution, resulting in extinction. HEI survival strategies developing through unhurried evolutionary processes may not generate critical mass to energise rescue interventions. The

HEI management's role in the integration of learning technologies in higher education may happen either through reluctant consent or through active intervention.

THE CONTEXT

The Republic of South Africa comprises nine provinces with eleven official languages. The World Bank report on South Africa describes it as one of the most unequal societies in the world, with the top quintile accounting for 58% of the country's income and the bottom quintile accounting for 0.5% (World Bank, 2012). While South Africa has the continent's largest economy by far, unemployment levels are some of the highest in the world. The inability to create employment opportunities on a large enough scale necessitates a special focus on human capital development through education since assistance through social grants is neither sufficient, nor sustainable. The North-West University (NWU) in the North West Province of South Africa has three campuses: Mafikeng Campus, Potchefstroom Campus, and Vaal Triangle Campus. Approximately 30 000 of the about 60 000 teacher-students registered at the Potchefstroom Campus are unqualified or under qualified practising teachers, improving their qualifications through ODL, living and working in all nine provinces in South Africa and in the neighbouring countries, Namibia and Botswana. Contact sessions at 39 support centres across Southern Africa including four in Namibia augment ODL provided through a second generation correspondence distance education model (Taylor, 2001) at the School of Continuing Teacher Education (SCTE), NWU. The SCTE is a successful ODL provider. Reviews by an international panel of experts confirm quality standards at the SCTE (Aguti, Banks, Downes, & Henderikx, 2010). However, inadequate access, computer illiteracy, technological disadvantage and technophobia hamper implementation of electronic learning technologies.

TECHNOLOGY ENHANCED LEARNING INTEGRATION FRAMEWORK

This paper presents the main features of a framework for the integration of TEL in ODL at NWU comprising prominent aspects and how to address these. The framework emerged from an adapted design-based research (DBR) strategy (Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006) involving methodological pragmatism as a method of inquiry (Maxcy, 2003, p. 81). As participant observer in this research process, the first author was appointed e-learning manager at SCTE NWU from the beginning of 2011. His responsibilities include strategic planning and implementation of e-learning, research on integration of TEL in the context of SCTE, as well as development and implementation of academic staff training in the use of learning technology. Urgent implementation of solutions necessitated the use design research methods so that research and development could be performed simultaneously (Barab & Squire, 2004).

The Push to Participate

It is crucial to urgently develop 21st Century Skills (UNESCO, 2002; White, 2009) of students and faculty for survival in the knowledge-based society(MacKeogh & Fox, 2008) (Pelgrum, 2008). University management may agree with this statement and analyse the required characteristics of a modern day university. This may result in increased emphasis on the role of information communication technologies (ICTs) in the teaching and learning strategy and formulation of policies. Likely outcomes may be revised policies containing stronger emphasis on technology use. Such top-down approaches may result in failure to address the real requirements needed to engage academic staff and students (MacKeogh & Fox, 2008).

From the perspective of SCTE faculty, we expect reactions to such initiatives to lie on a continuum between enthusiasm, and reservation. We do not consider those with reservations to doubt the need for learning technology adoption; we rather expect them to doubt their own courage to optimistically engage with technology. Faculty with enthusiasm may welcome initiatives which they expect to be interventions addressing barriers to adoption. Previous research determined that faculty and teacher-students at the SCTE NWU are already convinced that learning technologies and the use of ICTs in teaching and learning hold solutions to their learning requirements and will directly benefit their learners (Hendrik D Esterhuizen, Blignaut, & Ellis, 2012; Hendrik D Esterhuizen, Blignaut, Ellis, & Els, 2012). World-wide faculty feel responsible to embrace technologies in teaching and learning, but many find it difficult to show convincing progress (Lin, 2011; MacKeogh & Fox, 2008). Frantic attempts of investing in technology to demonstrate willingness to educate for the knowledge society may result in failure to address the real issues and requirements. Establishment of personal profiles requiring registrations and passwords on more and more networks allow individuals access to novel information gathering and sharing, and personal association platforms. In these social spaces they get connected; adding circles of friends and contacts through proliferating electronically connected tools and gadgets. Multiplexing attention spans between increasing numbers of information clusters wearies and diverts. Some educators feel compelled to, however fretfully, stamp digital footprints in cyberspace to prove their residency in the knowledge society. On the other hand, a renewed perspective from essentials in teaching and learning, enquiring about requirements of learners, and mature application of experience may better satisfy

learning requirements of students as well as faculty. People-centeredness in education promises hope for efficient and enjoyable learning. Using novel social networking tools to address learning requirements will over time systematically add convincing fortifications to an arsenal of useful learning technologies while learning requirements drive the process.

While perpetual learning ("Lifelong Learning": Beller & Or, 1998; Longworth & Davies, 1996) is a worthy life goal and inquisitiveness a human virtue, self-fulfilment is best reached voluntarily. Pursuing success is more efficient while riding the wave of technological innovation; feeling in control reassures, while being pushed perpetuates panic. Calls for revaluating priorities in education include focusing on people and pedagogy instead of on technology per se. Learning and living with technology should be about people enjoying life, ambition and attainment, rising to challenges, overcoming barriers, gratitude, and upgrading their competencies.

Observations on how to accommodate the so-called Net Generation (Oblinger & Oblinger, 2005) may have contributed to technology investment initiatives in desperate attempts to move ahead in education. Perspectives of present technological innovations built on mounds of innovation of previous generations appear when even younger generations are disappointed in their ability to apply their technological dexterity to practical academic use. Growing instances of inadequate literacy, including computer literacy in younger learners, focus on the necessity for cooperation across generations (Müller, 2011; OECD, 2010). Younger generation learners do not represent a homogenous group with similar characteristics in terms of technology adeptness (Sánchez, Salinas, Contreras, & Meyer, 2010). While there are certainly some young learners who excel independently, many require support in living and learning, using technology in general. David White considers the skills many young people have in technology use for social networking to be *communal,* not *collaborative,* and as a result they do not perform as well as anticipated in utilising technology in educational settings (Melrose Training, 2011).

Intentions to Adopt Technology in Teaching and Learning

We initiated approaches to ascertain enablers and barriers to learning technology adoption at SCTE from the perspectives of participants to provide substance to a framework for the integration of TEL. The Technology Acceptance Model (TAM) is an adaptation of the theory of reasoned action by Fishbein and Ajzen (1975). Davis, Bagozzi and Warshaw (1989) applied TAM to investigate why people accept and reject information technologies. The TAM predicts actual technology use from *intention to use* through *perceived usefulness* and *perceived ease of use* of technology as preconditions. Taking cues from the TAM, a survey instrument was developed with the specific intention of learning more about perceptions of SCTE teacher-students who experienced difficulty with computer literacy. The survey comprised single-input and open-ended questions that collected data from a purposeful sample of 338 teacher-students attending additional contact sessions after unsuccessfully completing a computer literacy course. The questions probed perceived usefulness and ease of use of technology, technophobia, the availability of and access to computers and the Internet. An overwhelming majority of these teacher-students (98.4%) declared that they looked forward to using computers better; while 94% considered computers useful for everyday life and 78.5% believed their learners might benefit from using computers (Hendrik D Esterhuizen, Blignaut, Ellis et al., 2012). Thus, intention to use technology was already established, even amongst teacher-students who needed additional computer literacy training. Analysis of teacher-students' perceptions revealed a strong need for support and an enabling environment as preconditions for trust in order to attempt using technology. Once attempts were made to use technology, self-confidence increased together with intentions to persevere towards attainment of techno-competence. SCTE faculty also have the intention to increase the use of TEL in teaching and learning

TEL adoption interventions regarding academic staff and teacher-students of SCTE should not focus on cultivating intentions to use technology, since that has been established. Interventions should focus on the reasons why the intentions to use technology do not result in adoption. Empowerment and support must be addressed. Instead of drastic top-down interventions, such support may be characterised more by unobtrusive pre-emptive support as a result of requirements identified through bottom-up feedback

From Intentions to Adoption

Teacher-students have expressed intentions and commitment to adopt technology in teaching and learning, and these have been confirmed by academics. We suggest that a demonstrated gesture is required from the HEI's management on declared intent. This should be accompanied by tangible commitment to support. However, faculty remain the change agents in technology adoption (Hendrik D Esterhuizen, Blignaut, & Ellis, 2012). While some faculty may welcome such confirmation from university management with enthusiasm or with some reservation, the obligation to the adoption of TEL will then established—it will be official. The South African policy on e-Education (2004) demands ICT mastery in teacher training, and formally sanctioned

technology use to be implemented across three stages since 2003. Although the target for mature technology integration was set at 2013, little has been accomplished. While faculty may be convinced and some may have tried, without tangible support from university management little progress can be expected from faculty, even if they agree in principle with TEL adoption.

First Steps Towards Interactivity

As a result of technological disadvantage and computer illiteracy on the part of SCTE teacher-students, a second generation distance education model (Taylor, 2001) using printed media dominates learning technology use at SCTE. Hybrid digital versatile disks (DVDs) are included in the study material teacher-students receive through surface mail and bulk short messaging service (SMS) mobile text communication is utilised for administrative arrangements. Teacher-student support at 39 regional contact centres enable teacher-students to regularly engage face-to-face with approximately 350 SCTE facilitators. The thirty seven SCTE faculty regularly travelled to these regional contact centres to engage with teacher-students and facilitators. Since 2010, electronic interactive whiteboards (IWBs) have been installed at regional support centres. By the second semester 2012, two IWBs had been installed at each of the 39 regional contact centres in South Africa and Namibia, enabling SCTE faculty to interact with teacher-students synchronously. Though faculty still occasionally travel to support centres, using IWBs has enabled faculty on campus to train facilitators and interact with the teacher-students at the regional support centres at the same time. Teacher-students may pose questions, write on the IWB at any of these venues and participate in learning experiences. SCTE supplied the Internet connectivity at the centres through four-megabit asymmetric digital subscriber lines (ADSL) subscriptions to enable the use of IWBs to synchronously share learning spaces between these centres and venues on campus.

SCTE teacher-students who are teachers in the process of improving their qualifications need strong encouragement to overcome inhibitions and participate in IWB sessions. Teacher-students expect direct instruction where "teachers provide intellectual and scholarly leadership and share their subject matter knowledge with students" (Anderson, Rourke, Garrison, & Archer, 2001, p. 8) and rarely respond to opportunities to pose questions. Opportunities are available to send questions using SMS before, during or after IWB sessions. This service potentially could contribute to interactivity and provide teacher-students who do not have the courage to ask questions during an IWB session a familiar way of communicating with the faculty and with the group. Concerted efforts should be made to encourage use of the SMS service. Teacher-students at remote locations should be involved by striking a balance between enforced participation in the learning opportunity (and possibly offending them in the process) and perpetuating transmissive teaching styles with minimal interaction. Possibilities such as greater involvement of facilitators in coordination of participatory activities during IWB sessions are currently under investigation. Faculty mentioned time scheduling and the inadequate length of IWB sessions as a limiting factor. Subjects teacher-students enrolled for must each receive allotted time on a Friday afternoon or Saturday. Since large portions of the scope of each topic require discussion, high density information transfer is inevitable and participatory interactivity is an unaffordable luxury as a result of time constraints. If SCTE could improve asynchronous communication so that teacher-student needs could be identified in advance and teacher-students would be better prepared for IWB sessions, and some of these lurking limitations could be minimised. Eventually, asynchronous online learning may address some of these challenges. In summary, SCTE teacher-students require affordable mobile connectivity, adequate Internet access and computer literacy to enable substantial information exchange and collaboration. Faculty need confidence in initiating interactivity, facilitation of online learning and projecting social, cognitive, and teaching presence (Garrison, 2007). Since faculty may be required to participate in online activities after hours, their residential Internet connectivity should receive attention as well. At the same time, SCTE should prepare comprehensively for appropriate TEL implementation, starting with the teacher-students who are in the position to utilise it.

Initial Socially Transformative TEL Integration Framework

The particular adaption of DBR strategy in this research involved five design research cycles collectively comprising one macro DBR cycle. The purpose of this macro DBR cycle is to guide an emergent TEL integration framework, as the culmination of the current research. The recommendations from the DBR cycle should initiate future macro DBR cycles as part of on-going TEL integration towards e-maturity at the SCTE. The five DBR cycles in the current research constituted an initial technology integration framework, quantitative analysis of teacher-students' computer literacy, multi-methods analysis of teacher-students' computer literacy learning emotions, multi-methods analysis of faculty's perceptions during e-learning staff development, as well as the emergent TEL integration framework. The last of these is the focus of this paper.

The authors presented an initial learning technology integration framework for SCTE at the 24th ICDE conference in Bali (Hendrik D Esterhuizen & Blignaut, 2011). It recommended interventions to consider seven aspects prominent for a framework for integration of TEL from pre-existing needs and requirements to a transformed focus on people, education and technology. The aspects are: (i) unqualified and under-qualified teacher-students in the process of upgrading their professional qualifications; (ii) faculty responsible for instructional design of learning material and facilitators responsible for the delivery of the curriculum at remote learning centres; and (iii) the university with its particular vision for teaching and learning. Through DBR analysis of practical challenges in close collaboration with practitioners and analyses of institutional strategic planning and policy, four themes emerged used during interviews with strategic stakeholders. They relate to (iv) the curriculum, (v) information, (vi) access and connectivity, and (vii) learning technologies. The initial framework (Hendrik D Esterhuizen & Blignaut, 2011) expressed the need for interventions, empowered through provision of resources from the HEI. The process depicted in Figure 1 illustrates how each of the aspects is transformed from a socially ascribed before the intervention to a transformed status after administering the intervention.

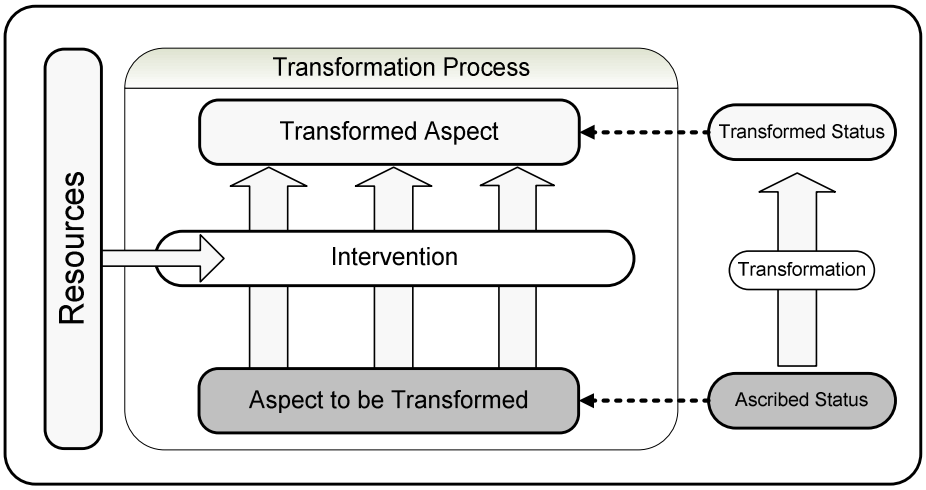

Figure 1: Social transformation of aspects included in the framework through intervention

The first five aspects required people-centred interventions to transform. Interventions requiring intensive logistical and staff input includes initial assessment of computer literacy of teacher-students, followed by tailor-made ICT training at regional tuition centres across Southern Africa. These should go hand in hand with introduction to learner management system (LMS) use, library use, information gathering techniques, study methods, as well as reading and academic writing competencies. Once acceptable computer literacy has been established, it should enable some online and other interactive media alternatives such as mobile learning interventions. It is possible to leapfrog into the use of mobile technologies to achieve learning goals in certain instances. However, the fact that SCTE teacher-students are teachers themselves necessitates conventional computer literacy—computers are found in many schools and prevalent in the world of work. Also, teacher-students should be able to prepare their learners for the computer literacy expectations of commercial, industrial, public administration and higher education environments in Southern Africa.

These interventions would have far-reaching implications, since they require repeated contact sessions over time involving thousands of teacher-students. For practising teachers in deep rural areas, attending such sessions involves considerable effort, and such interventions would be logistically complicated. Due to the wide-ranging computer illiteracy, such sessions should be hands-on. The first phases can especially not be conducted online or asynchronously. Only when teacher-students could confidently navigate LMSs, asynchronous online learning could be attempted. However, inadequate personal access to technology and connectivity limits learning technology adoption, still necessitating paper-based distance education.

SCTE faculty, as the second aspect in the initial learning technology integration framework, display powerful positive group dynamics, consciousness of teacher-student requirements, dedication through a strong work ethic, commitment to development, further qualifications, research and technology adoption. They have expectations of technology mastery and a willingness to learn through experience. Aspects that must be addressed are insufficient time due to excessive workload, unfamiliarity with new technologies, and in some cases perceived

technological disadvantage and technophobia. Some consider their computer literacy as inadequate. They request training as first hand experiences both individually and in group settings. In response to the urgent need for short term solutions, the e-learning manager has started with such hands-on training in 2011, focussing on the use of IWBs and improving faculty confidence in using computers while interacting with teacher-students. Faculty confirmed their appreciation, but requested further training. Practice-based training is needed in the development of skills in using new technologies and focusing on participation and interaction between teacher-students rather than continuous focus on receptive modes of communication (Schneckenberg, Ehlers, & Adelsberger, 2011). Comprehensive training, demonstration and participation in the use of a learner management system (LMS) will be required, since currently LMS use is limited to storage of study guides, study letters and examples of previous examination papers. Though many teacher-students already download material from the LMS, facilitation, collaboration and/or interaction between faculty and ODL teacher-students by means of LMS is not prevalent.

Regarding the institution, curriculum and information as the next three aspects, people-centred interventions include provision of instructional designers and online curriculum implementation initiatives. Overcommitted academic staff members are expected to initiate technology adoption without much institutional support (Blignaut & Trollip, 2003). Faculty should have opportunities to experiment with e-learning techniques, develop skills, acquiring first-hand experience all of which should be informed by research. Faculty should receive real-time support from in-house instructional designers, graphic designers, media designers and information technology assistance. Bold initiatives are needed to invest in human capacity building with instructional design and technology based course curriculum renewal informed by localised research. We consider additional SCTE faculty appointments feasible in relation to the workload, especially in light of the shortage of instructional designers to assist with a transition to online learning. Comprehensive interventions are necessary around instructional design and curriculum and pedagogy design appropriate for online learning focused on optimally engaging learners while using technology. Both faculty and SCTE students need to experience online learning.

Following the preceding discussion, we propose that interventions have preconditions which are determined by internal, external and time dependant factors of which one, two or all three factors may be applicable. Figure 1 indicates resources as preconditions for intervention. Figure 2 shows three classifications of preconditions. If only internal precondition factors exist, intervention is immediately possible without dependence on resources or additional empowerment from outside SCTE. An example in this case would be staff training provided to build academic staff confidence and mastery of learning technology. Examples of external preconditions may involve requesting adequate instructional design assistance from the institution for the 37 SCTE faculty, or requesting sufficient Internet connectivity and provision of open Wi-Fi access to teacher-students at the 39 regional support centres. Such interventions cannot be undertaken without elaborate motivation and university management approval. Possibilities of the Department of Education initiatives or private sector cooperation through investment in furthering teacher training for development may provide Internet connectivity at regional centres, again dependent on external preconditions. Time dependent preconditions may involve processes of consultation and approval regarding external preconditions, or on the other hand could be related to time required for other interventions to bear fruit. Development of e-Maturity will require considerable time. Training is time dependent and must progress in phases where hands-on experience implemented in real application may generate need for more experience as a result of trial and error. In some instances, no interventions may be required and a condition may improve by itself, given enough time.

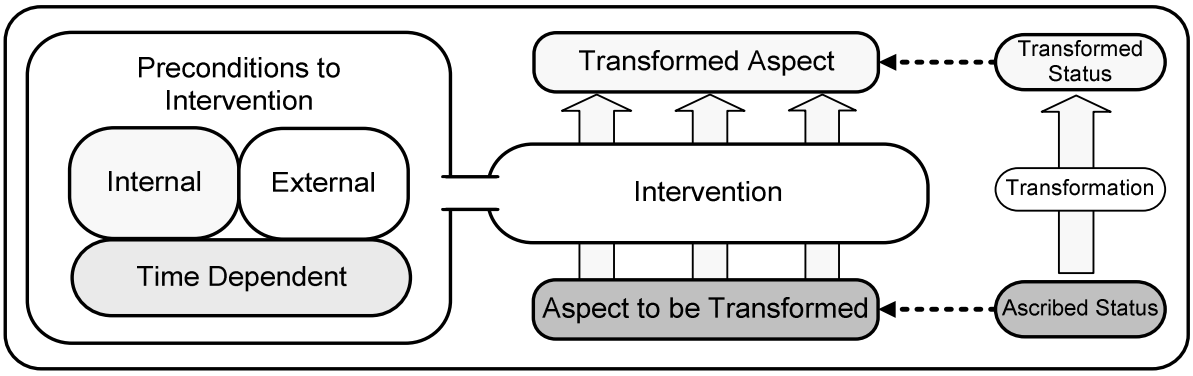

Figure 2: Preconditions to interventions required for transformation

Seamless Pre-emptive Support

Organisational learning includes a process of detection and correction of errors (Chris Argyris, 1976). From error-driven provision of support, we do not expect optimal learning experiences. Reactionary support would be characterised by attempts to rectify errors in actual outcomes compared to intended outcomes, which implies that mistakes are inevitable to attain some measure of stability. In order to reduce the impact of errors, reaction time must be minimal. Rapid-reaction erratic interventions may result, experienced as uncertainty and instability in learning processes. When reaction time is slow, the effects of unintended errors are aggravated. Ideally, provision of support towards pleasurable learning experiences should be informed by latent requests of participants. The unuttered requirements should guide pre-emptive support provision. In addition to feedback, feedforward algorithms are needed in design processes to provide stable control of learning experiences. Seamless support should sustain learning enhanced through technology, based on bottom-up driven requirements built into timeous planning of empowerment and provision. This progressive approach to provision of support in response to requirements has elements of the double-loop learning principle and Deutero-loop learning where the learning process itself is examined and improved upon (C Argyris & Schön, 1978; Bateson, 1979). Seamless pre-emptive support through a strategy containing forward-looking top-down interventions as well as bottom-up initiatives listening to latent unuttered requirements must provide an effortless travelling experience to participants crossing the digital divide.

Participatory Staff Training as DBR Intervention

The e-learning manager facilitated training where small groups of SCTE faculty interacted informally with one another between different IWB venues without being connected to remote sites. They took turns in leading the discussion based on learning content displayed simultaneously on the IWBs in the venues on campus. With only colleagues present, they attempted to use an IWB to manage a computer while establishing a collaborative learning atmosphere with participants in multiple locations, initially in a non-threatening environment. In this way, SCTE's faculty obtained confidence in basic use of IWBs through informal participatory practice sessions. Since the beginning of 2011, practice sessions like these had been interspersed with formal scheduled sessions of interaction with SCTE teacher-students at the regional support centres using IWBs. These cycles of training and lecturing/facilitation provided confidential opportunities to learn and develop IWB practices, experience challenges and devise solutions while support is available. Opportunities for on-going research as part of future macro design research cycles may refine solutions, methods and design principles. This paper regards these cycles as part of long term components of the framework. In line with the approach of providing seamless support, the aim is to pre-empt people-centred requirements for TEL and minimise uncertainty and anxiousness from the perspective of faculty. Though uncertainty may result due to the complex nature of people-technology interaction, protracted frustrations should be avoided. Occasional unintended errors should only serve to build faculty confidence in coping with limited levels of uncertainty and seamless support should prevent prolonged instability.

Initially when SCTE faculty start using synchronous computer mediated IWB conferencing, tendencies are for them to lecture blindly using PowerPoint™ slides, occasionally writing onto the slides presented through an IWB to emphasise important aspects, interspersed with occasional questions to the teacher-students at the remote sites. Instructivist teaching methods characteristic of transmissive teaching styles dominate. Cultivating interactive lecturing requires practice, and an on-going professional development programme for faculty is crucial. Interventions should in time transform faculty to foster creativity and enable learning content and curriculum transformation as "educators' roles are changing from managing content to connecting learners in new ways to other learners, resources, and expertise" (Schwier, 2010, p. 91).

Interventions such as staff training combined with observation of IWB sessions were essential activities in the development of solutions in iterative cycles of testing and refinement during the DBR cycles. During these, *design principles* were produced to enhance solution implementation in practice, enabling *refinement of problems, solutions, methods and design principles* (Herrington, McKenney, Reeves, & Oliver, 2007; Reeves, 2006).

Introducing Asynchronous Online Learning

Interconnected IWB communication can introduce SCTE teacher-students in remote areas to online learning in the near future. We have to demonstrate online learning in IWB synchronous mode to facilitators and teacher-students using hands-on step-by-step procedures to build confidence to attempt using LMS interaction in asynchronous mode, away from assistance of faculty and facilitators. A precondition would be improved Internet bandwidth at regional support centres to facilitate teacher-students' Internet access while still maintaining sufficient bandwidth for continued synchronous computer mediated IWB conferencing. Apart from

requirements for facilities, an important precondition in this context is that faculty should have proficiency in interacting with teacher-students on a technical level. This may require much more techno-proficiency than interacting around non-technical teacher-training subject content. Intensive participatory staff training should transform faculty to required maturity in these contexts. We intend to provide seamless support in these areas as well. Faculty should perceive their competencies developing with minimum inconvenience necessary in acquiring unconscious competence (Jung, 1990) through repetitive practice, building on confidence acquired in other related areas.

Analysis of SCTE teacher-students' emotional responses during computer literacy training data indicated that "wide-ranging uncertainty and fear emerged and revolved from gratefulness, expectation and engagement to confidence as a result of hands-on training with patient and caring facilitators" (Hendrik D Esterhuizen & Blignaut, 2011). This finding relates to the opinion of Kort, Reilly and Picard (2001). When positive emotions dispel negatives after successful interaction with technology, Davis and Wong (2007) translate this as the flow experience between challenge and skill. Technology adoption with teacher-students could be stimulated with interventions based on exposure to technology (Moolman & Blignaut, 2008) and promoting accomplishment.

Promoting accomplishment during exposure to technology would build confidence in SCTE teacher-students, faculty and facilitators. Asynchronous online learning would enable interaction through TEL once preconditions allow necessary interventions and seamless support to become effective.

Examples of DBR Cycle Detail in Practice
Early in 2011 the dominant electronic learning technology at SCTE was synchronous computer mediated conferencing using IWBs. Faculty used IWBs during scheduled sessions. It was imperative to observe SCTE academic staff during interaction with IWBs and evaluate quality of both academic facilitation and technology mastery. These aspects had to be addressed instantly and they represented a DBR cycle involving analysis of practical problems by researchers and practitioners in collaboration (Herrington *et al.*, 2007; Reeves, 2006). Testing and refinement of developed solutions in practice involved human perspectives as well as technology adaptations at a level of complexity typical when people interact with technology.

On the one hand, faculty had to communicate with multiple remote locations. Classrooms may be noisy environments, filled to capacity with teacher-students who needed to hear clearly while viewing what was being displayed on the IWBs. Communication is in English, which in most cases is not the home language of either faculty or teacher-students. Implemented technology solutions included optimising efficient communication, cost-effectiveness and reliability including head-worn wireless microphones for faculty and compressor-limiter audio dynamics processing. Audio mixers with USB interfacing were installed at the IWB venues on campus to enable controlling audio feeds to the remote sites. When faculty wanted to include multimedia objects during IWB sessions, the audio mixers enabled feeding the audio from the computer to the remote sites in addition to the microphone feed of the faculty. Mixers also allowed optimising speech spectrum equalisation by emphasising the 2 kHz octave and reducing gain at low frequencies for improved speech intelligibility. Mixers also allowed uncomplicated manual control to improve intelligibility at the SCTE location when teacher-students asked questions at remote sites in non-ideal acoustical environments. The detail of interaction in practice between technology and faculty, communication and learning experiences, ease of use and usefulness, features and simplicity, all result in appreciating the necessity of a design-based research approach.

Initially, the IWB venues on campus utilised laptops and free standing projectors. The temporary nature of wires connecting the equipment and a tendency to borrow loose standing equipment reduced reliability. Free standing projectors meant that bumping the table required calibration of the projector in relation to the IWB before continuing. Installing projectors permanently and installing computer boxes hard-wired to the access points and peripherals improved the permanency of installations, and as a result the reliability and repeatability of IWB use.

On the other hand, faculty required uncomplicated procedures in using IWBs in order to reduce anxiety and enable them to focus on the teaching and learning experience. The training they required had to instil confidence while cultivating unconscious competence in using technology (Jung, 1990). At the same time, some lecturers perceived themselves as in need of improved computer literacy.

Since e-learning support staff is available at the SCTE but not at the remote sites or where IWB venues are situated at other NWU campuses, indiscriminate duplication of technical facilities as used at SCTE at all IWB remote venues is not feasible. When manually operated electronic mixers are installed where experienced e-learning support staff are not available, the possibility of users adjusting the myriad of control knobs creates

unpredictable results and unreliable operation. Outcomes of DBR exercises during this study involving IWB and ancillary equipment with enhanced features are that programmable audio processing and matrix switching equipment is being installed in the eight IWB venues at SCTE at the end of 2012. Using internally programmable facilities would enable processing to be automated. Matrix switching would allow scenario choices to be simplified for IWB users in the absence of e-learning support staff with advanced technical knowledge. Users only have to choose icons on a control panel and the equipment automatically chooses combinations of required settings. The ability to access and re-program such equipment remotely over the Internet would simplify updating programmed settings at remote IWB venues in future. Programmed processors cannot haphazardly be re-adjusted by users in the absence of support staff.

The complex nature of teaching and learning using electronic technology is aptly illustrated during the entire process of training interspersed with practical application. Observation of faculty using IWBs enabled the development of training opportunities, and the collaboration process produced refinement of solutions in practice regarding human factors and technology affordances. Discussions, observations, as well as structured and open-ended questions in training evaluation surveys contributed to evolving strategies for training and support. Within the space of a few months faculty attained confidence in interacting with teacher-students across Southern Africa in synchronous computer mediated IWB conferencing. High levels of technological reliability resulted and ease of use stabilised. Aspects of interactivity could still improve and pedagogical issues are still under consideration. Through seamless support, the self-confidence in users of technology in teaching and learning can be instilled, not by perpetuating anxiety but by exposure to technology and promoting accomplishment.

These examples illustrate the nature of urgent interventions required at the beginning of 2011. While similar detail of other aspects cannot be provided here, much has also transpired regarding other aspects included in the framework.

Process towards an Emerged TEL Integration Framework for NWU

The specific nature regarding the adaptation of DBR involved the limitation of using design cycles addressing only one macro design cycle, and not an extended series of macro design cycles. The recommended TEL integration framework which is the outcome of this macro DBR cycle is intended to be the input to future macro DBR cycles, not part of the current endeavour. The framework should objectively address urgent short term requirements through interventions and solutions developed as a result of analysis of practical problems during close collaboration between the researcher and practitioners. The actions performed during the inquiry informed subsequent interventions which in turn built on what had happened previously (Van den Akker *et al.*, 2006). If DBR methods are derived from the definition of the research problem in close collaboration with practitioners and fine-tuned through literature, what is already known about the problem becomes clear and guide the development of potential solutions. The inquiry that forms the basis of DBR helps the researcher to understand the underpinning processes and variables (Van den Akker *et al.*, 2006). The research towards a framework for integration of TEL in ODL was a commitment to pragmatic strategy aiming to be functional:

> Thus, pragmatists decide what they want to research, guided by their personal value systems; that is, they study what they think is important to study. They then study the topic in a way that is congruent with their value system, including variables and units of analysis that they feel are most appropriate for finding an answer to their research question (Tashakkori & Teddlie, 1998, p. 26).

According to Maxcy, pragmaticism is Peirce's (1966) contribution to research methodology and his position has three ingredients: (a) the acceptance of reality; (b) the role of the future as the space within which things may be known; and (c) a purport, or a commitment to purposive action, following a plan with an end or highest good (Maxcy, 2003, p. 67). Methodological pragmatism, "proposes that pragmatism itself be conceived either as (a) a method for selecting inquiry methods or (b) a method of inquiry itself, broadly conceived. As such, methodological pragmatism has a weaker and stronger version" (Maxcy, 2003, p. 81). Our research position in developing the framework is *methodological pragmatism* as a method of inquiry.

As e-learning manager, the first author have been in constant close collaboration with academic and support staff of SCTE as well as university management and role players in technology planning, provision, support and logistics. The following diagram (Figure 3) provides an explanation of the overall process of development of the Emerged TEL Framework through an adapted DBR process, resulting in five research papers of which this paper is the last. Analysis of practical problems in relation to the perspectives of the institution as well as the teacher-students and faculty, contributed to the initial framework (1– Initial Framework: Figure 3), the focus of

the first research paper (Hendrik D Esterhuizen & Blignaut, 2011). Analysis of SCTE teacher-students' perceived computer literacy competencies (2–Student Computer Literacy Analysis: Figure 3) resulted in the second research paper (Hendrik D Esterhuizen, Blignaut, Ellis et al., 2012), which contributed to the Initial Framework. During this stage, the need emerged to analyse affective responses of SCTE teacher-students (3–Computer Literacy Learning Emotions: Figure 3), resulting in the third research paper (Hendrik D Esterhuizen, Blignaut, Els, & Ellis, 2012). The fourth research paper (Hendrik D Esterhuizen, Blignaut, & Ellis, 2012), followed after a series of DBR cycles where interventions and solutions recommended in the Initial Framework were applied and analysed. The paper (4–Faculty Perceptions during e-Learning Staff Development: Figure 3) resulted from analysis of longitudinal observations of SCTE faculty during technology use while requiring assistance and training. The data gathered through observation was compared with data from interviews, discussions and responses to questionnaires and a survey. The DBR cycles of all these research papers contributed to this paper (5–Emerged TEL Framework: Figure 3).

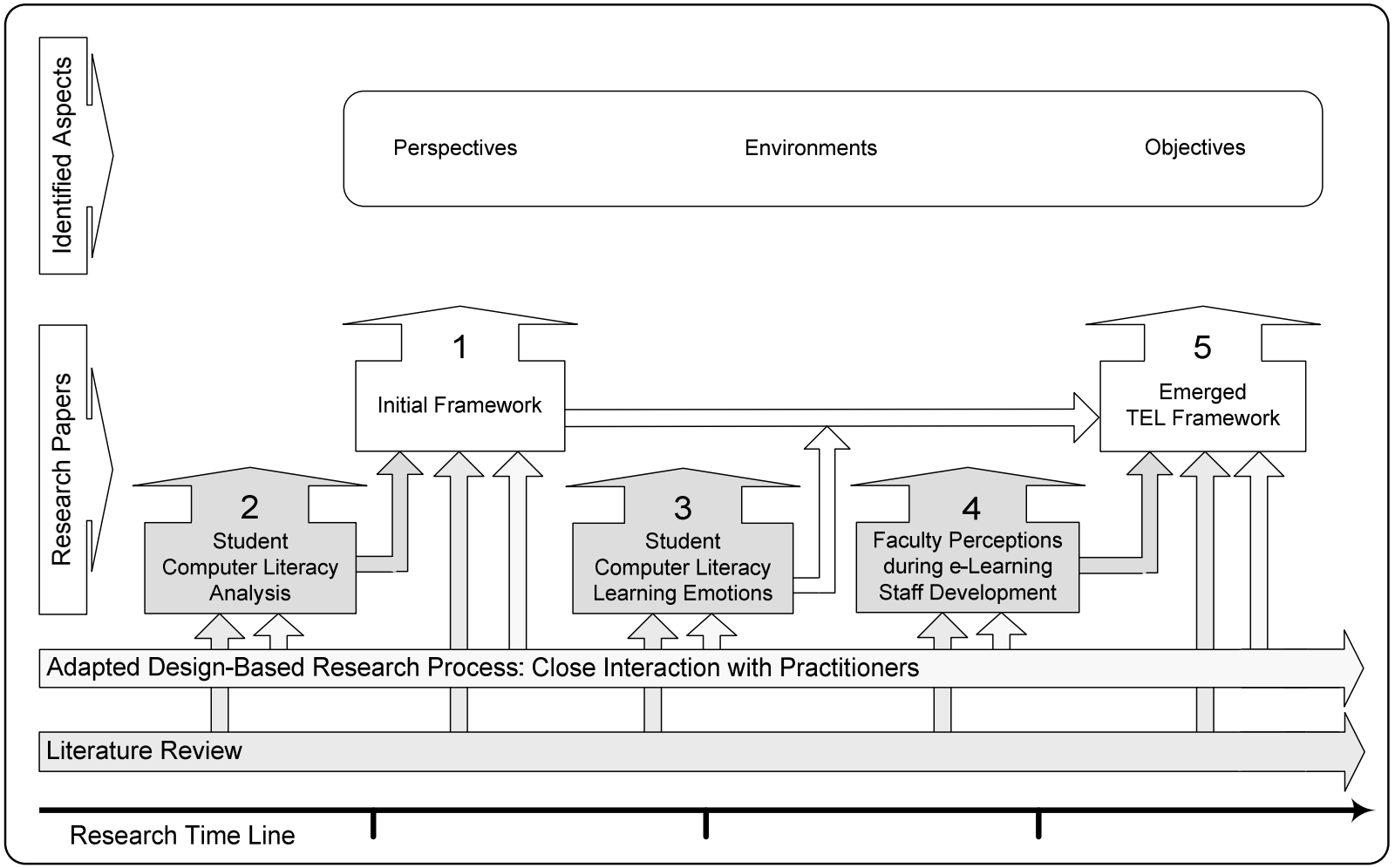

Figure 3: Development of the Emerged TEL Framework through an adapted DBR process resulting in five research papers

The process of developing a framework for the integration of TEL in ODL at NWU involved identifying aspects to include in the framework and recommendations on how to address these identified aspects. During the evolvement of the initial framework (1– Initial Framework: Figure 3), seven prominent aspects emerged. The researchers evaluated perceptions of teacher-students and faculty as the first two aspects included in the framework in relation to their experiences with learning technology as presented by the university as institution. It became clear that complex relationships exist between the aspects themselves as well as in relation to perspectives they have on strategies, policies and practices in the university as institution. While it was possible to examine perspectives of each of the other five aspects towards the strategies, policies and practices in the university, this has not been done yet. A possibility would be examining the relationships between the curriculum and the Teaching and Learning Strategy of the university pertaining to TEL. Is there harmony between the requirements of promoting learning enhanced by technology and the Teaching and Learning Framework from the perspective of the curriculum? Does development of infrastructure at the university allow reaching the aims of the Teaching and Learning Strategy in terms of TEL from the perspective of the curriculum? Thus, the aspects emerging in the initial framework represent *Perspectives* in the Emerged TEL framework (5–Emerged TEL Framework: Figure 3). The *Environments* were the aspects through which empowerment were to be provided from the university to reach the *Objectives* in Figure 3.

Why Necessarily a Framework?

Reporting on learning technology integration could be presented at numerous levels: As a presentation to management accompanied by a written report, delivering the findings as a research report, technical recommendation, treatise, motivated strategy, and training course, publishing the findings as a blog or web site, a tool or simply as guidelines. Using a framework was justified. There were (i) significant identifiable existing uncertainties, (ii) clear short term requirements for action, (iii) possibilities to address uncertainties through distinct interventions, (iv) a need for continuation of effort and persistence during intermediate phases of transition where (v) proceeding actions are dependent on evolving perceptions, maturing attitudes and commitments. Framework indicators and milestones could enable (vi) assessment of initiatives and evaluations of performance target attainment and (vii) reflection and research to perform cyclic review of long term goals. Since it was unlikely that involved procedures and intricate interventions would stay the course if left to individual people's aims and personal views, a comprehensive framework which would transcend personal whims and integrate efforts and investments seemed an appropriate choice. Well documented strategies systematically evaluated could enable research and reporting to share results with the education community and outlive individual personalities to contribute to an enduring institutional consciousness. While this paper cannot accommodate comprehensive detail of the framework, the main aspects and how to address these follow.

Emergent TEL Integration Framework

The focus of this paper is *Technology Enhanced Learning in Open Distance Learning at NWU* emphasising *support as a precondition to adoption*. Relationships between objectives, environments and perspectives are examined using an adapted DBR approach where solutions to practical problems are developed through close collaboration between practitioners and researcher.

The framework to integrate TEL in ODL at NWU is not a static recipe, but involves a dynamic process. The current state of the framework is the result of one macro DBR cycle that emerged after a series of design-based research cycles, aimed at determining short term, medium term and long term requirements and solutions to these. Urgency in addressing short-term requirements through interventions required that research and development occur simultaneously. This paper is the last cycle from the process. The framework will evolve continuously and constant interaction between objectives, environments and perspectives will determine new short term goals at any given point. Revised requirements will require new interventions with new time scales. Medium term and long term objectives could be tentative, but priorities from each perspective will be towards the highest good through methodological pragmatism at the time.
Characteristics of the framework are (Figure 4):

1. Aspects consisting of three groups comprising *Objectives, Environments* and *Perspectives* which guide TEL integration.
2. New TEL integration initiatives could conceivably be introduced from within any aspect in the groups of *Objectives, Environments* and *Perspectives.*
3. Consideration of *People* takes precedence over consideration for *Technology*.
4. Primary *Objectives* should be chosen and interpreted in relation to *Environments,* to determine validity and to be sanctioned and guided according to the HEI.
5. Remaining *Objectives* may become secondary objectives, requirements or outcomes.
6. *Support and Empowerment* are required to reach *Objectives* for adoption of TEL.

7. Examining intended actions and TEL integration strategies from each of the *Perspectives* or initial DBR cycle investigations should reveal requirements through *Environments* which prevent meeting *Objectives.*
8. All *Perspectives* must be considered, but first *Students*, then *Faculty* and lastly *Learning Technologies.*
9. Interventions and seamless support should be developed through DBR approaches.
10. Preconditions to interventions could be *Internal, External* and *Time Dependent*.
11. To provide *Seamless Support*, early indications of latent requirements should be utilised and implemented as pre-emptive support to minimise inconvenience to participants
12. TEL integration maturity classification phases to evaluate progress in each of the aspects include five phases ranging from Phase 0 (Unrecognised) to Phase 4 (Regenerative).
13. Every aspect from the three groups *Objectives, Environments* and *Perspectives* could be classified at a different maturity classification phase as stratified maturity.
14. DBR analysis of practical problems in close collaboration with practitioners will inform future revisions of each TEL aspect as well as the overall process.

People–technology interactions in teaching and learning, determined by objectives to the highest good within environments from the various perspectives, have complex relationships. Approaches are determined in close collaboration and in priority order from the perspectives of teacher-students and faculty, taking into account all relevant perspectives to reach objectives within given environments.

The following diagram (Figure 4) illustrates the three groups: *Perspectives, Environments* and *Objectives* and the interaction between these groups of aspects. In line with the approach of this paper, the requirements for *Support and Empowerment* should guide any route of association between these three groups. The nature of *Seamless Support* should be determined taking cognisance of latent requests of participants during the earliest possible design cycles, while attempting to negotiate linearly through the route from *Perspectives* to *Consequences*. If an attempt to initiate *Technology Interaction in Teaching and Learning* starts with any of the aspects in one of the three groups, navigation through the diagram must be done with consideration of *People* taking precedence over consideration for *Technology*. Suitable *Support and Empowerment* are required to reach *Objectives* in the last group in the diagram. *Environments* guide implementation and determine boundaries, compliance and required *Support and Empowerment*, resources and provision. After required *Seamless Support* for each of the *Environments* is established, the process may be negotiated by starting from any of the aspects in any group. Verification would then be possible of optimally reaching *Objectives* resulting in intended *Consequences*.

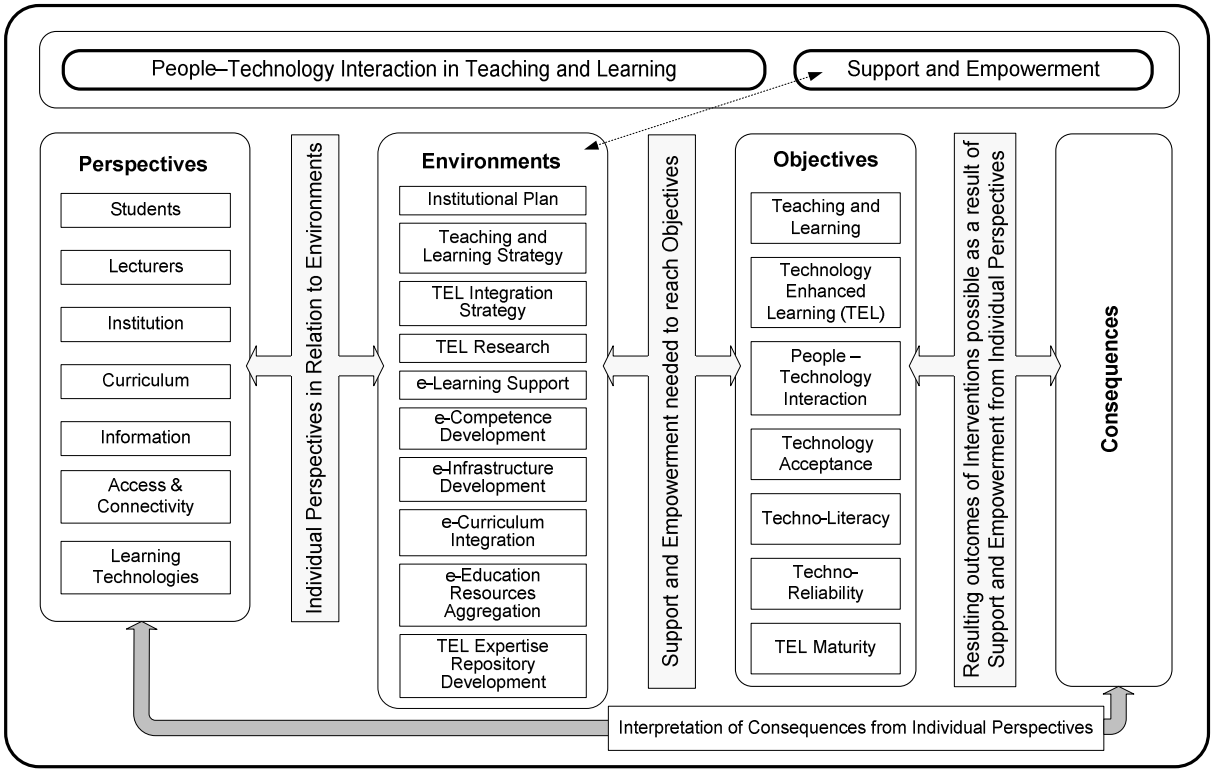

Figure 4: Complex relationships exist in support and empowerment required for optimum interaction between people and technology in teaching and learning

To initiate Technology Interaction in Teaching and Learning
Consideration of preferred sequences to reach *Objectives* within relevant *Environments* will determine actions. Good practices involve cognisance of *Support and Empowerment* needed for successful interaction between people and technology for teaching and learning from applicable *Perspectives*.

As an example: Faculty want to initiate asynchronous online learning in a module common to many courses involving introduction to research principles. It is important to consider to which extent each of the *Objectives* is applicable. It would be wise to start by aiming for the *Teaching and Learning* outcomes most appropriate for the intended module. As the most relevant and primary *Objectives* are isolated, other *Objectives* may become requirements or outcomes. In this example *Techno-Literacy, Techno-Reliability* and *Technology Acceptance* are requirements, while *TEL, People–Technology Interaction* and *TEL Maturity* are secondary outcomes. Now, *Environments* should provide sanction and determine boundaries, compliance and required *Support and Empowerment*, resources and provision. All this will be determined by each of the *Perspectives*. In this example, if the *Objectives* are sanctioned by the *Institutional Plan, Teaching and Learning Strategy, TEL Integration Strategy* and supported by *TEL Research*, successfully implementing the asynchronous online learning research module would need *e-Learning Support*. It would both require and contribute to *e-Competence Development, e-Infrastructure Development, e-Curriculum Integration, e-Resources Aggregation* and *TEL Expertise Repository Development.* From the *Perspective* of *Access and Connectivity* and *Learning* Technologies it would not be able to implement the endeavour without required *e-Infrastructure Development.* If any of these aspects fail to meet required performance within applicable *Environments*, more interventions and seamless support would be required. If the preconditions for the interventions are *Internal* and *Time Dependency* is within requirements, the intervention may be initiated and once the aspect has been transformed to requirements the intended enterprise could proceed and be concluded for the present *Objectives.* At that time, continuing DBR cycles would inform new short term, medium term and long term requirements and solutions. Initially, primary *Objectives* would determine short term, medium term and long term *Objectives.* Long term objectives should always include TEL integration maturity at the highest level and must be aligned with the *Institutional Plan* and *Teaching and Learning Strategy*.

Seven aspects were included in the initial framework (1–Initial Framework: Figure 3): *Students, Faculty, Institution, Curriculum, Information, Access and Connectivity* and *Learning Technologies.* These are now represented as the group *Perspectives* in Figure 4. In the *Initial Framework,* interventions were suggested for each of these. Some of these interventions were inter-related and progress depends on sequences determined by

other processes or commitments and discussions around policies. Some interventions were possible without *External Preconditions*, others not.

At the beginning of 2011, we had already analysed the SCTE student computer literacy survey results (2–Student Computer Literacy Analysis: Figure 3). We recommended that new teacher-students should be evaluated and where needed computer literacy should be developed as intervention consisting of participatory hands-on tailor-made ICT training at regional tuition centres across Southern Africa. Introduction to learner management system (LMS) use, library use, information gathering techniques, study methods, and reading and academic writing competencies should also be included as interventions. These interventions have considerable preconditions.

The e-learning manager started with hands-on faculty training in 2011 focussing on the use of IWBs and improving faculty confidence in using computers while interacting with teacher-students. Through seamless support, he aimed at introducing faculty to synchronous computer mediated IWB conferencing in such a way that their anxiety about technology use could be quelled. Ensuing scheduled IWB sessions provided opportunities to build faculty confidence while determining usability, efficiency and reliability of technology, student reaction and observing unintended consequences. Adaptations to presentation, scheduling, technology and communication continued as research and development were performed simultaneously. Any changes in the conditions or circumstances influencing one or more of these aspects influenced the others in various ways. Close collaboration contributed to developing solutions and produced design principles needed to address these. Faculty utilised continuous opportunities for participatory staff development, exploring new avenues developed through experience garnered during every series of scheduled IWB sessions. Survey responses of faculty during training confirmed commitment and renewed requests for more training (Hendrik D Esterhuizen, Blignaut, & Ellis, 2012).

Internet connectivity is crucial and could be jeopardised in many ways. These included power outages, university network reliability and availability of information technology support after hours or over weekends, external network reliability, cloud server reliability and local conditions at each of the regional support centres. Successful learning experiences require optimum performance on the part of each of these aspects. While problems with connectivity or technology resulted in intensified measures to increase redundancy and minimise reoccurrence, in real terms very little interruption to IWB sessions resulted. Some teacher-students travel great distances with considerable effort to attend these sessions, so interruptions should be avoided at all costs. In the event that IWB sessions cannot continue, facilitators at regional centres can provide alternative support as well.

Changing technological conditions directly influence staff training. Attempts to draw up formal procedures in using technology and expecting staff to memorise these while changes are being effected in technologies are not productive. During the period from early 2011 to mid-2012, all computers on campus changed the operating system version from Windows XP to Windows 7, several changes in software versions transpired regarding IWB software, and various other computer programs and logon procedures for staff members changed. Preferred practices need to be updated continuously. Faculty have to adapt continuously and learn not to memorise procedures, but develop technological intuitiveness. Technical assistance must be readily available at all times.

The complex interaction between and among Perspectives, Environments and Objectives is illustrated in Figure 5. Considering aspects such as the *Curriculum, Information, Access and Connectivity and Learning Technologies* as having their own *Perspectives* may be confusing to some. However, looking from the perspective of technology at *Environments* reveals either accommodating or inhibiting relationships, depending on the characteristics of the technology, the particular environment and the intended *Objectives*. Interaction between perspectives as well as interaction between environments may improve or hinder the measure of harmony from the perspective of each. Possible interventions or pre-emptive support may facilitate interaction. If such facilitation is not possible, revision of *Objectives* could be required or unintended consequences will result. Looking at *Environments* from the other *Perspectives* will confirm or reject possibilities of intervention and support in each case.

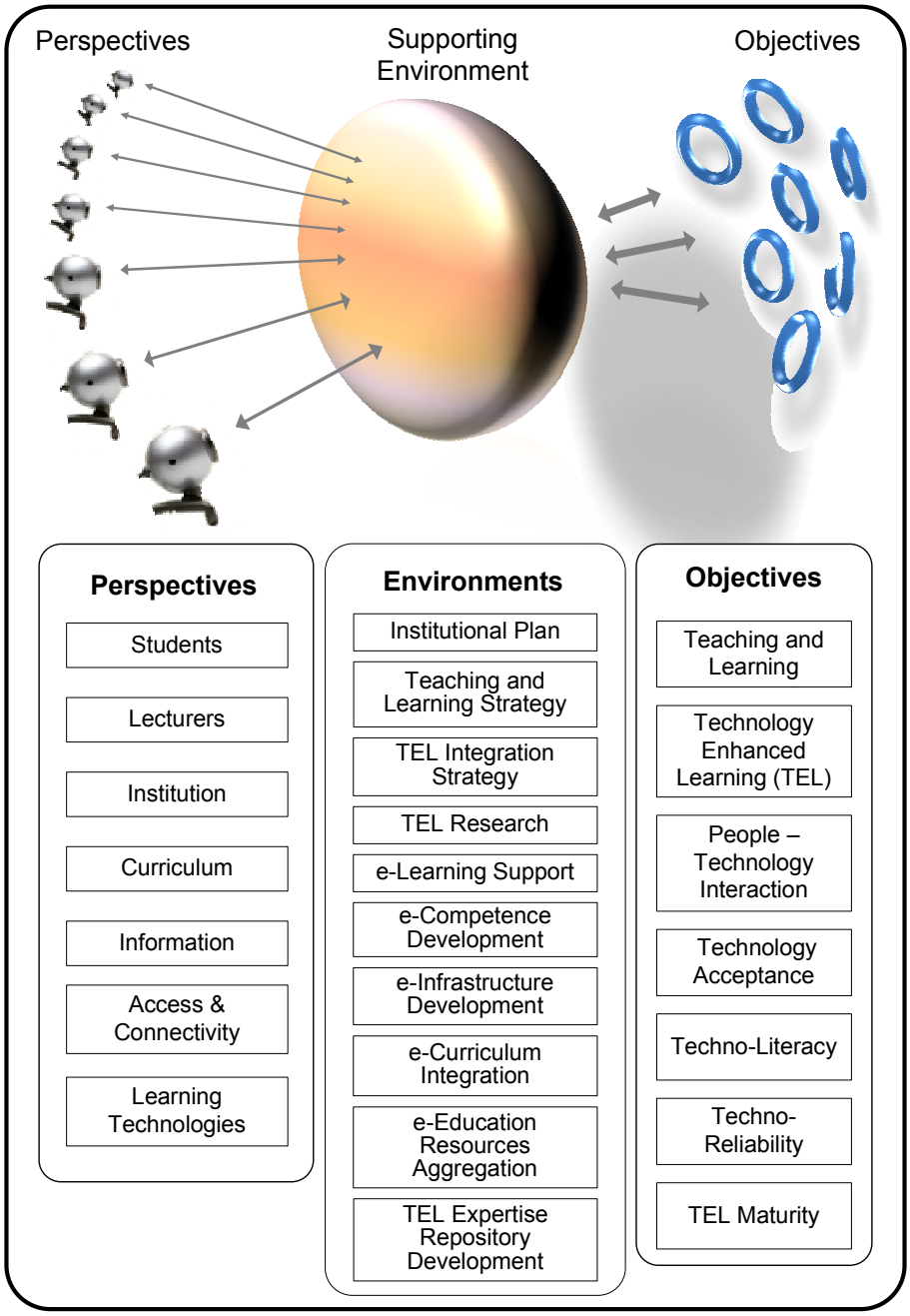

Figure 5: Interaction between Perspectives, Support, Environments and Objectives

A framework for the integration of TEL should inform the interactions between learners, faculty and learning technology. Scanlon (2010) quotes Issroff and Scanlon (2002) in saying that they "distinguish between two groups of theories in use in work with learning technologies. The first are related to 'principled decisions about the design of learning materials' and the second are used to 'influence the way we frame our research on learning'. They argue that both types of work are necessary to research learning in relation to technology. What we require as educational technologists are theories which provide a framework in which we can understand the complex interactions between learners, teachers and the resources they use" (Scanlon, 2010).

Experience in synchronous computer mediated IWB conferencing and perceptions of teacher-students and staff to date provides glimpses of uncertainties and variableness which may constantly require management as SCTE teacher-students increasingly begin to adopt TEL. The framework includes elements of recently acquired experience, and impressions of present localised requirements projected into expectations of future requirements. Much of the framework is based on imminent requirements to prepare for the present and near future. Medium term and long term solutions and design principles should evolve through future DBR cycles. Overall medium and long term requirements will always include building and increasing TEL maturity.

Maturity Determination
Wenger (1998) used five types of relationship defining the acceptance that an institution might have in moving toward adopting the concept of a learning community. These inspired suggested stages for classifying maturity in TEL at NWU for the purpose of this framework (Table 1).

Table 1: TEL integration maturity classification phases

Classification of TEL integration maturity	**Characteristics evident in TEL integration maturity which may determine which phase is applicable**
Phase 0 Unrecognised: There is a lack of awareness of the value of the concept, or… Obscured: The concept is visible informally to a circle of people (Bootlegged)	In some instances resembling the current TEL maturity level: Perceptions are still prevalent that online learning only involves making available text-based learning content on the internet as downloadable files, PowerPoint presentations or lectures, copying face-to-face instruction methods. The ability to clearly define e-Learning and re-use or design and produce learning objects eliciting participation in learning is lacking
Phase 1 Legitimised: The concept is officially sanctioned but may be over managed and under scrutiny	Reached when participants are aware of implemented TEL support initiatives. Enthusiasm to develop TEL activities in faculty subject areas grows. Staff should feel encouraged to spend time experimenting with learning objects introduced to students. Social communication tools become exciting to use. Benefits are discovered in learning technology utilisation for students. Faculty change from dictatorially managing content to being facilitators connecting learners in new ways to other learners, resources, and expertise: From being *the sage on the stage* to *the guide on the side*
Phase 2 Strategic: The concept is widely recognised as central to the organisation's success	Assessment and research undertaken by academic staff confirm successful adoption of TEL to the extent that learning experiences exceed those obtainable through face-to-face delivery of teaching. Interaction between learners, content and teachers become reciprocal though successful teaching presence, social presence and cognitive presence
Phase 3 Transformative: The concept is able to be redefined	Mature learning culture emerging from established interaction with students through socially constructed learning communities enables authoritative expansion into distant education markets with similar requirements. Research and peer review acknowledge attainment internationally
Phase 4 Regenerative: The redefined concept matures to a level of reproduction as a result of its own vitality	The unique learning culture emerging from localised indigenous experiences enriched by internationalisation develops abilities to reproduce in other contexts. It grows and starts to initiate self-sustaining results

Each of the aspects shown in Figure 5 may develop in maturity as a result of support through interventions. TEL integration maturity for each aspect may at a given moment be different from that of the other aspects. Each could be classified at a maturity level according to the phases suggested above. In this way, for each aspect stratified classification may enable development of solutions informed by applicable design principles and technological innovations followed by iterative cycles of testing and refinement of solutions in practice (Herrington *et al.*, 2007; Reeves, 2006). In this way, interventions and required support could be determined through continuing DBR cycles.

Main Aspects not Included in the TEL Integration Framework
This framework is not focussed on evaluation of cost-effectiveness; cost of ownership; and drivers and benefits of using technology in teaching and learning for the following reasons:

- The current e-maturity state of the distance students at SCTE necessitates far-reaching measures and estimates of success in such strategies will be premature.
- The level of commitment and support forthcoming from university management and the resulting impact on technology adoption will have to be evaluated before realistic cost-effectiveness and cost of ownership estimates can be meaningful.

In this paper, we emphasize the need for support from HEI management in the implementation process. Support from HEI management will determine the success of technology integration at NWU. At SCTE, teacher-students as well as faculty have the intention to adopt technology in teaching and learning.

PRIORITIES TOWARDS THE INTEGRATION OF TEL IN ODL AT NWU

The institution should commit to a comprehensive TEL integration strategy displaying a declared intent with visible actions. This will mark Phase 1 in institutional TEL integration maturity classification. This strategy should evolve from the bottom up by inviting schools within faculties to collaborate and contribute to their own TEL strategies. At the same time, top-down empowerment should demonstrate intent through visible commitment. Legitimised TEL strategies as a result of Phase 1 initiatives in relevant environments may over time contribute to visible curriculum maturity where technology is of strategic importance, integrated into core elements of the curriculum and not added on. Information TEL integration maturity classification in Phase 1 would be valid when students are required to demonstrate competency in information gathering, classification and utilisation.

Successfully concluding Phase 1 in institutional TEL integration maturity should result in Phase 1 faculty TEL integration maturity once faculty become aware of implemented TEL support initiatives. Enthusiasm to develop TEL activities in faculty subject areas is growing. Staff feel encouraged to spend time experimenting with learning objects introduced to students. Social communication tools become exciting to use. Benefits are discovered in utilising learning technology for students. Faculty change from dictatorially managing content to being facilitators connecting learners in new ways to other learners, resources, and expertise: From being the *sage on the stage* to the *guide on the side*. On the part of faculty, responsibilities for adoption should remain focused on teaching and learning, pedagogical requirements, and promoting cognitive presence, social presence and teaching presence in communities of inquiry. In a non-threatening environment using social networking the e-learning manager intends to instil self-confidence in faculty as well as students, not by perpetuating anxiety but by exposure to technology and promoting accomplishment.

Since SCTE had to arrange Internet connectivity at regional tuition centres to enable the use of IWBs for synchronous computer mediated IWB conferencing, provision of Internet connectivity through Wi-Fi to students and facilitators at these centres will enable small-scale e-Learning projects to be initiated. Saturation will soon be reached, however, since the bandwidth available at present will not be sufficient for large-scale use of Internet facilities by students. Meticulous arrangements may be required, such as limiting bandwidth availability to coincide with IWB sessions. This may lead to other complications since the bandwidth needed for the IEW sessions may be drained by student use. Lasting solutions would include proper provision of Internet at all regional tuition centres.

In this way, initial steps may establish Phase 1 maturity in each of the relevant aspects. It will be possible to reach advanced maturity with commitment, support and empowerment.

CONCLUSION

Seamless support should weather the raging waters that demotivate and provide a safe travelling experience, while bridging the divide, towards confident participation in the knowledge society. Support from university management will determine the success of technology integration at NWU. At SCTE, teacher-students and faculty both have the intention to adopt technology in teaching and learning. Responsible planning, commitment and execution on the part of university management will enable these intentions to result in adoption.

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